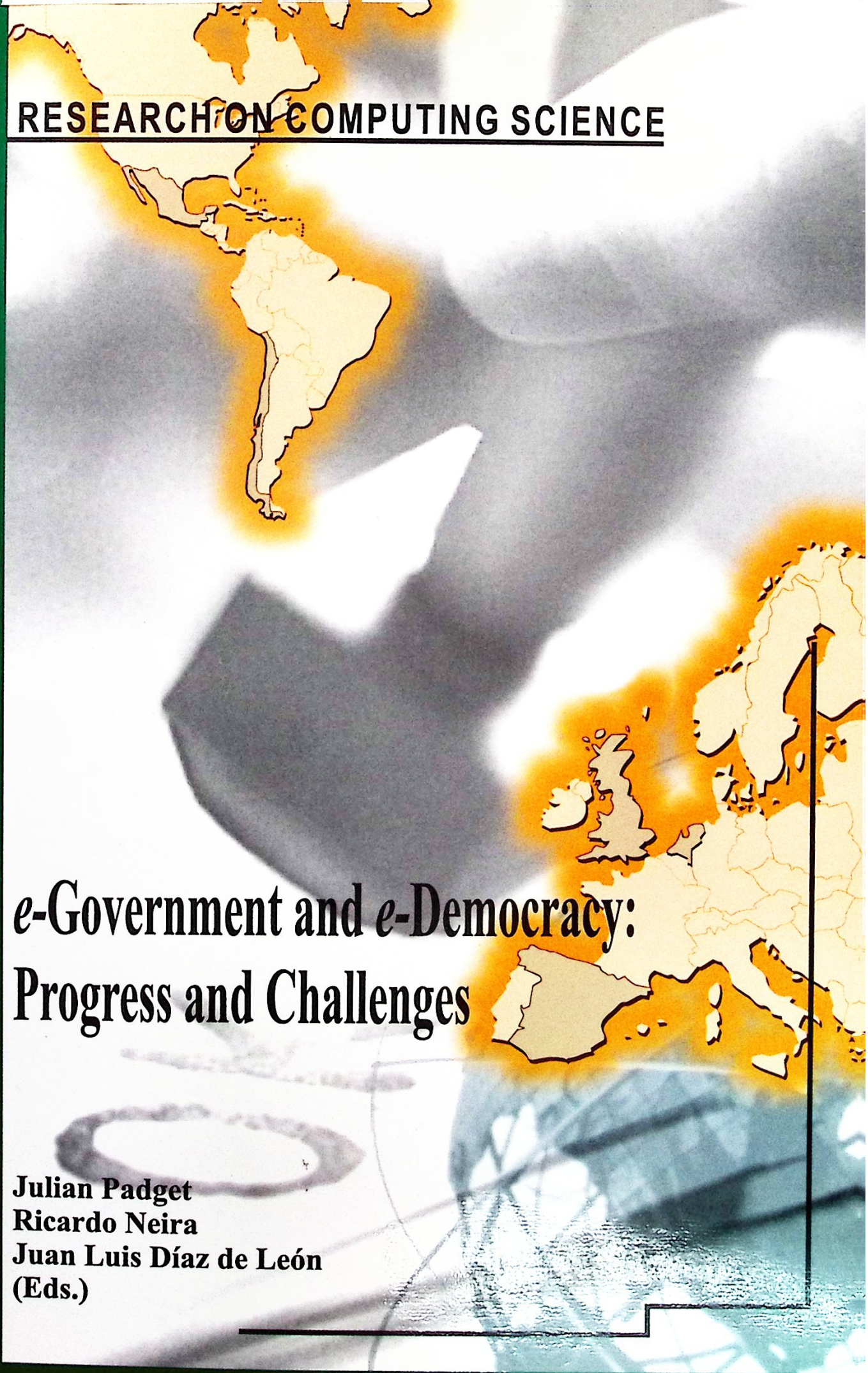
RESEARCH ON COMPUTING SCIENCE



# *e*-Government and *e*-Democracy: Progress and Challenges

**Julian Padget**
**Ricardo Neira**
**Juan Luis Díaz de León**
**(Eds.)**

EU-LAT

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Julian Padget
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# Preface

The EULAT project has been funded by the European Commission to hold a series of three workshops located in Latin America. The objective of the workshops is to showcase European and Latin American research in the areas of (a) e-Health (b) *e*-Government and e-Democracy (c) *e*-Environment, and create a forum in which to bring together research groups, companies and SMEs from the European Union and Latin America to encourage collaboration on proposals to the Framework 6 funding program.

**The Book**
This book contains a selection of the papers presented at the EU-LAT Workshop on *e*-Government and *e*-Democracy, held in the Salón del Ex Congreso, Morándé N 441, Santiago Centro from May 24th to May 27th, incorporating an Information Day about the Framework 6 program on May 26th.

**The Papers**
A total of twenty-six papers were submitted of which sixteen were accepted for presentation. Those papers fell into the following categories, which are also reflected in the organization of the contents of the book:

***e*-Government**, including a description of aspects of the eGOIA project in Brazil, experiences with *e*-Government in Sweden and a report on supporting government processes electronically in the Canary Islands.

***e*-Democracy and *e*-Participation**, addressing knowledge representation and management in public organizations, web-based tools for *e*-mediation and *e*-participation in local decision making, a review of technologies to enable democratic processes, and descriptions of projects aiming to use those technologies and tools.

**Legal and Identity Issues**, covering the use of knowledge management to assist in the creation of more legally tractable legislation, *e*-Voting from practical, theoretical and legal perspectives, further application of knowledge management and security and identity issues.

The call invited a range of contributions reflecting finished work, preliminary studies with promising innovative ideas and experience reports, especially from governmental bodies and companies, while the solicited topics included:

**Procedures:** electronic voting, law (e-commerce, digital government), e-governance.

**Security and trust:** authorization, authentication, signatures, identity theft

**Issues in C2G/G2C and B2G/G2B:** participation in decision making, digital access, digital divide, information access for citizens, G2B/B2G for funding / planning / agreement, taxation, procurement. **Enabling science and technology:** legal reasoning, legal knowledge-based systems, artificial intelligence and law, formal models of legislation, regulations and other norms, legal case-based reasoning, administrative process modelling.

**Invited Speakers**

The invited speakers came from across the spectrum of stakeholders in *e*-Government and *e*-Democracy, including politicians, people implementing electronic systems, those working to raise awareness and engage citizenry in *e*-Democracy projects and researchers in Computer Science, Law, Knowledge Management. The speakers were:

**Fernando Flores** discussing the opportunities and risks arising from *e*-Government and *e*-Democracy.

**Carlos Cantero** outlining his ideas for engaging citizens in *e*-Democracy (http://www.gobernabilidad.cl)

**Tom van Engers** describing how knowledge engineering can contribute to the improvement of legislation from a legal perspective

**Hans Hagedorn** reporting on his experiences in mediation and the application of *e*-Participation tools in several major public projects in Germany

**Carlos Jaso** assessing the impact of *e*-Procurement on government purchasing in Mexico

**Alejandra Sepulveda** describing the Chilean state reform and modernization project (http://www.modernizacion.cl)

**GrazynaWojcieszko** giving a sketch of the *e*-Europe project and the funding instruments available for participation

**Simon Bensasson** presenting the bigger picture in international relations and the role of *e*-Government and *e*-Democracy in European and Latin American collaboration.

**The Panels**

Two panels were organized to address two of the many aspects and issues raised by these topics, but intentionally focussing on the two parties involved, namely government and society. Thus the two panels were:

***e*-Government**, in which the panellists were Alejandra Sepulveda (State reform and modernization project, CL), Grayzna Wojcieszko (Commission of the European Union), Ake Grönlund (¨Orebro University, SE), Adriana Muñoz (Congreso Nacional).
The issues for this panel were the mechanics, problems and opportunities for government created by the transition to *e*-Government.

**The Civil Society**, in which the panellists were Claudio Orrego, Hans Hagedorn (Zebralog, DE), Patricio Gutierrez (State reform and modernization project, CL), Tom van Engers (University of Amsterdam). The issues for this panel were the threats to democracy arising from a move to *e*-Democracy, responses to those threats and the opportunities for engagement of the citizen in the move along with the potential for wider participation.

**Acknowledgements**
The workshop organizers would like to thank:

The many institutions and offices of the Chilean state that have been so open, supportive and helpful in setting up this workshop, especially those at the office of the Project for the Reform and Modernization of the State and at the office of Senator Carlos Cantero.
Cecilia Angela Loayza, Marcelo Muñoz Diaz and the staff of the office of the Vice Rector for Technology Transfer for local organization.
The hard-working reviewers on the program committee who had to cope with demanding time constraints to keep the workshop on schedule.
The Instituto Politécnico Nacional de México for printing the book.
The European Commission for their support of this project (IST-2001-32792 EUMEX) and the assistance of Jean-Yves Roger and Grayzna Wojcieszko.

**Support**
This particular workshop in the EULAT series was supported by

The Chilean Senate (http://www.senado.cl)
The Chilean Chamber of Deputies (http://www.camara.cl)
The InterParliamentary Union (http://www.ipu.org).
The Project for the Reform and Modernization of the State (http://www.modernizacion.cl).

The Inter-University Centre for Academic Development (CINDA: www.cinda.cl)
The Metropolitan Technical University, Santiago (UTEM: http://www.utem.cl)
The Inter-Parliamentary Union was holding a seminar in Santiago at the same time as the EULAT workshop and in view of the common interests, a plenary session of the two meetings was scheduled (see program).

May, 2004

Julian Padget, Ricardo Neira

# Part I

# e-Government

# Implementing Electronic Government: The eGOIA Project*

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**Abstract.** This paper presents the activities accomplished and the first results achieved by the eGOIA project in the context of @LIS – ALliance for the Information Society - Program of the European Commission. This initiative aims to reinforce the partnership between European Union (EU) and Latin America (LA) in the field of the Information Society. The paper shows the current situation of the eGOIA project and the effort (strategic, tactic, operational) to implement a demonstration system based on the development of a software infrastructure in order to allow the access of citizens, through the internet, to integrate public services at several levels (municipalities, regional or states and federal) and Citizen Points of Access (CPA). It is focused in the integration of front-office technologies and of the back office systems. Also, it details the general requirements, the structure and four-tier architecture of the demonstrator, the enabling technologies (e.g., enagoOSP, MDA, EDOC), the selected services (ID card) and a study of user groups (e.g., skilled and unskilled poor people, classes of employees) as well as, it presents the future initiatives.

## 1. Introduction

The eGOIA – Electronic GOvernment Innovation and Access - project is an @LIS - ALliance for the Information Society – initiative [1]. The @LIS is a program of the European Commission aiming to reinforce the partnership between the European Union (EU) and Latin America (LA) in the field of the Information Society. Its objectives are to establish dialogue and cooperation on policy and

* This publication has been produced with assistance of the European Union. The content of this publication is the sole responsibility of the authors and can in no way be taken to reflect the views of the European Union.

J. Padget, R. Neira, J. Díaz de León (Eds.). e-Government and e-Democracy: Progress and Challenges

regulatory frameworks in key areas and to boost interconnections between research networks and communities in both regions. Also, @LIS program aims to implement demonstration projects in LA gathering best practices in EU and LA in order to show the benefits of the information society applications to the citizens of both continents in several thematic area and, particularly, electronic government.

According to ONU [2], the broadest definition about electronic government (e-government) includes virtually all information and communication technology (ICT) platforms and applications in use by the public sector. For the purpose of this initiative e-government can be defined as: "utilizing the Internet and world-wide-web for delivering government information and services to citizens, enterprises and the administration itself". Some reasons for e-government advent are: i) governments are under strong pressure to meet rising expectations of service in times of limited resources; and ii) public institutions have to demonstrate their value to society, offering citizen-centric services and eliminating waste of time and resources. But the main purpose of the e-government initiative is the use of ICT in public administration combined with organizational change and new skills in order to improve public services and democratic processes and strengthen support to public and social policies [3].

The intensive use of ICT appears as an answer to these challenges. The technology availability and the demand by services have as consequence an emergence feeling, all over the world, to quickly implement the digital infrastructures in the different levels of government (municipal, state or region, federal). In Latin America, particularly in Brazil, this is occurring in a very heterogeneous way, due to the geographical differences of social, political and economical development. However, many barriers and obstacles need to be overcome, policy needs to be deployed efficiently to everyone and sizeable investments are necessary. Change processes in organization and culture take time: it can take several years before the combined investment in ICT and organization and skills development deliver the full benefits that, probably, it will take several democratic mandates. In this context, it is being developed the "Electronic GOvernment Innovation and Access – eGOIA" project [4, 5] supported by the EU @LIS program.

The main goal of eGOIA is the instantiation of demonstrators that show future-oriented public administration services to a broad public in Latin America. The vision of the eGOIA project is the provision of a single virtual space supporting the interaction of citizens (independent of social status, gender, race, abilities and age) and the public administration in a simple, future-oriented and cost-effective way. eGOIA aims to demonstrate an e-government system based on an open service infrastructure in order to allow the access of citizens through the Internet to integrated public services at several levels: local, regional and federal. The project is being developed with 8 partners from Germany, Brazil, Portugal, United Kingdom and Peru (appendix).

The roadmap for eGOIA is:

eGOIA intends to develop a long term, ambitious set of guidelines and strategies for future e-attendance agency solutions;

Begins with the demonstration of some integrated citizen-centric electronic services (e-services) based on the current set of public services;

Offers these services to the public in the newly established Citizen Access Points;
Evaluates service usage through monitoring the behavior of selected user groups associated with the assessment of the results;
Multiplies the lessons learned into different Brazilian regions/states and also into other countries (i.e., Peru and Portugal).

This paper summarizes the activities that have been accomplished and presents the first results from the project. In section 2 a short description of a Citizen Service Center, named *Poupatempo* [6] is given. The current situation of *Poupatempo*, the benefits brought to the population and the challenges faced are presented as well. The main requirements of the eGOIA demonstrator are described in section 3. The architecture of eGOIA demonstrator is presented in section 4. The selected services and the characterization of the user groups for the first version of the demonstrator are discussed in section 5. Finally, discussions about the experiences and the future work are presented in section 6. In appendix, a brief description of eGOIA partners is provided.

## 2. Current situation

The first result of the eGOIA was the creation of a common vision of the project in order to establish targets based upon benchmarking social requirements, knowledge of system capability and knowledge contributed by the people who will have to do the work. In additional, the objective with the benefits of "benchmarking" is to enable governments to achieve higher level of performance and puts credible targets to the users (citizens – G2C, employees – G2E, businesses – G2B).

To create a common project vision, as shown in the figure 1, the project investigated the background knowledge, such as knowledge of partners, existing Latin American government applications and services, successful stories/best practice examples from LA and Europe that are relevant for the eGOIA demonstrator, relevant standards and initiatives and existing technology and infrastructures. To define the requirements of the eGOIA demonstrator the interests of the eGOIA partners and user groups were analyzed. The aim was to identify requirements from different viewpoints such as social, legal, organizational, technical, political, financial, economical and security requirements. Constraints influencing the eGOIA demonstrator were gathered. These constraints can be for example laws and regulations, standards that have to be applied, available infrastructure, financial constraints, employee education, etc. The results of this investigation were presented in one of the project deliverables in the middle of March 2004 [7]. In addition, a framework of strategies and policy deployment for the adjacent subprojects were discussed and elaborated, they will be both the guidelines to e-government demonstrator implementation and the basis for the activities of dissemination and exploitation of the demonstrator.

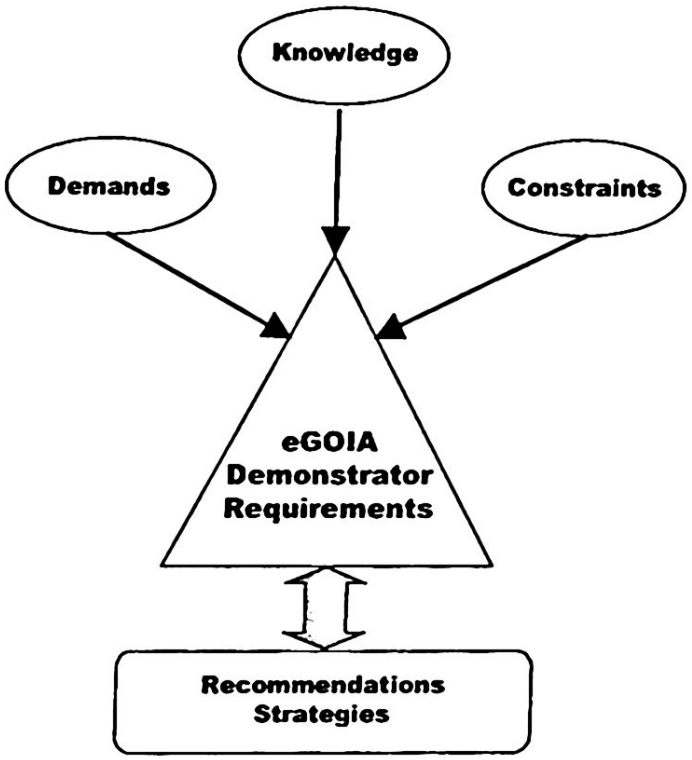


Figure 1 - Definition of the eGOIA Demonstrator.

The following activities were accomplished:

a) **Knowledge**: Examination of e-government current situation in LA, applications and services, good practice examples from Europe and LA, relevant standards and initiatives and existing technology and infrastructures towards their applicability to eGOIA.

b) **Demands**: Identification of functional and non-functional requirements (e.g., social, organizational, technical, political, financial, economical, security requirements etc.) and from different points of view of the stakeholders. The interests of the eGOIA partners and user groups (stakeholders) have to be analyzed and evaluated. The user groups consist of citizens, employees of the public administration, administrators, etc and must take into account all their social and physical diversity. eGOIA focuses on G2C (government to citizen) demonstrations. G2B and G2G (government-to-business and the government-to-government) scenarios and applications may be of interest in later versions of the demonstrator.

c) **Constraints**: Identification of constraints that are requirements that postulate boundaries for the design, implementation and deployment of the eGOIA demonstrator. These constraints can be of different nature, for example legal constraints, financial constraints, technical constraints and organizational constraints such as the available infrastructure, employee persuasion and education, etc. Considering constraints and external conditions for planning, developing, building and running an e-government system, it should be clear – and carefully distinguished – that there are qualitative as well as quantitative effects. Non-quantitative and non-rational (nevertheless existing) reasons to

refuse a system or to refuse a proposed application scenario have to be taken into account as well.

These three main activities are being used as a basis to define the general requirements of eGOIA demonstrator supporting the transformation of the current state of the government systems to the target state, that is, a real enterprise integration able to offer a set of services to the different user groups.

**General requirements** of eGOIA demonstrator are being worked out and described, based on the knowledge, demands and constraints with the main focus on demonstration to the user groups and the back-office integration. The demonstrator will be used as an experimental system to be tested and evaluated.

**Recommendations and strategies** are being specified to achieve compliance with the project objectives and to provide guidelines for the adjacent subprojects. Recommendations and strategies comprise the business and administration processes and how the results can be multiplied into different regions, states and countries. This includes an analysis of motivational maintainers for the usage of e-government and how this can be achieved in the target demonstration environments. Also, preliminary economic strategies such as pricing of products/services have to be taken into account.

## 3. eGOIA General Requirements

Technically the eGOIA demonstrator is based on two main paradigms – front-office and back-office integration. Back-office integration concentrates on a unified approach to access already existing and newly emerging government services. Requirements for faster development cycles, decreased effort, and greater software reuse motivate the creation and use of middleware and middleware-based architectures. These architectures create a virtual boundary around application components (i.e., e-government services) that interact with each other only through well-defined interfaces and define the standard mechanisms to compose and execute components in generic component servers. Besides the integration of back-office processes the main factor for the acceptance of e-government services is an intuitive user-interface integrating the diverse e-government services available (front-office). eGOIA will instantiated these services in so-called Citizen Access Points focusing on the integration and participation of poor people with a lack of possibilities and experiences towards this new technological environment. Therefore the applications – citizen-centric services – have to be easily usable by concentrating on certain life-situations (such as child birth, marriage, looking for a job, social assistance required, etc) that are easy to follow by the target user group.

To provide high-quality eGOIA services for the citizens, the user requirements (functional and non-functional requirements) are gathered and constantly evaluated. These assessments are fed into the development process in different phases of the project.

The figure 2 shows the context of the eGOIA demonstrator in the sense that it will integrate many kinds of e-government initiatives. It presents the Brazilian initiative called e-Poupatempo, but could also include any other national or

regional experiences. The Peruvian initiative could be e-Democracy or e-CityMall, etc. And Portugal could provide any equivalent initiatives.

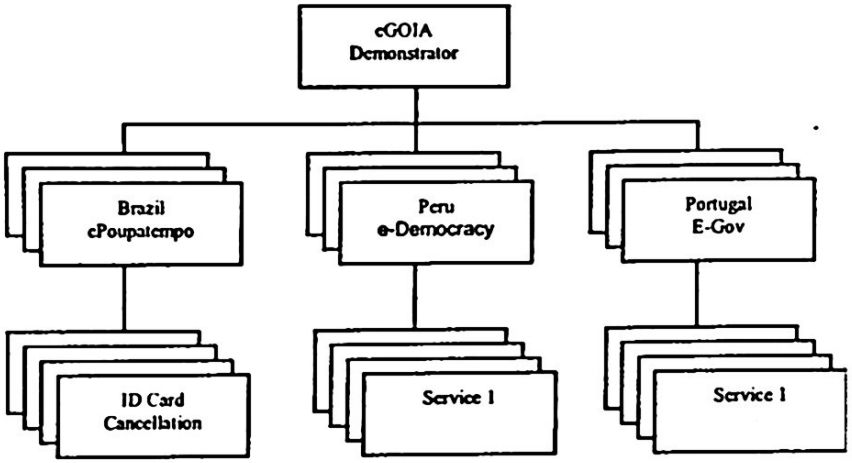


Figure 2 – Integration context of the eGOIA demonstrator.

The figure 3 shows the context of the eGOIA demonstrator in terms of the main actors that will interact with it. The first and most important group of actors that will interact with the eGOIA demonstrator is the citizen's group. The citizens will start the majority of the services implemented in the demonstrator. The second group of actors is the public Institutions. These institutions will provide the services that will be integrated and composed by the eGOIA demonstrator. The third group is the commerce institutions. These institutions will request citizen information and pay for these information. The fourth group is the bank institutions. These institutions are qualified bank agencies to bill commerce institutions that use paid public services and to receive payments, such as taxes, fines, etc.

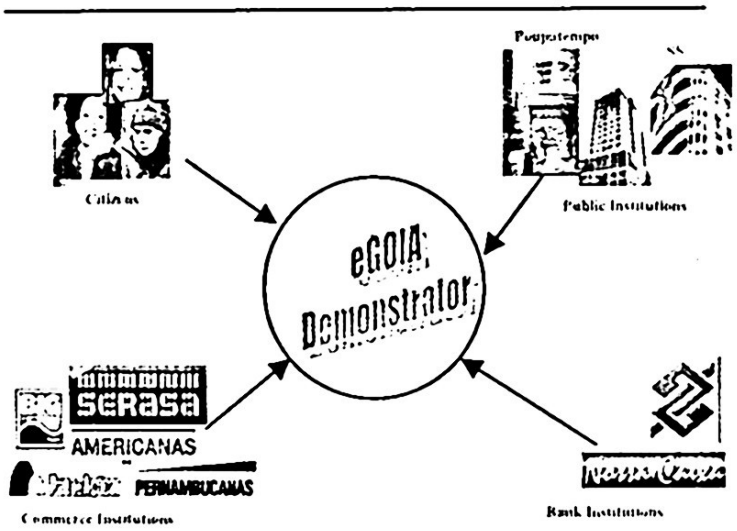


Figure 3 – Main actors of the eGOIA Demonstrator.

Some of the most general requirements are listed below. Most of these requirements are strongly associated to the provision of facilities to the citizens, as they are the most important group of users. The eGOIA demonstrator will provide ubiquitous access in the sense that the citizen will access the e-government services from anywhere through a single user friendly Web portal. For some kind of services the system will provide identification, authentication and authorization mechanisms to allow the citizen to make personalized access to the public services. The service provision must be reliable, secure and preserve the users data integrity. The citizen must not have the feeling that his/her profile is inconsistent and dispersed in the government entities. It is important to guarantee a non-stop service offer by some electronic communications channels opened 24hs, 7 days a week for the population. The eGOIA demonstrator will provide mechanisms for service certification to guarantee that the citizen has a certificate that proves the service execution. Any document delivered or accepted by the e-government system must pass through a certification and authentication process. To attend the great diversity of the public, including tourists and naturalized citizens that are unable to read in the administration natural language but is fluent in another language the eGOIA demonstrator must support at least Portuguese, Spanish and English languages. The system must provide mechanisms to support a variety of end-user interfaces, wide area of range, wireless devices and information consistency, independently on the place or time the system is accessed.

The main requirements from the back office perspective are the following. The eGOIA demonstrator has to provide mechanisms to access back office data and transform them to be consumed by different services or presented to the citizen. The implementation of some services consider the integration and composition of some mainframe based legacy applications. In order to orchestrate these actions the eGOIA demonstrator will be constructed using a middleware service integration platform, called enago [8]. Security, digital signature management, certificate handling, processing of forms and contract/request tracking stuff have also to be considered in the back office integration perspective.

## 4. The eGOIA Demonstrator system

The eGOIA Demonstrator will be an e-government demonstration system that will support the interaction of citizens and civil public servants with different types of e-government services through the Internet and Citizen Points of Access (CPAs). For such, it will focus in the integration of front-office technologies and of the back office systems. The figure 4 illustrates the structure of the eGOIA demonstrator.

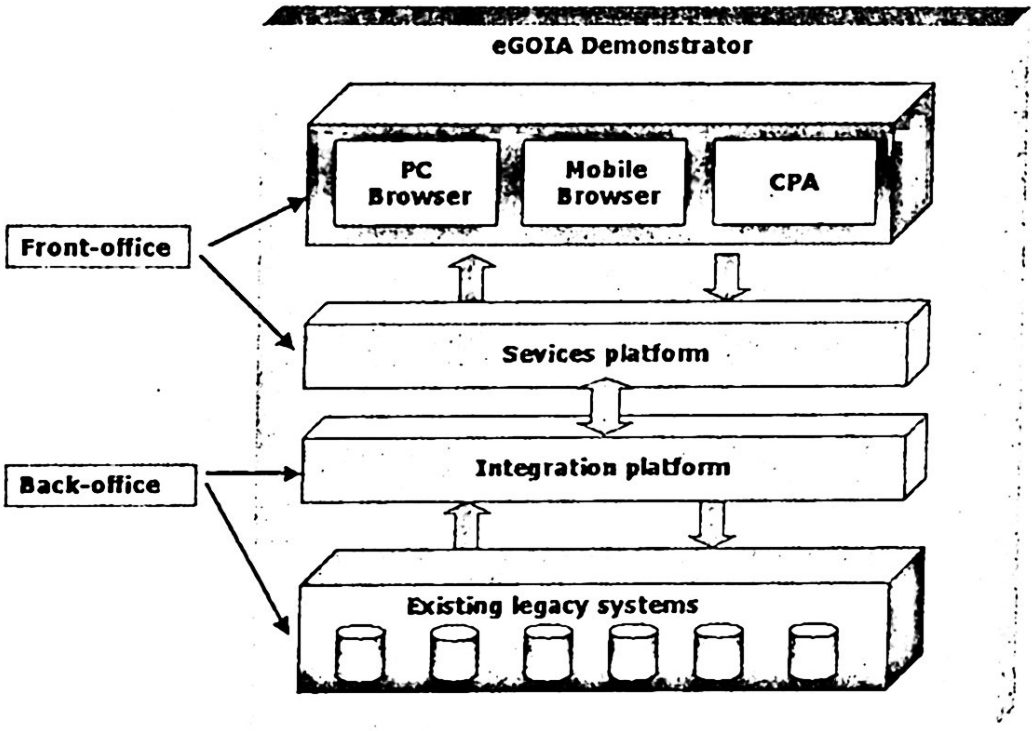


Figure 4 – eGOIA demonstrator structure.

### 4.1. Front-office Integration

The first task of the front-office integration will be the assessment of points of access to the public services aiming at the creation of advanced points of attendance to the citizen, in the modality of auto-attendance (advanced users) or mediated by a person who orientates, such as in the presential agency. From the existing points of access ("infocenters", kiosks, schools, etc), it will be selected those that will be used, as Citizen Point of Access, in the project demonstration.

Experimentation performed in the project, will identify models of public services access and users skills, considering aspects such as socio-economical and cultural situation. Thus, the second task of the front-office integration will consist of the applications of these models, through the design and implementation of user interfaces regarding user skills and the channels used.

### 4.2. Back Office Integration

The conception of the eGOIA demonstrator will take into account that it has to be possible to provide e-government applications in an open and distributed environment (Internet), configured in a flexible way, considering the autonomy and evolution of the involved government departments. So, the proposed architecture will integrate all the existing legacy systems, specifically the existing databases, and preserve the autonomy of all entities, responsible for the services.

### 4.3. Demonstrator Architecture

eGOIA software architecture is illustrated in figure 5, which depicts the software logical architecture and an envisioned physical distribution using four tiers. The logical architecture follows the traditional Web application approach and is comprised of the following blocks:

The **User Logic** deals with the functionality required by the user and the devices used;

The **Business Logic** is comprised of the processing services responsible for common services (both domain specific and general) that can be used by multiple users. Legacy systems and integration components belong to this block ;

The **Persistence Logic** is responsible for physical data storage and data management.

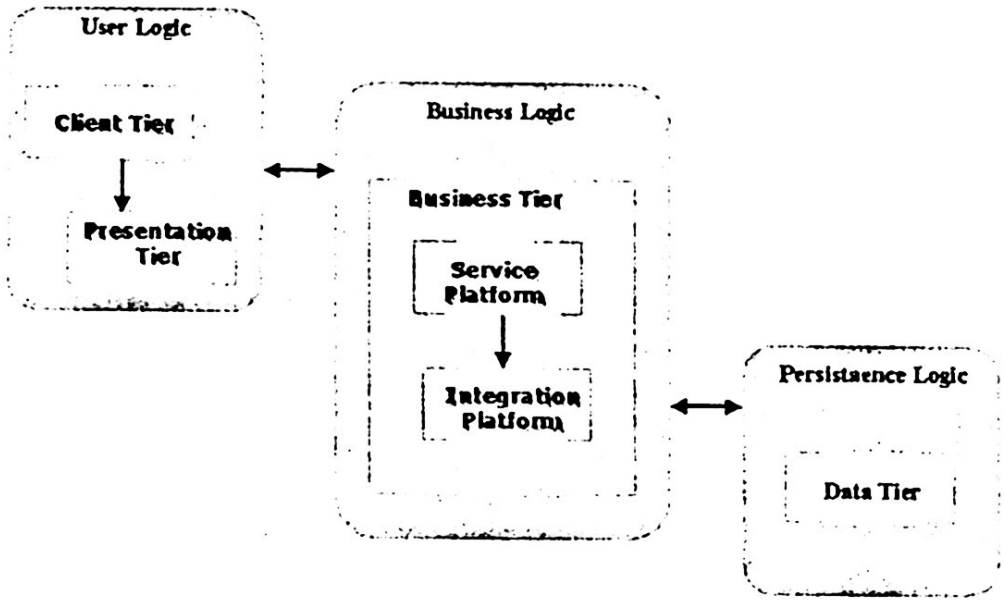


Figure 5 – eGOIA demonstrator architecture.

Regarding component distribution, eGOIA project aims to achieve a multi-tier structure, described as follows.

The **Client Tier** represents different access channels, required by different users, terminals, transmission paths, as well as different application purposes, in order to interact with dedicated applications. The different access channels comprise e.g. Web access over Web Browser or special Browser plug-in, portable radiotelephones and personnel digital assistants (PDAs), and external systems.

The **Presentation Tier** describes the information preparation for the client and the interaction of the user with dedicated applications. The presentation

component covers all standards for communication with the regarded end-systems of the Client Tier.

The **Business Tier** encloses the e-government components and services and can be regarded as the core of e-government-specific applications. In this tier the specific business logic of the diverse e-government applications is combined and integrated. In this tier the highest integration need is expected for e-government solutions. The Business Tier processes the data from the persistence tier.

The **Persistence Tier** comprises the back-end and guarantees the data storage. Data storage is usually solved by means of databases. The back-end stands as comprehensive term for functionalities of the operating system, specific databases, and in addition, for existing legacy or ERP systems and services.

### 4.4. GOIA Demonstrator Enabling Technologies

The eGOIA project has chosen a service integration platform that supports the needs for modern e-government service integration scenarios. This platform is already used for e-government in Berlin, Germany. The enago Open Service Platform (enagoOSP) provides a uniform service access, execution and management environment, particularly across different administrative and technological domains. It is based on state of the art CORBA and Java 2 technologies that enable component based e-service and service portal implementation. enagoOSP has been designed to support efficiently and economically the different roles involved in e-government, namely end users/citizen, government offices, infrastructure providers and third party providers by the provision of a unique service integration platform.

The main focus of enagoOSP is to enable the integration, composition and management of existing and emerging application services based on different programming languages, different access technologies and different service technologies, and to provide a controlled (secure) and uniform access to these services by means of one-stop shopping and single sign on capabilities including customization by means of profiles to the customers and end users.

The development of e-government applications (i.e., e-services in the eGOIA context) will be model driven aiming the following goals: (i) decrease development time, by generating code automatically rather than handwriting it; (ii) improve code consistency and maintainability; and (iii) increase portability across middleware vendors, by defining models independently of platform.

Model Driven Architecture MDA [9] is the modeling technology adopted in the eGOIA project. MDA and the standards that support it allow the same model specifying system functionality to be realized on multiple platforms through auxiliary mapping standards, or through point mappings to specific platforms, and allows different applications to be integrated by explicitly relating their models, enabling integration and interoperability and supporting system evolution as platform technologies come and go.

To model a system, MDA defines three kinds of models [9]:

A **Computation Independent Model** (CIM) is a view of a system from the computation independent viewpoint. A CIM does not show details of the structure of systems and is sometimes called a domain model and a vocabulary that is familiar to the practitioners of the domain in question is used in its specification.

A **Platform Independent Model** (PIM) is a view of a system from the platform independent viewpoint. A PIM exhibits a specified degree of platform independence so as to be suitable for use with a number of different platforms of similar type.

A **Platform Specific Model** (PSM) provides a set of technical concepts, representing the different kinds of parts that make up a platform and the services provided by that platform. It also provides, for use in a platform specific model, concepts representing the different kinds of elements to be used in specifying the use of the platform by an application.

Based on this approach, eGOIA demonstrator will make use of a modeling infrastructure that supports the software development for enagoOSP based on UML and EDOC [10]. This modeling infrastructure contains modeling and development tools and their interconnection. Each of these tools or modeling techniques support a different phase or activity in the development process for a software system, as follows.

The platform independent modeling tools based on UML and EDOC directly support the abstract PIM and refined PIM modeling steps;

The PSM modeling tools based on UML and a UML profile for enagoOSP support the enagoOSP platform specific modeling tasks;

The integration between the modeling infrastructure and the IDE Eclipse (www.eclipse.org) does support the final Java developments and compilation of system components; and

enagoOSP supports the integration of these components, their operation and the maintenance of the resulting system.

## 5. Select Services and User Groups

The success of the demonstrator depends on the ability of the eGOIA project team to identify the needs and expectations of the citizens and governmental agencies and to quickly implement services that meet these needs and expectations, and can be offered in a friendly use way.

### 5.1. User Groups

According to main purposes of eGOIA project, it was defined, as future beneficiaries of the project outcomes, two main groups: the population (citizens) and the public services providers. The population group was detailed to allow focusing on a well defined target segment in order to face the digital exclusion.

The public services providers group was detailed aiming to the system integration of different governmental domains and the services improvement.

Based on previous study of the population of Sao Paulo region [11], it was identified that income, education and age are the most important parameters to define user groups. Also, it was observed that "there is a strong correlation between education and age and income distribution that, for the project purposes, the education and age related problems are represented among the people classified by income variable" [12].

According to these considerations, the target group of the population is the poor segment, defined as those people with monthly income of three Brazilian legal minimum wages. Besides, this target segment was divided into *Internet skilled* and *Internet unskilled* people to allow the identification of specific needs and expectations. The ability was established by observation of the users' behavior in the access to the Internet. The study showed that "people with some familiarity with internet tend to play a special role among their close social environment (family and friends), that seems to be particularly important in stimulating social and digital inclusion and anticipating needs of the unskilled majority". In additional, the study showed that the skilled poor people segment tend to include users with low to medium educational level, working in more qualified jobs or places with computers and they are younger than forty. On the other hand, the unskilled poor people segment "tend to include users with low educational level, unemployed or working in less qualified jobs (as mostly in agriculture), as well as people over forty" [11].

As part of the adopted methodology for data capture, it was defined a *control segment* that includes skilled people with income over three Brazilian minimum wages ("not poor people"). This third group is important because of, both, eliminating causes of educational deficiency related to not well succeeded solutions and comparing the needs in order to evaluate if they are related to social conditions. This segment tends to include people from medium to high educational level, working in qualified jobs with computers and younger than forty.

The public services providers consider both governmental and private institutions because of the current situation of the public service provision based on the Brazilian and Sao Paulo State Constitutions that established roles concerning the public services delivery by governmental, non-governmental and private agencies in an independent way. The group of providers was divided into *direction staff*, *ICT managers*, *back-office employees* and *Citizen Points of Access - CPA (or front-office) employees*, in order to represent the specific needs and expectation and to assess the result by each perspective [12]. They have the following characteristics:

a) **Direction staff**: They are the public or private responsible authorities for the services provision. They must represent the different domains needs and expectations, as well as the assessment of results by their perspective.
b) **ICT managers**: They are the ICT personnel, committed on ICT specifying, developing, implementing and maintaining the technological resources. They must represent the specific ICT needs and expectations, as well as the assessment of results by their perspective.

c) **Back-office employees:** They are the personnel committed on non-automatic activities and decisions related to the services to be changed to the demonstrator. They must represent the specific internal processes needs and expectations, as well the assessment of results by their perspective.
d) **CPA employees:** They are the personnel committed on the real time, direct support to the citizens needs during the provision of public services by Internet. They must represent the citizens direct support processes needs and expectations, as well as the assessment of results by their perspectives.

### 5.2. Select Services

Since it would be hardly possible to assess in depth every service characteristics, we should strive to apply a combination of criteria that ensures, as much as possible, the highest pay-off with the minimal risk at the selection of services to be applied in the demonstrator, while taking into account the characteristics of the technology available to the project.

The service selection characteristics:

a) A service that searches for information in the existing mainframe system and in the "low platform". As a service like this was not identified, this characteristic was changed for services that access each of the mainframes.
b) A service that makes records and saves information in the mainframe system.
c) "Multi-organizational" services. Services, which processes belong to more than one organization.
d) Services that require user identification to be accessed.
e) Services that accept anonymous users. Any person, without previous registration, could demand some e-government services.
f) Services that require to be accompanied. The service is realized in intermediate steps. The user must be informed about the service states through reports.
g) Services that accomplish financial transaction. One or more tax must be paid for the conclusion of the service. Electronic credit transference should be considered.

According to these criteria and for this phase of eGOIA project, it was chosen a service collection: the citizen identification services – identification card (ID card), involving the Public Safety Secretary of Sao Paulo State (SSP – SP). The ID card is a national citizen identification document, with national validity, federal regulation and issued by every Federated State, issued over 140.000/month just in Poupatempo agencies and it is based on mainframe legacy system. It must be presented to apply for all others official documents. It is asked, for personal identification, by governmental agencies, for appliance to public services, rights and documents issuing; by employers, for employment and labor agreements; by third parts, for contractual relationship; and by financial agents and commerce, for buying on credit and for getting visa.

In addition to social relevance of the ID card, some important technical aspects of the selected services for the eGOIA demonstrator has to be considered, such as integration - the eGOIA demonstrator will integrate different mainframe based legacy systems and Windows based systems; online service accounting could be

performed in many ways, such as by lot of services, one-by-one, by time-slice, etc.; user identification, for some services the citizen has to make login in order to access the system; scalability – when thousands or millions of citizens try to use the same service in the same time.

## 6. Conclusion and Future Work

This paper presented the vision, goals, objectives and the initial strategies of the eGOIA project. In short, the eGOIA project is focusing on G2C (government to citizen) demonstrations, nevertheless also the G2B (government-to-business) and G2G (government-to-government) scenarios and applications may be of interest in later versions of the demonstrator. Also, this paper shows the progress reached in the first six months of activities [7, 8, 12]. These activities can be synthesized as the identification of:

Existing knowledge, considering the situation of existent in three partners: Brazil, Peru and Portugal.
Good practices of eGOIA partners.
Technical frameworks and standards.
General requirements and constraints.
Selected services for the demonstrator.
User groups.

An important milestone was the project official web site: http://www.egoia.info . It is updated regularly with eGOIA information, news and achievements and it is planned to support multilingual information, i.e., English, Portuguese and Spanish. Other milestone was the first presentation of the project for the international community at the 3rd IFIP Conference on e-Commerce, e-Business, and e-government [5].

As a future work, it is necessary to create a plan (strategic, tactic, operational) that mediates the interactions between the eGOIA project and the governments, facilitates the identification of demonstrator opportunities, defines governmental segments and enlarges the identification of customer and governmental needs.

To prepare the regional dissemination and multiplication of results, meetings took place with the representatives of Public Service Agencies in Cuiabá (Mato Grosso State, Brazil). The Brazilian state participants were: *Ganha Tempo (Mato Grosso do Sul); SACI (Pará); SAC (Bahia); DETRAN (Pernambuco); Central do Cidadão (Rio Grande do Norte); Serviço de Atendimento Imediato ao Cidadão – Na Hora – Brasília* (Federal District). The initial aim was to gather information on inventory, description of the e-government processes, technology used, requirements, legal aspects, etc of the services potentially selected for the demonstration project. Besides ID card, an initial suggestion of choices of services of national responsibility of the states comprise in particular those related to *DETRAN* (Department of Traffic) and Job Services, these are common services of great demand and high cost of production to all agencies. Also, a presentation about e-GOIA progress to representatives of 18 ABEP associates was performed.

In Peru initial contacts with the municipalities have been established and it was possible to know the Peruvian experience in Citizen Access Points (kiosks).

In addition, members of the project have known the experience of Berlin in using a eGOIA similar concept of middleware platform in the integration of legacy systems.

Finally, the eGOIA initiative has proposed three level of activities: strategic, tactic and operational. This paper has shown the strategic level gathering benchmarking, policy deployment and strategic guidelines for e-government implementation. The next steps will be the tactic (technological and organizational change management) and operational (government process reengineering and demonstrator implementation) activities.

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## Appendix

**eGOIA partners**

**Fraunhofer FOKUS** - Institute for Open Communication Systems, Berlin, Germany - http://www.fokus.fraunhofer.de

**Secretaria de Estado da Casa Civil** - São Paulo, Brazil - http://www.saopaulo.sp.gov.br

**Centro de Pesquisas Renato Archer - CenPRA** - Campinas, Brazil - http://www.cenpra.gov.br

**Associação Brasileira de Empresas Estaduais de Processamento de Dados – ABEP** - Taboão da Serra, Brazil - http://www.abep.sp.gov.br

**Consejo Nacional de Ciencia y Tecnología – CONCYTEC** - Lima, Peru - http://www.concytec.gob.pe

**Helios ICT Management Ltd.** - Murieston Livingston, West Lothian, UK

**Meticube Sistemas de Informação, Comunicação e Multimédia, Lda.** - Taveiro, Portugal - http://www.meticube.com

**INI-GraphicsNet Stiftung** - Darmstadt, Germany - http://www.inigraphicsnet-stiftung.de

# CoGPlat: Using Composition to Enable Collaborative e-Government Services

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**Abstract.** The use of Information and Communication Technologies on the public administration can be considered a reality - many public services delivered by governments to the society are already available through electronic means. Nevertheless, Collaboration, e-Democracy and e-Governance are new ideas that promise, to a certain extent, a revolution on public administration. The main goal of these mechanisms is to increase the transparency and legitimacy of the public administration decisions, what leads to more efficient governments and to a better integration with the society, with other public entities and also with the private sector. This article describes preliminary studies about a running project that has as its main goal the study and proposal of new Collaborative e-Government and e-Governance mechanisms, validated through the modelling and implementation of a platform, which we call *CoGPlat - Collaborative e-Government Platform*.

## 1 Introduction

The Information and Communication Technologies (ICTs) are being applied vigorously by governmental units at national, regional and local levels around the world [7]. This use of ICTs on public processes and services is often termed e-Government, which has as its most common applications the ones related to the provision of information to the society. Besides that, many services that before were delivered only through traditional means are also being successfully offered through electronic means - in Brazil two examples are the on-line Federal Income Tax declaration system and also the Electronic Police Department (São Paulo's State Government initiative).

A variation on the classic e-Government model appeared recently: Collaborative e-Government. Following this model, new work and cooperation relationships with the private sector and with non-governmental organizations (NGOs) are established in order to deliver a greater variety of services to citizens and to permit a greater participation of the society on the government decisions. This opportunity for governments to redesign services through collaboration has as one of its main facilitators the rapid evolution of the ICTs and the Internet [3].

Although there are many researches related to the classic e-Government model, the application of collaboration mechanisms on the public administration represents a new area of study. The research project we present next consists basically of an e-Government platform (**CoGPlat**) which supports collaboration among different public

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and private organizations and the citizens. This collaboration support will allow both the society and the local organizations to actively participate on the public affairs, respecting the democratic and legal precepts. Aspects like privacy, security and traceability are also considered.

A modelling process based on MDA (*Model Driven Architeture* - Section 2.2) is suggested in order to guarantee platform independence. To validate the model we propose a prototype implementation based on a service-oriented approach (Sect. 2.3) applying Orchestration and Choreography (Sect. 2.4) mechanisms.

This article is organized as follows: Section 2 presents some basic concepts related to this work; Section 3 introduces some researches in the area of e-Government and e-Governance; Section 4 presents an overview of the platform; Finally, Section 5 presents some nal considerations.

## 2 Concepts

Next we present some concepts and de nitions related to our project.

### 2.1 e-Government and e-Governance

Electronic Government (or e-Government), as an expression, was coined after the example of Electronic Commerce. In spite of being a recent expression, it designates a eld of activity which is with us for several decades yet. To some extent, e-Government is just a new name for the informatization of the public sector. [5]. The use of ICTs in public administration and in other branches of government (including parliaments and the judiciary) has attained a high level in many countries of the industrialized world.

Nevertheless, the term e-Governance is much more than the simple electronic delivery of services. It is closer to concepts like e-Democracy, offering a greater citizen participation support on the government decisions and acts [1].

While the motivation for traditional e-Government applications is usually the improvement of a speci c service delivery, the motivation for the appliance of e-Governance mechanisms includes [2]:

1. The aim to have the society supporting the government decisions;
2. The possibility to increase the credibility and transparency of the governments;
3. The opportunity to gather, effectively, the private sector, the third sector and the citizens together on the challenges of the public administration.

### 2.2 Model Driven Architecture

The Model Driven Architecture (MDA) [8] is a new way of writing speci cations and developing applications, based on a platform-independent model (PIM). A complete MDA speci cation consists of a de niti ve platform-independent base UML model, plus one or more platform-speci c models (PSM) and interface de nition sets, each describing how the base model is implemented on a different middleware platform. A complete

MDA application consists of a de niti ve PIM, plus one or more PSMs and complete implementations, one on each platform that the application developer decides to support [9].

MDA development focuses rst on the functionality and behavior of a distributed application or system, undistorted by idiosyncrasies of the technology or technologies in which it will be implemented. MDA divorces implementation details from practical functions. Thus, it is not necessary to repeat the process of modeling an application or system's functionality and behavior each time a new technology comes along. Other architectures are generally tied to a particular technology. With MDA, functionality and behavior are modeled once and only once. Mapping from a PIM through a PSM to the supported MDA platforms can be implemented by tools, easing the task of supporting new or different technologies [9].

## 2.3 Service-oriented Computing

*Service-oriented computing* (*SOC*) is a computing paradigm that considers services as fundamental elements for the development of applications [11]. Services are offered by service providers - organizations that procure the service implementations, supply their service descriptions, and provide related technical and functional support. The application of SOC on the Web is manifested by Web Services - a speci c kind of service that is identi ed by a URI, whose service description and transport utilize open Internet standards. Interactions between Web Services typically occur as SOAP calls carrying XML data content. Interface descriptions of the Web Services are expressed using Web Services De nition Language (WSDL). The Universal Description, Discovery, and Integration (UDDI) standard de nes a protocol for directory services that contain Web service descriptions. UDDI enables Web service clients to locate candidate services and discover their details [11].

## 2.4 Service Composition

The Web Services are migrating to a new phase, where more robust interactions are supported, characterized by composition. This composition is achieved through mechanisms like orchestration and choreography. They de ne how a set of Web Services interactions can be grouped (composed) in order to execute a determined process.

Orchestration describes how Web Services can interact with each other at the message level, including the business logic and execution order of the interactions. These interactions may span applications and/or organizations, and result in a longlived, transactional, multi-step process models [12].

Choreography tracks the sequence of messages that may involve multiple parties and multiple sources, including customers, suppliers, and partners. Choreography is typically associated with the public message exchanges that occur between multiple Web Services, rather than a speci c business process that is executed by a single party [12].

There is an important distinction between Web Services orchestration and choreography. Orchestration de nes an executable business process that may interact with

both internal and external Web Services (like in a work o w). Usually there is an entity that coordinates globally the composition - the Orchestration Engine. On the other hand, Choreography is more collaborative - only the public message exchanges are considered relevant. Differently from Orchestration, there is not an entity to control de composition globally - each party involved in the process describes the part they play in the interaction [12].

In order to de ne a web service composition (either through orchestration or choreography) the following questions should be considered:

1. Can the interactions happen in any order?
2. If no, which rules govern the sequence of interactions?
3. Is there any relationship between messages sent and/or received?
4. Is there a "beginning" and an "end" on a given sequence of interactions?
5. Can a given sequence of interactions be undone?
6. Is it possible/necessary to draw a global view of all message exchanges?

Two relevant speci cations that model this composition (and try to offer mechanisms to answer these questions) are BPEL4WS [19] and WSCI [20].

### 2.5 Collaboration

*Collaboration* can be de ned, from a technological viewpoint, as an agreement between a set of partners (Web Services, for instance) to achieve a common goal on a shared process.

In the context of our work, collaboration can be de ned as *"a reciprocal and voluntary agreement between two or more distinct public sector agencies, or between public and private or nonpro t entities, to deliver government services"* [3]. In general, these relationships involve a formal agreement about roles and responsibilities. The participating organizations share a common objective aimed at the delivery of a public service. They also share tangible and intangible risks, bene ts, and resources [3].

Collaboration, especially in the e-Commerce eld, has been widely discussed and many technological solutions have been proposed to support Collaborative e-Commerce (we could cite, for instance, the Virtual Marketplaces [10,17,18]). We will study these solutions and try to adapt some of them to the context of e-Government and e-Governance.

## 3 Related Work

In this section we present some researches in the eld of Collaboration and e-Governance related to our project. Due to the recentness of the area, these researches are still on their initial stages and the discussion is held on higher abstraction levels.

### 3.1 e-Governance Survey

A series of papers published by the *Commonwealth Centre for Electronic Governance* discuss different aspects of e-Governance and e-Government, including the following topics:

1. *Information Management and e-Government* [14];
2. *Knowledge Management and Technology* [16];
3. *The Role of Information in the Emerging Global e-Government, e-Governance and e-Democracy Environments* [15];
4. *e-Government vs. e-Governance: Examining the Differences in a Changing Public Sector Climate* [13].

### 3.2 New Models of Collaboration for Delivering Government Services

This article [3], published in an e-Government special issue of *Communications of the ACM*, presents a 2 year project held on USA, Canada and Europe. Various case studies were done on different areas of public administration trying to analyze where new collaboration models could be applied. A summary of the studied projects is presented on Table 1.

**Table 1.** Case Studies

| Place | Project | Objetive |
|---|---|---|
| USA | *NYS Geographic Information System Coordination Program* | Data sharing and development of expertise |
| USA | *Access Indiana* | Public access to state government information and transactions |
| USA | *IRS e- le* | Filing of personal income tax returns |
| USA | *First gov* | Public access to federal government information |
| Canada | *Casdastre Quebec* | Real property tax mapping |
| Canada | *E-Commerce for Occupational Health and Safety Claims* | Claims processing for workers compensation |
| Canada | *BonjourQuebec.com* | Quebec tourist information and transactions portal |
| Canada | *Service Ontario Self-Service Kiosks* | Network of kiosks allowing renewal of driving licenses and Social Security cards |
| Canada | *One-Stop Business Registration* | Unique kiosk allowing electronic ling of all forms required to open a new business |
| Europe | *Bremen On-Line* | Public access to city information and transactions |
| Europe | *Hotjob* | Job offers portal |

Based on these case studies, some observations regarding collaboration were done:

1. Each collaboration rests on an understood (but often tacit) working philosophy. Collaboration has many meanings and different projects operate on different working assumptions.
2. Collaborative relationships are evolving and dynamic. Each collaboration offers continuous opportunities for feedback and learning.
3. Data-intensive collaborations face issues of data ownership. In all of these collaborations, data is treated as a valuable asset.

4. Multi-organizational collaborations need an institutional framework. Because these initiatives stretch across the boundaries of distinct organizations, they need to establish a new kind of institutional legitimacy.
5. Technology choices affect participation and results.

### 3.3 eGOIA - Electronic GOvernment Innovation and Access

The European Commission launched a co-operation programme – @LIS ALliance for the Information Society – to accelerate the development of the Information Society in Latin America and to reinforce the partnership between the European Union and Latin America. eGOIA (Electronic Government Innovation and Access) [4,6] is an @LIS project that aims to implement a demonstration system supporting the access of citizens, through the Internet, to integrated public eGovernment services.

The main target of eGOIA is the demonstration of future-oriented public administration services to a broad public. Thereby the vision of the eGOIA project is the provision of a single virtual space supporting the interaction of citizens (independent of social status, gender, race, abilities and age) and the public administration in a simple, future-oriented and cost-effective way.

Technically the project is based on two main paradigms: front-of ce integration and back-of ce integration of e-Government services

## 4 CoGPlat Overview

The main goal of the **CoGPlat** platform is to support interaction and collaboration among governments, organizations (public, private and nonpro t) and citizens through the appliance of e-Governance and e-Democracy concepts.

The functionalities necessary to achieve this goal are presented next, together with a schema of the platform infrastructure and with a more detailed analysis on the rst functionality being developed - the *Transparent Services*. Also on this section some implementation issues are discussed and an application scenario is presented.

### 4.1 Platform Functionalities

The platform should be prepared to support the following functionalities:

1. Dynamic Integration and Management of various services delivered to the citizens:
   (a) Transparent Service concept: after a citizen request, *CoGPlat* manages all burocratic steps involved on a determined process, simplifying it to the citizen.
   **Example**: to get an authorization X emitted by the municipality, different entities should be contacted (Fire Department, Planning Secretary, Engineers Council etc) on a determined chronological sequence. This process is usually slow and consists basically of the transport of documents by the citizen from one entity to the other. The *CoGPlat* could help managing all this steps (electronically), making the authorization X process transparent to the citizen.
2. Mechanisms to support society participation on the public administration processes.

3. Mechanisms to guarantee the transparency of the public processes:
   (a) Possibility of inspection/audition of all public processes on a simply and immediately way by any citizen or organization.
4. Con ict resolution support (including support for different regulations).
5. Multilateral negotiation support.
6. Decision-making support. Examples:
   (a) Do the different regulations allow that decision?
   (b) Is their support (legitimacy) from the involved society sectors to that decision?
7. Support for medium- and long-term planning. Examples:
   (a) Are there other entities (municipalities, state government, private companies, NGOs etc) involved with such planning? If yes, what is their position and how can they contribute?

Besides that, scalability and computing platform independence are essential characteristics in order to integrate the platform in the best possible way with the heterogeneity of services already available electronically.

### 4.2 Infrastructure

**Facilities.** To implement the functionalities presented, the following managers are introduced:

1. **Transparent Services Manager**: responsible for the dynamic integration of services delivered to the society.
2. **e-Democracy Manager**: supports different participation ways of the society on the government decisions. It helps the other Managers offering legitimacy to the public administration acts, always respecting the local regulation.
3. **Auditing Manager**: makes it possible for the society to exam clearly and directly all public administration acts, increasing government transparency and credibility.
4. **Con ict Mediation Manager**: responsible to help in the resolution of con icts among different entities, especially when different regulations are involved or even when there is no de ned regulation.
5. **Multilateral Negotiation Manager**: important on a negotiation process that involves various parts - it works together with the Con ict Mediation Manager when necessary.
6. **Decision-making Support Manager**: helps determining the political legitimacy, legal and statistical support for decision-making.
7. **Planning Manager**: offers support to medium- and long- term planning, integrating on a collaborative way the entities involved on a determined process.

These managers collaborate with each other to deliver the services supported by the platform. The Fig. 1 presents a general schema of the platform.

Besides the managers, two other facilities are part of the platform. These facilities are responsible to manage the integration with external entities and applications:

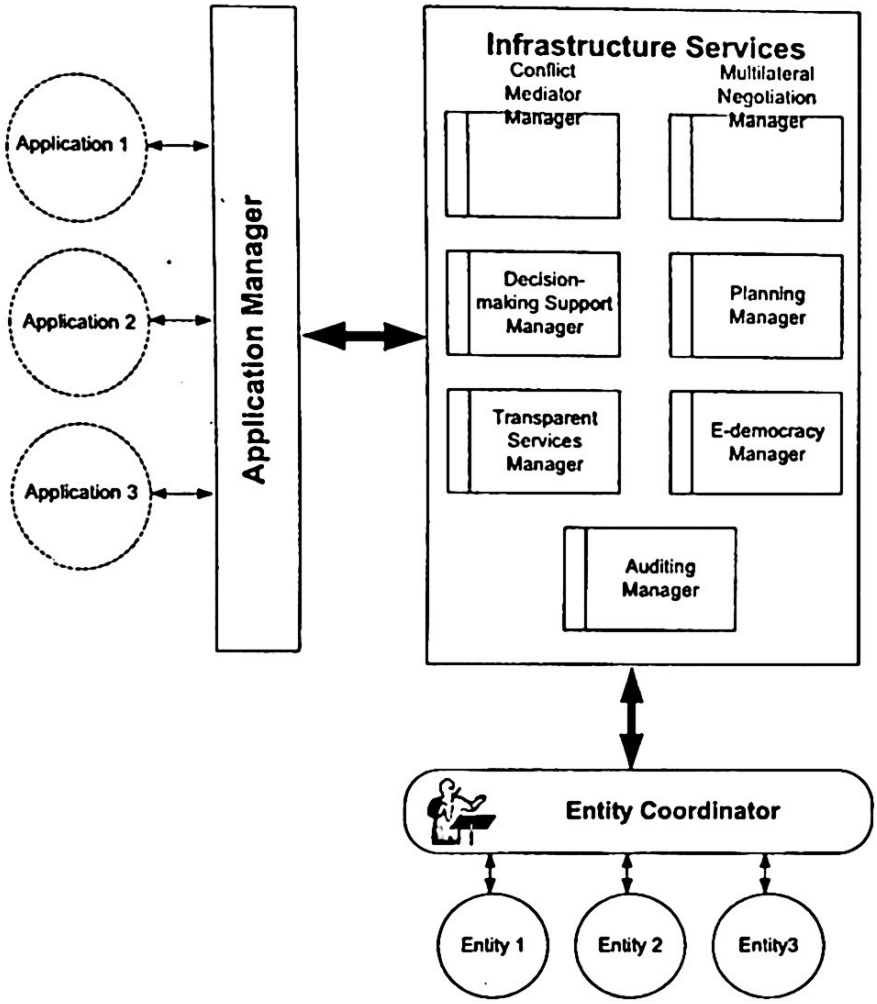


**Fig. 1.** *CoGPlat* infrastructure schema

1. **Entity Coordinator**: responsible for the integration of other entities to the platform. An entity is an organizational unit that participates on the platform environment offering and/or using any service. Examples of entities are municipalities, public organizations, NGOs, private companies etc. The *Entity Coordinator* is also responsible for managing the collaboration (using orchestration and choreography of services, for instance).

2. **Application Manager**: catalogs and manages the applications and their dynamic integration. An application, in this context, can be de ned as a set of (computing) services that interact with other to achieve a common goal. An application can also be considered a service and be part of a composition forming another application.

The interactions among the different actors that are part of the platform are being formalized at the current stage of the project.

### 4.3 Implementation

A prototype that implements the most important functions of the infrastructure in order to validate is to be implemented next. Besides this prototype, some application examples will also be developed over the platform (Subsection 4.3) showing its potentials.

For the development of the prototype, some issues are being considered:

1. **Heterogeneity**:
   (a) The entities that will participate on the platform have independent and heterogeneous systems.
   (b) The political, legal and cultural aspects of the entities may also have a great diversity.
2. **Privacy and Integrity**: The way **CoGPlat** will manage the privacy and integrity of the information belonging to governmental systems, entities and citizens is a key factor for the success of the platform.
3. **Traceability**: Besides the transparency and auditing issues already mentioned, the platform prototype must also offer to whom concerns the possibility of following the processes and activities running over it.

Based on a MDA model (which is platform independent), the use of a technology based on the SOC paradigm (like Web Services) to integrate the different services that are going to participate on the **CoGPlat** environment could be a very appropriate solution to treat some of these issues – the SOC paradigm makes the integration of different applications and entities easier (at service level), preserving the peculiarities of the intra-organizational processes.

Besides that, to compose the services and offer support for collaboration, we propose the use of Orchestration and Choreography. When, for example, the composition is made up by services of an entity that controls others, an orchestration approach is more appropriate. On the other hand, when there is only collaboration among the entities (no administrative links or hierarchy and fully decentralized control), choreography is the most appropriate choice.

**Current Stage.** The rst facility being developed on the platform is the *Transparent Services Manager*. An MDA model of it (and of all other facilities) will be of great importance to guarantee independence of platform to the speci cation of the **CoGPlat**. In terms of implementation, the *Transparent Services Manager* is the facility responsible for the integration of services delivered by different governmental entities to citizens dynamically through the application of Orchestration and Choreography of Services. The second facility to be implemented is the *Auditing Manager*, responsible to offer support for traceability to the platform. The E-democracy Manager is the third facility to be implemented due to its importance to the platform.

**Application Scenario** The rst application to be built over *CoGPlat* will treat collaboration among municipalities. Metropolitan regions face various problems that involve different municipalities: con icts of interest, public transportation issues, scal disagreements, inter-municipal projects, security etc. Collaborative e-Government and e-Governance mechanisms could help a lot on the resolution of those problems.

## 5 Final Considerations

This article presents preliminary studies about a running project (**CoGPlat**) that contributes by modelling and developing a service infrastructure based on e-Governance and Collaborative e-Government concepts. Aspects like the support for heterogeneity and traceability are to be among the main contributions of the platform.

A model is being developed using the MDA approach, and a prototype is to be implemented to validate it. Service-oriented Computing and Orchestration/Choreography are applied to facilitate the integration of heterogeneous services delivered by governments and entities to citizens.

Besides that, some example applications (starting with Municipalities and Metropolitan Regions) are going to be developed over the infrastructure to show its potentials.

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# Making *e*Government happen, and why it doesn't. Exploring four hypotheses

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**Abstract:** eGovernment studies consistently report a lack of the much hoped-for efficiency gains by reorganization and cross-organizational integration, particularly at local level. As this is seen as one of the main eGovernment opportunities, there is a need to find out why this is still the case after several years of investment. This paper does so by investigating nine Swedish government agencies – local, regional and national – regarding their view of drivers and obstacles. We explore four hypotheses suggested by literature, including (lack of) economic incentives, sense of crisis, user "e-readiness", and conflicting goals. We find three of the hypotheses worthy of further investigating "Conflicting goals" was found the most important one, whereas there was no support for the "user e-readiness" one. Altogether this means that the officially claimed steady if slow progress towards a politically defined goal should be challenged.

## 1. Introduction

The eGovernment (eGov) agenda has been ongoing for several years in many countries. After initial rapid progress with putting government agencies online and introducing self-service for basic services [13] the development seems to have come to a halt, especially in local government. For example, The Society of Information Technology Management, monitoring progress in the UK, found that in 2004, while all of the 467 councils in England, Scotland, Wales and
Northern Ireland have web sites only some five per cent - 23 councils in all - have 'transactional' services, which is the highest step on the EU benchmarking scale [17].
A lack of cross-organizational integration has been observed, and as this is seen as one of the main potentials of eGovernment, and indeed the main effectivization opportunity, there is a need to find out why this is still the case after several years of expansion of IT use in government, internally as well as for self-service. [16]. This paper studies the European scene, as expressed by Swedish agencies, but the findings should be of interest in any country, as aligning local and central interests – crucial for eGovernment success as integration and standardization is key –is a problem everywhere.
This paper reports an investigation of nine Swedish government agencies – local, regional and national – regarding their progress towards eGovernment. Focus is on how the management views factors driving and inhibiting the organizations, and we

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want to find out to what extent these views are aligned with the national eGovernment agenda (which is echoing the EU one). The purpose of this study is to explore the validity of some hypotheses about possible reasons for the slowdown in the development proposed in the literature.

Sweden provides a good case for exploring eGovernment frontier problems as the country has one of the highest rates of Internet connectivity in the world, a generally IT-friendly population, is sparsely populated, and has an ambitious eGovernment agenda ongoing since several years in combination with a centralized government structure and dramatic efficiency pressure on the government agencies. All these factors should contribute to make eGov an interesting alternative both economically and for service improvement purposes, and indeed EU eGov benchmarking reports put Sweden among the top performers in putting services online [2],[1]. The paper proceeds as follows:

Next, we review previous research, outline problems and research question

Section 2 discusses our research method

Section 3 reports our findings in relation to the four hypotheses.

Section 4 discusses the findings and implications for further eGov development.

## Problem and Research Question

Looking into the eGov literature for ideas of why eGov, particularly at local level, is not making the rapid progress some have expected or at least hoped for, we found four hypotheses.

The official Swedish eGovemment agenda (though initially differently labelled) dates back to the establishment of the "Top Leaders' Forum" in 1995, including top managers of major national government agencies, by means of which informal but practical cooperation and coordination among the main national government agencies was encouraged. The agenda has gradually become more ambitious and more formalized under the influence of the technical and economic developments, as well as EU regulations and coordinating efforts. Hence the 1999/2000 Government Bill 1999/2000:86, "An Information Society for all" [8], is a close match to the EU initiative "eEurope" [6]. There are also other Bills that have been issued to drive the development, including Bill 1997/98:136, "Public Administration at the Service of the Citizens" [7] and Bill 2001/02:80, "Democracy for the New Millennium" [9]. The 1997/98:136 one started an ambitious implementation effort involving the Swedish Agency for Public Management (SAPM) in developing standards for IT and information transfer and initiating, supporting and monitoring progress among government agencies. There have been various projects, most recently under the label of The 24 Hour Agency, within which SAPM has since then published semiannual reports on the progress (www.statskontoret.se, all in Swedish).

These reports have made it very clear that progress is not found everywhere. The reports also correspond well with findings elsewhere in the world.

So far, there has been reasonably good development of e-services among large national government agencies. The Swedish Labour Market Agency is often quoted as a good example, where productivity has increased dramatically over a 10 year period due to electronic self-services. The social insurance agency and the tax administration

agency are other examples of large central government agencies that also have made considerable investment and savings, if not as dramatic.
However, major progress seems to occur only in large agencies where advantages of scale can be found within the organization itself. There is poor development at the level of local and regional government, as well as in smaller national government agencies. The SAPM [15] found the following problems

1. Investment comes first – payback comes... when? The one-year budget is strongly guiding the behaviour of the agencies.
2. Benefits to one agency may require investment in another.
3. Some investments are too large for individual agencies to bear, hence to make them happen some national support or cooperation is necessary.
4. Costs come at agency level, some payback may come at system level. Investments which yield societal benefits, bring small or no agency benefit, and cannot be financed by fees are not made.
5. Related to points 2, 3 and 4: it is unclear how to share development costs that benefit more agencies.

The SAPM reports point to a problem with the incentive structure. This seems to paint a gloomy picture as making eGovernment happen throughout the administration would require a major system revision including a new incentive structure replacing the current focus on profitability by agency by some system level incentives where not only economic measured but also ones concerned with benefits for citizens and/or society would have to be defined. Alternatively, local governments might cooperate on a basis of sharing costs, but so far this has not happenedother than occasionally. The SAPM is not alone in this analysis, examples from other countries include an EU effort to investigate and find models for "Value Creation in eGovernment projects" [4].
Following this discussion, the first hypothesis for our investigation is
*(H1) There is a lack of economic incentives, particularly at local level, to invest in eGov*
eGov research literature is not very helpul in explaining reasons for lack of progress in implementation. So far, the literature is mostly case studies, or rather case stories, where individual examples of eGov services are presented, sometimes along with, but often without, any measurement of success. A 2004 survey of three major eGov conferences found 53 % of the 170 papers to be descriptive with no attempt of theory testing or creation whereas only 29 % made such attempts [11]. Further, eGov research is typically oriented towards technology and (individual) organizations and does not concern system level efficiency (all government agencies together) or effectiveness (government's contribution to society). System level studies are typically made by political scientists and do not concern eGovernment but rather the political organization. Some studies are critical at a theoretical and principal level, but do not measure implementation [14]. There is thus a lack of integration, and even compatibility or comparability, between different strands of government related research, and hence a need for new research.
This said, some hypotheses are at least discussed if not conclusively tested. Kawalek et al [12] assumed, following the Lewinan approach of Dent [5], that there is not sufficient crisis felt in the agencies supposed to implement eGov. They investigated

one case and found no change, no preparedness, no sense of crisis, and indeed obstruction towards change. Though only a single-case study, the potential implications of this situaion being widespread would be far-reaching, so we found it worth following up, hence our second hypothesis is:

*(H2) There is no sense of crisis requiring eGovernment investment in the agencies where it is supposed to be implemented*

Other traditional explanations have focused on lack of "e-preparedness", less sophisticated users. Though rarely explicitly stated, this hypothesis can be found underlying the official efforts of the EU, and as an effect also among national stategies. Broadband connectivity, user "trust" and education are prioritized as efforts to make the information society happen. Examples include the *eEurope Action Plan* of June 2000 [6] where "A cheaper (for the users) and more secure and trustworthy Internet", "Increased user competence", and "Increased Internet use" are the main points on the agenda. Both the Swedish Bill and the EU action plan mention "trust", also related to users' lack of use, as one of the top priorities to achieve more use.

This line of reasoning seems to expect a steady, while perhaps at times slow, development towards eGov, starting with putting services online, then helping users to use and trust the new technology (incidentally, there is no mentioning of the potential lack of trust in government, which might be expected given the trust debate in the e-commerce literature. This argument rests on studies finding many people still not connected to Internet and many of the existing services little used (e.g. [1]). As this hypothesis underlies large parts of the EU funding scheme, it must be investigated:

*(H3) Users – including both "end users" of services, citizens, and service providers within government agencies – are still lacking skills and means to make use of the electronic medium.*

While our experiences from various projects led us to find both H1 and H2 credible, we were reluctant about H3. After all, Sweden can boast some 70 % connectivity in the home, more if job connections are included. Swedes are also the most frequent mobile phone users in the world and generally keen on using technology. An earlier study of the same field that we made in January 2003 based on research findings from other organizations and Internet use surveys [10] suggested that H3 would not be supported. It rather implied that other factors might contribute more substantially, in particular the existence of conflicting goals in many agencies. For example, many municipalities, certainly small rural ones, may see local employment as the most crucial, and problematic, factor. Hence they might hesitate to scrap public sector jobs for achieving a more efficient public sector as the whole municipality would then suffer from increased unemployment. Other examples would include the problem of closing manual services as long as there are people not using the Internet, and hence the risk that e-services would only increase costs. This argument led us to a fourth hypothesis:

*(H4) Agencies have conflicting goals, and other ones are sometimes prioritised over investing in eGov to improve government efficiency.*

## 2. Method

We explored the four above mentioned hypotheses qualitatively by interviewing leading officials in government organizations. The reason for the choice of method was that we wanted to find out how management reasoned about electronic services. We wanted to explore the rationalities guiding the daily activities of the operative agencies where eGovernment is to be implemented. As these might be intricate, and as there might be more explanations than the four we hypothesized based on earlier studies. Hence our study was made rather to provide increased understanding for the various explanations offered by hypotheses rather than trying to test them in any quantitative way. To this end we made a sample of agencies based on several criteria designed to find different kinds of organizations. We selected both those who had shown great interest in e-services, and those who so far had not. As discussed above, we had four hypotheses found in literature:

- *(H1) There is a lack of economic incentives, particularly at local level, to invest in eGov*
- *(H2) There is no sense of crisis requiring eGovernment investment in the agencies where it is supposed to be implemented.*
- *(H3) Users – including both "end users" of services, citizens, and service providers within government agencies are still lacking skills to make use of the electronic medium*
- *(H4) Agencies have conflicting goals, and other ones are sometimes prioritised over government efficiency*

We investigated the hypotheses qualitatively by interviewing leading officials representing nine government agencies. The questions asked were designed to consider the fact that eGovernment implementation is in fact compulsory in principle, but only to minor parts detailed (e g regarding some aspects of email use). This means everyone will claim they are indeed implementing eGov, no matter how slow progress may seem from outside. Interviews hence have to be made in a positive manner ("What drives your efforts...") rather than accusing ("why haven't you....").The interviews were semistructured guided by the following questions (related hypotheses in brackets):

- *Which are the driving forces for developing e-services?* (H1-H4) Here, we wanted to find out to what extent user demand, internal efficiency crises, national government policy were important factors, and in what ways they influenced activities.
- *What is the knowledge about, and the view on, the national policy documents in the field?* (H4) As the national policy is clearly not implemented straight-forwardly, there must be either lack of knowledge abuot it, or some other view about what is important, or both.
- *What e-services have been implemented?* (H1, H3) This question intended to complement Q1, as implemented services would indicate the existence of some incentive in that area and unimplemented services would indicate a lack thereof.
- *What are the visions for the future?* (H1-H4) This question intended to find the organization's own strategic goals, to complement Q1 and 3 which also include environment factors of today.

- *What is the influence of companies on the development of public e-services?* (H1) One idea here was that there might be a supply push from companies developing IT tools or handling services on an outsourcing basis.
- *How are e-services developed?* (H1-H4) The main issue here was to find out if this is done as part of daily business routines or as innovation projects not anchored in the business processes and if, and how, eGov was used to drive reorganization.
- *What organized cross-organizational cooperation is there, and how do the actors view the needs in this respect?* (H4) As this is something many investigations have found lacking, the purpose here was to find out why this is so, and if there are developments underway to change this.
- *What are the main obstacles for further development?* (H1-H4). This question was intended to complement Q1 and Q4 – how operative are the "visions" conceived, and what incentives, or lack thereof, are considered crucial?

Several questions related to more than one hypothesis, and one guiding principle was to make the respondents speak rather freely so as to not suggest to them what we consider important and what not. The hypotheses were not mentioned.

The interviews were made by telephone by two PhD students. Interviews lasted 45-60 minutes and were semi-structured based on the questions listed above. The interviews were analysed by the interviewers and one senior researcher independently. From the answers, as stated by the respondents, we extracted statements that expressed the respondents view in four categories according to a SWOT scheme: Perceived organizational ability (Strengths), perceived organizational disability (Weaknesses), perceived environmental enablers (Opportunities), and perceived environmental obstacles (Threats). This enabled us to distinguish between what people saw as possible to achieve relying on their own capabilities (S and W), and what depended on the whole system characteristics (O and T). We then excluded duplicates and "normalized" answers by integrating similar answers into a common phrasing when this could be done without risk of changing the content of the answers. Finally, we applied the answers to our hypotheses. Each hypothesis then was assigned a number of Ss, Ws, Os, and Ts (possibly 0).

## Selection of cases and Respondents

Even though the sample of nine organizations is not statistically representative, in practise the views here expressed can be considered credible as representing typical views among leading government practitioners – the agencies together cover about 20 % of the Swedish population including the second largest city, the second largest region, and two of the largest national government agencies. The sample also includes six of the smallest towns and one rural region. Also, the views presented are founded in a long history of IT development and several years of eGovernment (including previous labels) efforts on part of the interviewees.

The sample sought to identify different aspects of e-service provision which are known or hypothesized to make a difference. Facors selected were large-small (differences in resources, differences in scale advantage), rural-urban (differences in culture, broadband connection, user socioeconomics, expertise availability), north-middle-south Sweden (different cultures, socioeconomics, population density), and

cooperation among governments. The sample included three regional governments (including one "extended" region integrating two former regions), three local governments (one of which is a cooperation among six municipalities), two national level government agencies, and one national level support services, a "portal to the public sector". The organizations investigated were:

**Regions**

Region 1: large, several large cities, southern. 1 135 000 inhabitants in 33 municipalities, including Swedens 3rd largest city.

Region 2: Small, rural, northern. 254 000 inhabitants in 15 municipalities.

Region 3: Small, part of central Sweden region. 273 000 inhabitants in 12 municipalities

**Municipalities**

City 1: 500 000 inhabitants in 21 districts.

City 2: A cooperative effort involving 6 independent municipalities, each with a population ranging from 4 000 to 10 000 people.

City 3: 50 000 inhabitants, in the Stockholm region

**Central government agencies**

Agency 1: Taxation authority

Agency 2: Social insurance agency

Agency 3: Small agency providing a value-added electronic directory service

## 3. Findings

From the interviews we extracted statements that expressed the respondents' views in four categories according to a SWOT scheme. We found a total of 7 strengths, 14 weaknesses, 8 opportunities, and 14 threats. While the numbers themselves are not important – other than indicating a situation including many factors – the proportion seems to indicate a problematic situation. Further, the nature of the respective factor may worry. While many strengths are quite general and "soft" as drivers (e g unspecified "user demand"), many weaknesses and threats are quite specific and "hard" as obstacles (e g "lack of standards"). We then related each S, W, O and T to the hypotheses. In the following we consider each hypothesis in turn giving examples from the answers.

*(H1) There is a lack of economic incentives, particularly at local level, to invest in eGov.*

This hypothesis received 4 strengths, 7 weaknesses, 3 opportunities, and 6 threats. The number reveals a problematic area with several positive and negative factors. Unfortunately, as we shall see, the pluses and the minuses come in different proportions to different organizations, local government receiving the most minuses.

At central government level, incentives abound, and they always come from advantages of scale that can be achieved within a single organization. For example, Agency 2's automated voice service saves 88 % of the cost per call, hence the 84 million calls received in 2002 meant a saving of 84 MSEK (about 11MUSD). The estimate at Agency 2 is 700 MSEK savings in the next two years from using e services, which would mean investment is paid back in two years.

At local level, on the contrary, many mention a lack of economic incentives. Currently economic incentives are designed on a per-agency basis and do not favor cross-border cooperation. This means only large organizations can easily find incentives. Cooperation among small ones, such as small cities, is happening occasionally but is hampered by legislation, competition among cities, and traditions.
We found only two examples of (stated) increased efficiency in local government. One example (City 3) concerns the annual choice of schools (parents may choose school for their children) in a city where the respondents claim they saved 3-4 months of work and were able to make resources available for other work. However, this estimate is contested, and only days after our interviews there was a public debate growing about just how this calculation was made. The other example (City 2) concerns co-use of technical resources, such as sharing systems and hence saving on software licenses among small municipalities, quite a minor saving compared to the hopes for eGov, and the only reorganization efforts included shared switchboard operation and web administration. Although these examples are rare birds, at least they show that progress is possible. However, they also point to a low level of competence in measuring effects of e-service use in local government and very limited savings/efficiency gains so far.
As for weaknesses – perceived internal disabilities – it appears people have a defensive attitude. Generally, people perceive user demands for more and better services. Many mention this, nobody speaks against it. Some organizations report receiving suggestions from citizens frequently (Region 3, Agency 2). But the outer pressures such as user demands, benchmarking results and policy documents are outweighed by financing problems and difficulties to find economic rationality in services at local level. Large-scale services include considerable investment and the development is today typically not politically driven but seen as a lower-level administrative issue. All respondents mention lack of political leadership. This is a problem as it makes the planning horizon too short: E-services create more work in a short-term perspective as they also require reorganization. As departments are evaluated by annual economic assessment, political support is necessary for being able to make investments calculating future gains but resulting in budget deficits initially. A strict one-year planning horizon means costs have to be budgeted but future gains can not. Put differently, to make sense in small organizations e-services must be measured in other terms than direct economic savings, for example user gains. Examples mentioned in our investigation included the possibility to better utilize resources, but also a strive to achieve a more "modern" image which is supposed to make the city more attractive both for citizens and skilled employees (both are scarce resources in many cities).
All respondents directly require national directives in many issues, but some go so far as to requiring a national work division, regulation regarding what services should be developed locally and what should be the work of other actors (Region 3), as this would clarify what societal gains should count as important. It would also clarify a work distribution across government levels, and provide a yet lacking clear operationalization of the national eGovernment goals.
A problem further making investment difficult is the fact that municipal law forbids municipalities to sell innovations. Hence return on investment cannot be achieved by "exporting" products developed to other cities.

The respondents claim the national government currently focuses too much on technology. Instead, they should reward organizational change and interorganizational cooperation (City 3, Region 3, Region 2, Agency 2). Some claim that also internally the focus on technology is a problem – business departments too often leave issues to the IT department (City 1) and hence avoid issues of business process integration.

But cooperation, too, has its problems. One respondent mentioned is that it is hard to make shared investment as it is hard to calculate how costs should be shared (Agency 2). Some mention that cities want to maintain their own profile, both as a competitive advantage and as a response to local requirements, and similar services across cities would make this more difficult (City 1).

One risk mentioned is that good e-services would trigger demands for better services – "informed citizens demand more" and this might eat up calculated efficiency gains. This is one of the important contradictions of the eGov efforts. On the one hand, citizen engagement is officially hailed as an important potential, on the other hand, among those who are supposed to implement it, it is not. Citizen engagement is a democratic gain, but one that comes at societal level, not necessarily at the municipal planning office, where it is a cost. Although many mention positive effects of citizen demand, e g creating a pressure for reorganization, only one of the municipalities in our investigation has systematically worked for implementation of this.

The lack of technical and semantic standards is mentioned as an inhibiting factor, as it often makes it impossible for small organizations to develop services at all. It also prohibits information exchange among organizations and hence restricts cooperation. Even though some large organizations develop their own standards (Agency 2), the lack of national standards may mean a development towards technical diversity which will at a later stage prohibit integration even if individual (large) organization may come some way developing their own services.

Political decisions at national level regarding cooperation and standards are lacking, and are requested by all actors.

Finally, it must be mentioned that e-services appear to largely not yet be an integrated part of daily business operations. In both the regional organizations, for instance, they are handled by a project organization.

*(H2) There is no sense of crisis requiring eGovernment investment in the agencies where it is supposed to be implemented.*

This hypothesis received 1 strength, 3 weaknesses, and 2 threats, indicating a weak area. That is, there is little support for the idea of eGovernment being necessary, and hence there is support for the hypothesis.

All respondents report that e-service development is not politically driven, neither locally nor centrally. They requested leadership and standards from central government, but also locally issues are often delegated to lower level administration which means it happens within existing organization as "normal business" not as a crisis requiring major change. The exception in our study was City 3, which incidentally also was the only local government where reorganization was high on the agenda and economic benefits had been estimated. When asked for incentives, many local and regional respondents mention "better service", "modernization", etc., i.e. general issues of improvement that are not urgent.

There is indeed mentioning of crises, but these usually have to do with budget deficits and lack of staff, and eGovernment is not seen as a solution. Hence this crisis

awareness rather support hypothesis 4 – cities believe they have more urgent things on the agenda.

It should also be mentioned that our respondents do not look to research for assistance. Noone mention reading research reports or consulting researchers other than sporadically, and hence research findings apparently go unnoticed. This underlines the impression that eGovernment is seen as a straight-forward implementation issue, not a strategic – and hence political – one requiring looking around for new strategies.

While among leaders in the private sector today organization is seen more important than technology itself (Carr, 2003), in Sweden, eGov projects are still seen as technical and often driven by the IT department, which means re-organization is not often an issue (City 3, City 1). Although there is often a special organization for dealing with services on the web, this appears to be more of a project on top of the ordinary business than a change driver.

Many claim that central government goals should be accompanied by economic incentives for reorganization and/or cross-border cooperation (Region 2, Region 3, Agency 2). Currently policy requirement stop at technical details of services, such as "interactivity" (meaning user input). This policy echoes the benchmarking assessments that are regularly done at the EU level.

eGov driven cross-organizational integration is rare. We found one minor example of this among 6 small towns, apparently driven by economic problems in small municipalities. There is indeed sharing of ideas through conferences and competitions, the problems appear to be mo re in the field of implementing novel ideas than being aware of their existence.

*(H3) Users – including both "end users" of services, citizens, and service providers within government agencies are still lacking skills and means to make use of the electronic medium.*

This hypothesis received 1 strength, 3 weaknesses, 6 opportunities, and 2 threats, indicating an area with good hopes yet not fulfilled.

Citizen trust in government e-services is generally perceived as high, both as concerns the content and the security (City 3). Some respondents feel security issues is sometimes overrated for fear of being slack, and this may hamper ease of use and unnecessarily caution users (Region 1).

High citizen interest in developing new services is reported. Most respondents have a feeling that e-service supply is too limited, citizens want more. Some receive spontaneous suggestions for improvement (Region 3, Agency 2, Agency 1). Further, noone reports major problems with using services. Some report that one reason for not moving as quickly towards more services as they feel users would wish is a fear of them becoming so popular that they would require a lot of work on part of the service provider, something they feel they can not afford.

Existing e-services providing user value or enforced by organizational design are much used (Agency 2, Agency 1, City 3). Respondents also quote general features of the development, such as that the coming IT-generations are expected to demand more e-services, and that other businesses, such as the banks, are seen as role models. New communication channels such as SMS are also considered attractive among users and some services are developed, however mainly as additions to already

implemented e-services in the central government agencies. For example, Agency 2 claims SMS responses would reduce the load of phone calls by 3-4 million per year.
Even if many services are much used, some are not. This is attributed to lack of information – users are not aware of the existence of services. There are also examples of services that have not yet found their place. As an example, a value-adding directory service covering the whole public sector has been running for several years, but is largely not used. Instead, five large central government agencies have jointly developed another one, simpler and less comprehensive but integrated with the underlying systems and hence more effective. This is another example of the problems of aligning economic incentives and policies and simultaneously creating value for individual organizations and for the sector as a whole.
One apparent potential obstacle is that slow development and uneven distribution of the broadband infrastructure excludes many users. Our respondents blame central government for this. It should be noted here that there is central government subsidy to cities for investing in broadband infrastructure, but there is a debate as to the appropriateness of this subsidy. Also there is a "market policy", a hope in commercial development, such as DSL connections over the telephone network, something that so far has contributed to a lower penetration in rural areas.
It is also claimed that government's lack of care for privacy aspects may reduce users' willingness to use services, and there are also surveys that suggest this. There is great uncertainty about security issues. As an example one regional government (Region 2) use the disclaimer "We cannot assume responsibility for security on the Internet" also for trivial information pages. This appears overly cautious, as the information is not personal and no decisions are made based on it alone.
*(H4) Agencies have conflicting goals, and other ones are sometimes prioritized over government efficiency*
This hypothesis received no strengths, 3 weaknesses, 1 opportunity, and 3 threats. This indicates a very weak area with no reliance on own drivers (which would have been a strength) and only one opportunity.
Internal driving forces mentioned include providing better services, utilizing resources better, and attracting staff by being a more modern organization. These factors can to considerable degree be dealt with within each organization and are treated in this way. Cross-border cooperation is only rarely happening, and several respondents require the national government to either make some services compulsory or provide incentives for this to at all happen. It appears noone wants to make a risky investment, risk involving not only customer value and use but also some national policy later making local services obsolete.
It is unclear how services provided correspond to citizen needs, as structured investigations of needs/requirements are not made. This appears to indicate that eGovernment is either not considered that important or a self-evident development. Judging from the answers related to hypothesis 3, the latter appears to be the case, but the slow development at local level rather point to the former. One hypothesis that might be created from this is that the general passiveness stated by many is related to the uncertainty of national policy implementation that many mention, and hence currently at a turf war stage, along the lines of Simmons [23], where everybody maneuvers cautiously so as to let investment be made by someone else.

Many respondents claim the current situation with heavy (defensive, reactive) rationalization for the purpose of meeting budget constraints has meant there is not enough strength left for (proactive) reorganization for efficient e-services. There is, for example, an urgent need for more staff at the hospitals, and eGovernment is not seen as a solution to that. Hence, it appears local governments have more urgent things on the agenda. The sense of crisis needed for things to happen – as claimed by hypothesis 2 – is indeed around, but it does not appreciate eGovernment a solution. As eGovernment issues are typically delegated – not at the political strategic agenda – eGovernment is not considered in a larger perspective, e g in terms of automating some activities to free resources for other, e g the hospitals. eGovernment is a competing cost. City 3 is the exception here, they clearly express the intention to use e-services to be able to relocate resources.

There is a lack of tradition of cooperation, both among municipalities and between municipalities and companies (City 3). Both are attributed to cultural differences, the latter sometimes to government mistrust in companies (City 3). A further potential cooperation problem is that research results are not used.

Further, cooperation is by some seen as a threat to local innovation, adaptation to local conditions, and – for small municipalities in particular – local independence (City 1).

The public sector lacks procedures and experience in commercializing innovations. As mentioned above, this is also prohibited by Municipal Law.

## 4. Conclusions and Discussion

We started with four hypotheses regarding the incentives for further development of e-services. The findings indicate that Hypotheses 1, 2 and 4 (lack of economic incentives, no sense of crisis, and conflicting goals on part of government agencies) appear valid, while there are good reasons to consider hypothesis 3 including (lack of user "e-readiness") less important. While some users may not yet be "ready", the fundamental problems for further eGovernment development lie elsewhere.

A qualitative study with a small sample we can only show the existence of other explanations, not quantitatively test the hypotheses. We believe, however, that these findings give some insight into the various kinds of obstacles eGov is facing, and indeed that the officially claimed "lack of readiness", implying steady if slow progress towards a politically defined goal (hypothesis 3 in this study) should be challenged.

One particularly important point of concern in eGov is the potential for cross-organizational integration paving the way for increased efficiency. Our respondents almost unanimously claim central government is responsible for achieving this, by policy as well as incentives. However, there is an argument about the feasibility of top-down and bottom-up methods respectively to achieve integration and system level benefits. While elements of standardization both at technical level and service level are necessary to achieve advantages of scale among small units, simplifying for users of services from different providers, and facilitating interoperability among agencies, there is a question of how much standardization is optimal, and how to best achieve

this. There is a Swedish tradition of independent authorities, which has been both questioned and celebrated with respect to e-service development. This independence is currently reinforced by budget constaints which make each organization reluctant to investment in the first place, and certainly less eager o work for general societal goals when these bring monetary costs to the own organization and gains somewhere else or in intangible form. Our results indicate that lack of technical standards and shared resources, such as digital signature scheme and broadband connectivity particularly in more rural areas, is currently an obstacle, and that central government must somehow contribute to providing this. This is a result of a policy developed what appears a very different time – during the IT boom in the late 1990s, there was hope in central government that market players would take care of this. Our study indicates that this "market model" has not worked for reorganization across borders because individual authorities have different goals – conflicting or simply considered more urgent – or cannot make the necessary investment, or gains appear elsewhere than where the investment has to be made. Hence there is a need for some force at whole system level. While this does not necessarily mean strict centralization, it is clear that the central government's policy – based on EU directives – has not been operationalized in any clear way. There are not sufficient incentives at local level to make it happen. This said, it appears caution is commendable as to the methods for achieving this. While leadership is needed and lacking, local innovation and creative service models cannot be enforced.

We believe this is a lesson that should be considered in eGov efforts everywhere. eGovernment in any country will have to be developed along the traditions in that country – but not only. There has also to be innovation. Traditions will have to be changed at some point, and this investigation points at such a point in Sweden having been reached but not taken care of. It appears that when development within the tradition – decentralization and economic performance per department as the only measure of success – reached a point where small units were unable to continue, the lack of a true, operationalized, central or common vision for eServices became apparent, and so there was nothing there to support next step. Examples from other countries, such as Korea, indicates that the situation may be very different. There, a strong central government provided the necessary technical infrastructure, including broadband and electronic signatures very quickly. Still, there is more to electronic services than building them, and each country may encounter difficulties of different kinds at different stages in the development. The long list of factors discussed here – drivers as well as inhibitors – indicate that eGovernment development is indeed complex and involves a number of challenges. There is no one straight-forward way towards the electronic government, and what is positive at one stage may prove an obstacle at the next (e g the Swedish "market model").

More fundamental issueas regarding societal organization are at stake. In our investigation, cities claim their independence and profile would be threatened if all used the same services. This is something different than organizational efficiency by cooperation. It is apparently felt that in the strong competition among cities (for businesses and inhabitants), electronic services are still seen as a competitive advantage. This view should probably be changed. Electronic services will be, or are perhaps already a standard feature, and most cities will in the future probably have similar standard services, just like roads look much the same in any city. It appears a

good advice to go for the cheapest and most functional solution following both technical and service standards best possible, and use local creativity to make amendments and adaptions to best fit local interests. This may appear a bit dull, and probably it is advisable to for some time yet keep up the image of "creative IT projects" to attract some extra funding. There are indeed areas where much is not yet done, but for most municipal services, most cities should be happy with copying others concerning the technical tools, and create their "profile" baser on something else. Amount of use, accessibility, reorganization for efficiency... there are many things where excellence is still rare.

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# Integrating Spanish Autonomous Parliaments: A Model of E-Government, Issues and Technologies Support

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**Abstract.** The paradigm of *E-Government* is a way to advance towards a better administration in Spanish autonomous parliaments using information and communication technologies (ICT) in order to carry out one of the major initiatives of COPREPA (conference of presidents of autonomous parliaments from Spain). The goals of this initiative involve the sharing of information among legislative institutions, the increasing of productivity through higher operational efficiency, the offering of better quality services and innovation. In this paper, the main issues and technologies support related to the integration and cooperation among Spanish autonomous parliaments based on an e-government approach are presented. Firstly, the characteristic of Spanish legislative interaction problems are addressed and secondly, the conceptual architecture model for integrating Spanish parliaments and other institutions are presented. Different requirements are considered: interoperability problems arising from heterogeneous legacy parliament systems, components model, system access and security model. Finally, this paper acknowledges the potential of egovernment model to transform how parliaments can provide services online and how more sophisticated forms of consultations and cooperation between parliaments and other institutions can be encouraged.

## 1 Introduction

The idea of sharing information among parliamentary institutions was a result of the conference of autonomous presidents from Spain (COPREPA), where the projects and common interests among all the parliaments from Spain are established. In a meeting taken place by COPREPA arises the initiative of looking for some procedures that allows sharing information among the parliaments, with the purpose of having valuable information for the deployment of the legislation in each parliament.

The main functions of COPREPA are based on the exchange of experiences and information on the performance of the different autonomous parliaments and on the

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other hand, the study, and in their case approval of combined initiatives that improve the performance of the parliamentary cameras or of their intercommunication.

Furthermore, the conference of European regional parliament's presidents, (CALRE) which is integrated by the presidents of the legislative assemblies of the regions of Europe, promote at the same time the relationships between the regional legislative assemblies and the European institutions by means of the fomentation of the exchange of information through the use of information and communication technologies (ICT). CALRE consists of more than sixty assemblies that represent more than two hundred million Europeans. Concretely, CALRE is formed by the seventeen Spanish autonomous parliaments, all the Italian regional councils, the cameras of the regions and communities of Belgium, all the parliaments of the German Länder, the autonomous Parliament of the islands Åland of Finland and the regional assemblies of Azores and Madeira, belonging to Portugal.

However, public administration is the most complex organization in a society. For example, Spanish public administration consists of large and complex networks of institutions, administrations and agencies, which are conformed in seventeen autonomous communities. In each autonomous community, the legislative function is carried out by the autonomous parliament. It is the representative organ of the citizens of that autonomous community. Additionally, the legislative function is carried out by the senate and congress of deputies in the general courts, where the general courts are the representative organ in national Spanish state. Figure 1 illustrates the Spanish legislative environment, where a complex set of interactions between autonomous parliaments, senate, congress of deputies and other institutions may take place.

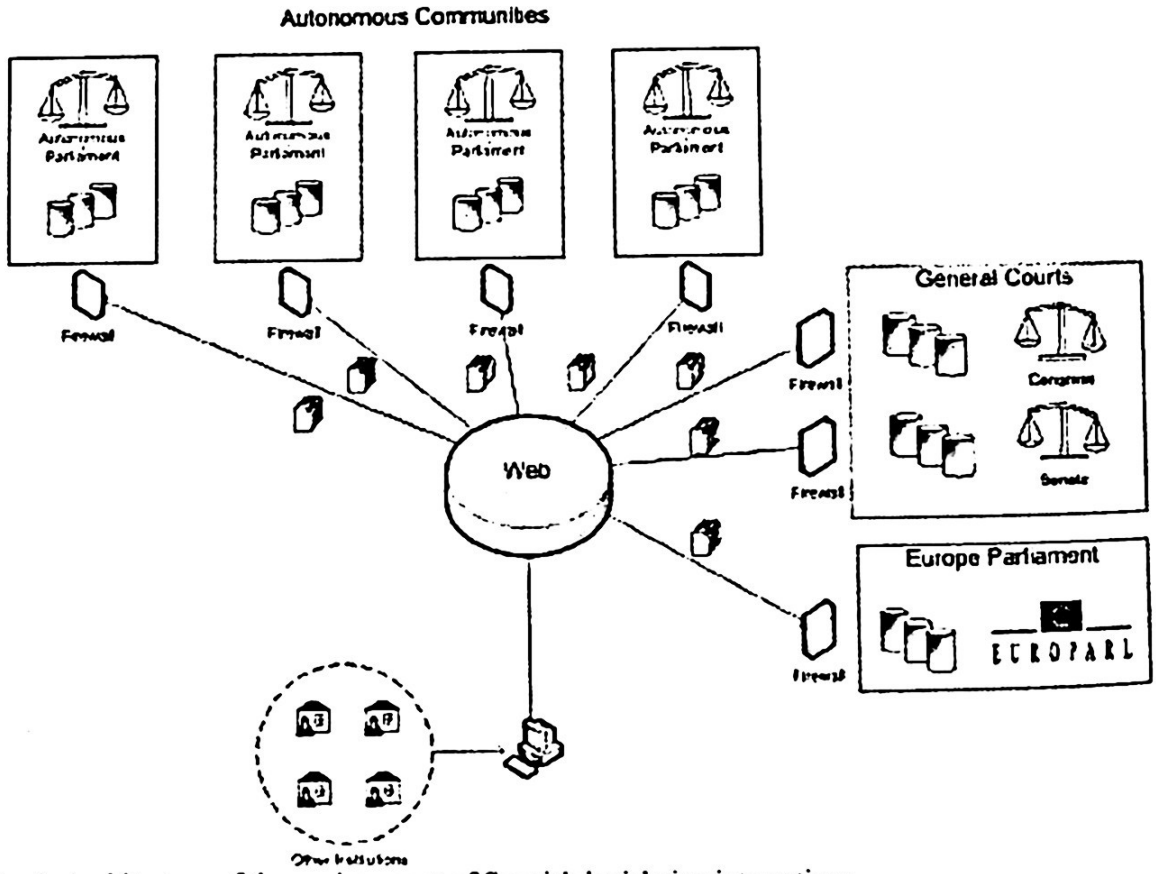


**Fig. 1.** Architecture of the environment of Spanish legislative interactions

At the same time, the use of *Web technologies* should also be considered changing the traditional mechanisms in which the institutions and administrations operate and interoperate. More importantly, the Web has introduced new paradigms in the way data and services are accessed.

To be precise, the paradigm of *E-Government* or *Digital Government* (DG) [1] is a way to advance towards a better administration in Spanish autonomous parliaments using information and communication technologies (ICT) in order to increase productivity through higher operational efficiency, offering better quality services and innovation.

In this paper, our launching pilot project, *WebSpanishParliament* project (*WebSP*), is presented, where the e-government paradigm is used in our approach of integrating Spanish parliaments in order to improve the interactions between parliaments and other institutions through the deployment of a digital infrastructure which allows sharing legislative data information among a number of distributed hosts. Information about documentation and procedure on the laws, information about legislative initiatives, statistics data on the legislative activity as well as the consultation of the librarians funds are illustrative examples of the need for cooperation between the different parliaments and other institutions. This cooperation and collaboration will contribute to improve each parliament's internal function through a more efficient administration and management of the information, as well as a significant reduction in the use of paper, mail and phone activities, and consequently, improving the services supplied to the legislative authority. This way, the efficiency and productivity are considerably increased by on-line DG services.

One of the critical issues in our *WebSpanishParliament* project is the interoperability problem arising from heterogeneous legacy parliament systems. To solve the problem, effective tools, methodologies and technologies are required to provide easy and seamless connections between systems that were developed by different people, running in different environments under different software/hardware platforms.

*WebSP* consists of an experimental digital infrastructure built around Web services technology solutions for the integration, cooperation and interoperability among the heterogeneous systems of information that integrate the distributed hosts in each autonomous parliament, general courts and other institutions in order to improve the internal legislative function of each one of these institutions.

The remainder of this paper is organized as follows. In Section 2, we address the different dimensions for evaluating the integration and cooperation between Spanish parliaments and other institutions related to content exchange, autonomy, heterogeneity and security. Section 3 provides an overview of Web services technology solutions. In Section 4, we present and discuss the conceptual architecture model for integrating Spanish parliaments and other institutions, where different requirements are considered: components model, system access model and security model. Finally, we provide some concluding remarks in Section 5.

## 2 Characteristics of Problems of Spanish Legislative Interactions

The development of an e-government infrastructure for the integration and cooperation between Spanish parliaments and other institutions entail a number of policy and technical challenges. It is interesting to note that many problems that appear in legislative environments share similarities with the judicial and executive environments. In this section, the major issues that must be addressed for a successful deployment are presented.

### 2.1 Integration of Heterogeneous Data

Spanish autonomous parliaments collect, produce and manage massive amounts of data. This information is typically distributed over a large number of autonomous, heterogeneous and large databases. An efficient administration and management of all this information is quite complex, due to the different situations that are presented:

- Some parliaments have specific applications that enable the sharing of relevant information based on HTML documents that can be accessed through a World Wide Web browser to a Web server.
- Other parliaments provide explicit resources to access to the legislative information systems, where the access to this information is restricted to authorized people of the parliament the information belongs to.
- There are also some parliaments that have no access mechanism to the information that other parliaments propose to share.
- Heterogeneous software architectures, platforms, applications and databases can be found among the parliaments that decide to share the legislative information. This way, the interoperability problem arises from heterogeneous legacy parliament systems.
- Spanish state is made up of seventeen autonomous communities, where several of them provide its legislative information in its proper language such as catalán, gallego and vasco language, which differ to the language used in the rest of the communities. On the other hand, each one of the European institutions stores their information in their own language. This context limits the formal treatment of the systems information using only one language. Therefore, resources of translation are required in order to take into account the different languages.

All the above mentioned issues involves developing solutions based on an interoperability architecture that perform the storage, sharing and management of the information among parliaments without imposing the substitution of the basic infrastructure of the systems of information, because no parliament can impose his approach on another parliament. Therefore, several challenges must be addressed to enable an efficient integrated access to the legislative information. These include: solution to the problem of the interoperability among computers, ontological integration, middleware support and query processing. This way, the solution of this

problem involves the coordination of the effort of different people with different skills and functions.

## 2.2 Scalability

An e-government infrastructure must be able to scale to support growing numbers of underlying systems and users. It also must easily accommodate new information systems and heterogeneous high volumes of information. Two important dimensions of the scalability problem must be addressed in Spanish legislative interactions: the number of transactions that can be supported in a given unit of time and the volume of accessible data.

## 2.3 Autonomy

The different computer systems that integrate the legislative environment are characterized by its autonomy in their design, communication and execution. This means that each individual department of computer science of each autonomous parliament select the process and content of description models, programming models, interaction models with the outside world, security model, etc. In a fully autonomous collaboration, each parliament is viewed as a black box, which is able to exchange information. As a result, the parliaments must interact via well-defined interfaces. However, a completely autonomous collaboration was very difficult to achieve some years ago because it requires effective support technologies that can resolve connections between systems that were developed on different environments under different software/hardware platforms.

## 2.4 Security

Autonomous parliaments collect and store huge amounts of sensitive information about laws and legislative information. Security is therefore one of the major concerns in the digital applications. Recent advances in cryptography and protocols for secure Internet communication significantly contributed in securing information transfers within digital parliamentary infrastructures.

Securing digital parliamentary infrastructures involves many aspects. Such as prevention, this is related to network security and enablement, which is related to identity and access management. For example, a service provider (e.g, any parliamentary institution or another institution) must be able to specify *who* may access the service, *how* and, *when* accesses are made [3].

Currently, the issue of securing the interoperability of Web services is one that has been the focus of many standardization bodies. Many standards for securing Web services have been proposed or are under development. Examples include: WS Security [2], XML Encryption [7], XML Digital Signature [8], SOAP Digital Signature [9], XACML [10], and SAML [11].

### 2.5 User Interface and User Accessibility

E-government applications are typically developed to be used by average users who in general have no special computer skills. Therefore, the user interfaces needed to access these applications must be easy to use and accessible to users with different aptitudes. Recent effort issues at developing "smart user interfaces" are arising. These issues are based on learning user's abilities and dynamically adapt to those. Technical solutions to the smart user interfaces problem can be covered by an agent system or multi-agent systems [4].

## 3 Web Services

The problems experienced in achieving collaboration between parliaments have been largely due to a lack of support technology that provides exposing and sharing heterogeneous and distributed databases and applications between parliaments and other institutions using standard technologies. Centralizing the relevant information that Spanish parliaments decide to share, without exposing the entire application and using standard initiatives is one of the major aims of each one of the Spanish autonomous parliaments. One of the critical issues is the interoperability problem arising from heterogeneous legacy of parliament systems. In order to solve the problem, in the early days of the Web, core technologies were used to provide an interface to distributed services (e.g., HTML forms calling CGI scripts). However, XML has accelerated this development, and has sparked the emergence of numerous XML-based environments that enable Web services technology solutions. In this respect, Web services [25, 26] are a useful component in e-government infrastructure due to the support of the broad interoperability problem between distributed applications using standard XML-based technology and Internet communication protocols (e.g., TCP/IP, HTTP). Web services technology, therefore have the potential to facilitate deeper and more sophisticated integration and consultation, that is, how to better share data information between applications and underlying architectures and reuse components between parliaments and other institutions.

The precise definition of Web services is still evolving; therefore several definitions for Web services can be found in the literature. For example, a Web service is said to be:

- A piece of business logic, located somewhere on the Internet, that is accessible through standard-based Internet protocols such as HTTP or SMTP. Using a web service could be as simple as logging on a site or as complex as facilitating a multi-organization business negotiation [5].
- Loosely coupled software components that interact with one another dynamically via standard Internet technologies (Gartner Group, a leading research and advisory firm).

- A software application identified by a URI (*Uniform Resource Identifier*), whose interfaces and binding are capable of being defined, described, and discovered by XML artefacts and supports direct interactions with other software applications using XML-based messages via Internet-based protocols (W3C, *World Wide Web Consortium*)
- A functionality that can be engaged over the Web [6].

### 3.1The Web service reference model

Interactions among Web services involve three types of participants: *service provider*, *service broker*, and *service requestor*. Service broker is also referred as *service registry*. The Web services functionalities are illustrated in Figure 2.

The architecture of Web Services is founded on issues and standards based on connection, communication, description, and discovery. This way, *service providers*, are the owners that offer services. They define descriptions of their services and *publish* them in the *service registry*, a searchable repository of service descriptions. Each description contains details about the corresponding service such as its data types, operations, and network location such as name, description and contact information of business data. *Service requestors* use a *find* operation to locate services of interest. The registry returns the description of each relevant service. The requestor uses this description to invoke the corresponding Web service.

Three major standardization initiatives XML-based technologies have been submitted to the W3C consortium to support interactions among Web services:

- WSDL (Web Services Description Language) [12]: WSDL is an XML-based language for describing operational features of Web services. WSDL descriptions are composed of *interface* and *implementation* definitions. The *interface* is an abstract and reusable service definition that can be referenced by multiple implementations. The *implementation* describes how the interface is implemented by a given provider. Most Web services development tools generate WSDL documents automatically. Therefore, it is not necessary for developers to fully understand the syntax of WSDL when they are building and deploying Web services.
- UDDI (Universal Description, Discovery, and Integration) [13]: UDDI enables developers and businesses to publish and locate Web services on a network through the *business registry*, an XML repository. As its name implies, the specification allows companies to describe their own services and electronic processes, discover those of other companies and integrate others services into their system. Conceptually, the information provided in a UDDI business registration consists of *white pages* (contact information), yellow pages (industrial categorization), and green pages (technical information about services).
- SOAP (Simple Object Access Protocol) [14]: SOAP is a messaging framework for exchanging XML formatted data among Web Services. SOAP can be used with a variety of transport protocols such as HTTP, SMTP, and FTP. A SOAP message consists of three main parts: an *envelope*, a *header* and a *body*. The *envelope* wraps the entire message and contains the *header* and *body* elements; the *header* is an

optional element that provides information regarding such topics as security and routing. The *body* of the SOAP message includes the actual exchanged data.

Besides standards for XML, SOAP, WSDL, and UDDI, there is a need for broad agreement on the semantics of specific domains. This is provided by the Resource Description Framework (RDF) [15, 16], the DARPA Agent Modelling Language (DAML) [17], DAML+OIL [18], DAML-S [19] and, more generally, ontologies [20].

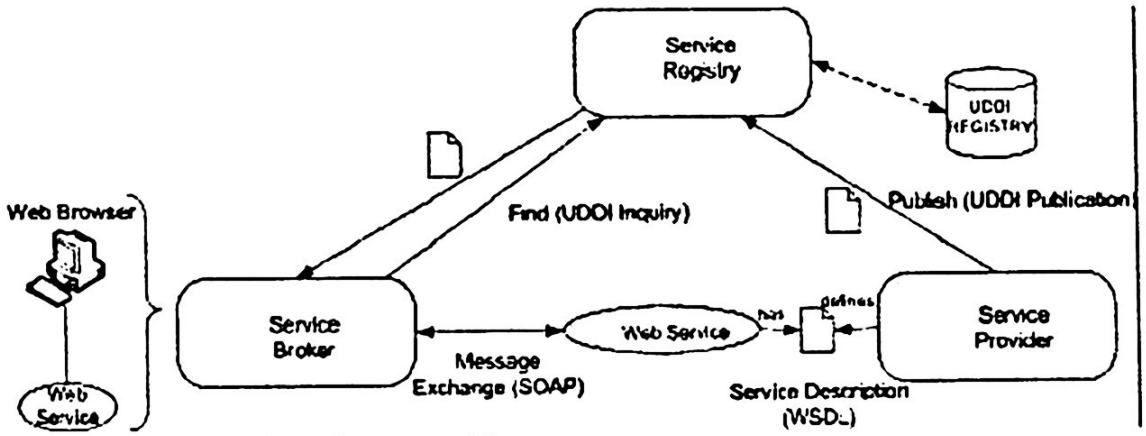


**Fig. 2.** The Web service reference model

### 3.2 Web Services Advantages

Among the most important advantages of the Web services technologies, the following ones can be stood out:

- Web services are built around open standards, which makes them truly independent platform and language neutral.
- Web services provide a suite of XML based interoperability standards for software deployed on Internet, so multiple organizations can communicate with the same Web service.
- Web services are comparatively easy and inexpensive to implement, because they employ an existent infrastructure (a network, such as the Web) to exchange data information. Moreover, most applications can be repackaged as Web services, so companies do not have to adopt entirely new software.
- Each vendor can have a unique Web services architecture, which is the most appropriate implementation to its proprietary platform, while adhering to the same XML standards to facilitate successful interoperation with users sticking to the same standards. This enables vendors to incorporate Web services support seamlessly into their platform products. This way, most major software vendors have recognized that Web services technology represents a significant step forward for computing paradigm. Ariba, Apache, IBM, Microsoft, Sun, Oracle, Hewlett-Packard and others have contributed to the development of Web services standards and toolkits that enable programmers to create and deploy Web services.

# 4 WebSpanishParliament Project (WebSP)

In this section, our research in designing and evaluating a comprehensive infrastructure for online legislative services is described, which is called *WebSP*. The major aim of *WebSP* is to develop techniques to efficiently facilitate the access to legislative databases and services using standard initiatives, resources that enable the management of different European languages and Web services technology solutions in order to facilitate the access, interaction and interoperability among distributed heterogeneous information systems where the information is provided in different European languages. The next sections discuss *WebSP's* major concepts and describe the essential components of its architecture.

A fundamental challenge in the development of our project is not to attempt to modify the resulting information systems which each parliament currently uses. Thus, we propose the use of standard initiatives such as XML-based technology and Internet HTTP protocol, which will allow completing the current systems of each parliament with the least incidence in them.

One of the essential requirements of this project is based on the solution of building modular Web services [21] in each autonomous parliament, as well as the development in each one of them of one or several modules that allows them to carry out consultations to their databases.

The development of three modular Web services in order to provide consultations to: bibliographical funds (B), legislative information data (L) and legislative activities (LA) are initially proposed in *WebSP*.

## 4.1 General Overview

In Figure 3, the global architecture of our system *WebSP* is presented. The overall system includes three components or layers of functionality: (1) *Process Manager Layer*, which enables the request of information using the deployed Web services in each autonomous parliament. (2) *Parliamentary Web Services* layer, which describes the implementation of Web service in each autonomous parliament and allow the consultation of each database within each parliament. And (3): *Security Processors Layer*, that addresses the aspect of security and management related to the sharing of data in each parliament.

In the design of the proposed architecture model, several issues should be taken into account:

- No additional training for the users is required, because the new system *WebSP* can be integrated inside the existent application of the local databases information search.
- At the present time, all the parliaments have all the information that they decide to share in some internal databases. However, the parliaments provide a myriad of heterogeneous databases such as Oracle, SQL Server, Informix, MySQL, Access, etc. Although the variety of databases is wide, the development of applications that allow the consultation of these databases is feasible. Therefore, the development of a Web service that allows the consulting of the required information of some

database is feasible at the same time. For example, if all the relative data about the books that a certain parliament possesses are stored in a database, then it is feasible to develop a Web service that allows consulting that parliament's bibliographical fund.

- Nowadays, any software company of database offers some ODBC/JDBC gateway that allows accessing the corresponding database.
- It is each parliament's task, to impose restrictions on the access to certain information. For example, in the previously described case of the bibliographical funds of a parliament, the parliament who owns the funds can establish to allow the consulting of all the information of each book, but to restrict the access to relative information related to the cost of the book, or their physical location.
- So that each parliament can publish new services or to modify the current services in an autonomous way, it is advisable for each parliament to have available a Web Service Registry (UDDI), where all the modifications carried out in each parliament's UDDI would be replied autonomously to the rest of the parliaments. This condition is not essential, due to a single Web Service Registry could be implemented in a single parliament, however it would imply that any modification in a Web service of a parliament would need the permission from the parliament that manages the Web Service Registry.

The following sections describe each layer of functionality of the proposed architecture model.

### 4.2 Process Manager Layer

The *process manager layer* is used to process all the incoming requests from the users of the system. Two types of requests are supported by *WebSP*: *request information* and *request subscriptions.*

The *process manager* will allow each parliament's users, especially the documental users, to be able to carry out consultations about certain information in a simultaneous way in all the parliaments that have enabled the appropriate Web service.

The use of Web services technology allows the access to the *process manager* to be developed as a HTML page via a *Graphical User Interface* (GUI), a specific software application or as an integrated application inside another existent application.

The *process manager* will be located in each parliamentary institution. Each institution will be able to carry out different implementations about the process manager layer in function of the available resources.

#### 4.2.1 Request Handler

All requests are received and processed by the *request handler module*. To cover all aspects of location, discovery and invocation of available Web services, a *service locator* module is used by the *request handler module*.

The *service locator* module discovers the available Web services through the examination of the Web service registry (UDDI). The Web service registry will be

able to be locally located in a centralized way in a certain parliament or in a distributed way.

The *request handler module* can improve the consultation of the system's information using the *translator* module. This module is based on the use of the database *Eurovoc* and *Eurodicautom.*

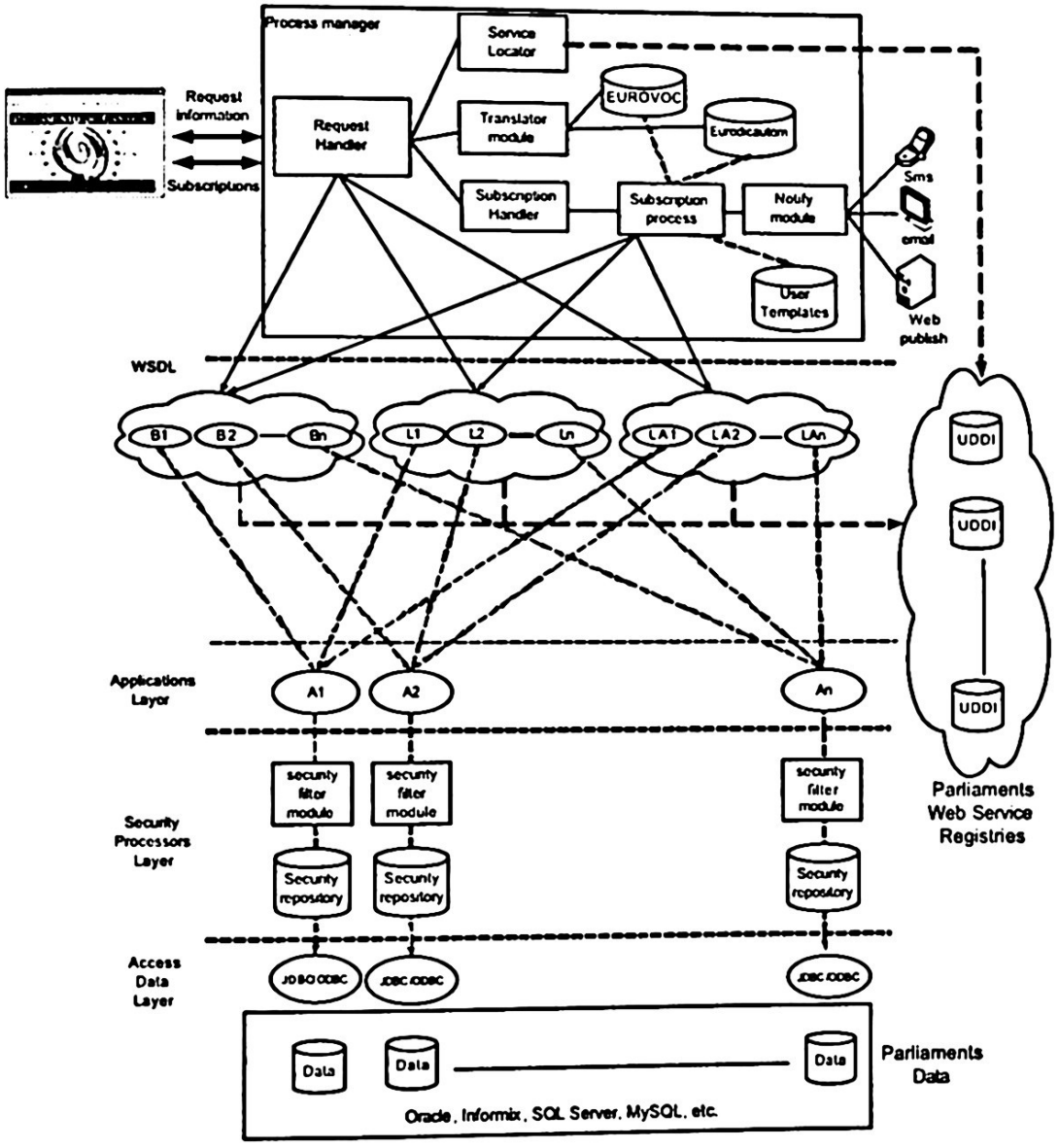


**Fig. 3.** Global WebSP architecture

Eurovoc [22] is a multilingual thesaurus covering the fields in which the European Communities are active; it provides a means of indexing the documents in the documentation systems of the European institutions and of their users. This documentation product is currently used by the European Parliament, the Office for Official Publications of the European Communities, national and regional parliaments in Europe, national government departments and certain European organisations. Eurovoc exists in the 11 official languages of the European Union (Spanish, Danish,

German, Greek, English, French, Italian, Dutch, Portuguese, Finnish and Swedish). In addition to these versions, it has been translated by the parliaments of a number of countries.

A thesaurus is a structured list of expressions intended to represent in unambiguous fashion the conceptual content of the documents in a documentary system and of the queries addressed to that system.

The European institutions, the national parliaments and the various users of Eurovoc have cooperated to produce the thesaurus. A team of Commission translator-terminologists was entrusted with the preparation of each language version.

If a correspondence is established between identical concepts expressed in different languages, the user of a multilingual thesaurus can in addition interrogate the documentary system in his own language and retrieve documents irrespective of the language in which they have been indexed.

On the other hand, Eurodicautom [23] is the European Commissions multilingual term bank. When it was first set up in 1973 the development team drew upon the know-how and lexicographic material of two other tools available to Commission translators: Dicautom, a phrasal automatic dictionary launched in 1964, and Euroterm, a translation dictionary developed in 1962-68. The four original languages of Eurodicautom were Dutch, French, German and Italian, to which Danish and English were added in 1973, Greek in 1981, Portuguese and Spanish in 1986, and Finnish and Swedish in 1995. Latin is also present.

Today it is an invaluable tool for translators, interpreters, terminologists and other linguists worldwide over the Internet, where it records a daily average of 120.000 enquiries.

This way, starting from the text that is required to search for in *WebSP* system, the key words of the search can be extracted and replaced by the equivalent term in another language using Eurovoc and Eurodicautom. As a result, we will be able to enlarge the consultation to institutions that present their information in another language, as well as to enlarge the search with synonymous terms.

### 4.2.2 Subscriptions

Besides requests of information, the *WebSP* system allows the user to be informed when something of his interest it is published in some parliament.

Each user will be able to select the subscription to a collection of established terms from the thesaurus Eurovoc and he will be able to denote the way that the system will notify him. The *user templates module* stores all the relative information about the subscriptions of the registered users. This way, the *notify module* will carry out the notification to the user in the way that has specified via for example sms, e-mail, web publishing, etc.

### 4.3 Parliamentary Web Services Layer

For each service that is required to be implemented in each parliament, an application will be deployed to implement the Web service in that parliament and this application will allow the consulting to the relative information of that service in a remote way for other parliaments.

Since this architecture model is completely decentralized it allows each parliament to decide to implement his Web services or not to do so. In the same way, each autonomous parliament can only deploy a Web service of all those outlined, or to carry out it in a progressive way.

When a *provider* parliament proposes to publish his new Web service so that the other parliaments can make use of it, he will only have to publish it in a Web Service Registry (UDDI) with the idea that the *consumer* parliaments can know its existence and consultation form. This way, *provider* parliaments define descriptions of their services and publish them in the *registry* and *consumer* parliaments access the *registry* to locate services of interest using the returned description of each relevant service from the *registry* to "understand" how to use the corresponding Web service.

Essential information about that must be contained in a certain Web service will be required to be established among all the parliaments. For example, the basic information required for the implementation of the Web service related to legislative consultations (L) illustrated in Figure 3 could include the following information: title, dates of beginning, current state and proposer.

All the relative information of the necessary data to invoke the Web service as well as the list of return data will come specified in the file WSDL implemented by each parliament that has previously been published in the Web Service Registry (UDDI).

In Figure 3, three different Web services have been represented in the model of proposed architecture of our project *WebSP*: consultations to the bibliographical funds (B), consultations to the legislative procedures (L) and information about legislative activities in general (LA); where the index in each one of them indicates the Web service implemented in each parliament.

Additionally, the application layer represents the gateway to the invocation of the Web services implemented in each parliament

### 4.4 Security Processors Layer

Preserving privacy is one of the most challenging tasks in deploying e-government infrastructures. The privacy problem is particularly complex due to the different perceptions that different staff of e-government services may have with regard to their privacy. Furthermore, a same user may have different privacy preferences associated to different types of information.

In order to solve the privacy problem, three issues are required: *privacy profiles*, *privacy credentials* and *privacy scopes*.

The set of privacy preferences applicable to a user's information is called *privacy profile*. The *privacy credentials* determine the *privacy scope* for the corresponding

user, where *the privacy scope* defines the information that a parliament service can disclose to a certain user.

When a request is received by a service, it checks that the request has the necessary credentials to access the requested operation according to its privacy policy. If the request can be answered, the service translates it into an equivalent data query that is submitted to the appropriate parliamentary database.

The system of security will be able to be integrated in a LDAP server [24] of each institution with the purpose of recovering all the relative information to each user. They will be able to establish security profiles to apply in different ways to each user as well as different profiles for each Institution. All the relative information to the security profiles will be stored in the security repository.

Each institution will be able to implement a *security processor layer* with the purpose of carrying out a control of who is using the corresponding Web service.

## 5 Conclusions

In this paper the potential of e-government paradigm is acknowledged and presented to transform how legislative institutions can provide services online and more sophisticated forms of consultation and cooperation between them. Information about documentation and procedure on the laws, information about legislative initiatives, statistics data on the legislative activity as well as the consultation of the librarians funds are illustrative examples of it. A discussion of key issues in Spanish legislative interactions in developing a digital infrastructure is introduced. This is followed by our launching pilot project, *WebSpanishParliament*. Our project is developed around three major concepts: use of standard initiatives, resources that enable management of different languages in the distributed information systems and Web services technology solutions. The standard initiative approaches were used in order to facilitate the access among heterogeneous systems. Management of different European languages was provided for interacting among different European institutions and Web services technology were used as wrappers that enable access to and interoperability amongst legislative services. The paper also provides an establishment about Web services solutions.

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# Part II

# e-Participation and e-Democracy

# Engineering Knowledge-Intensive Tasks in Public Organisations

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**Abstract.** Public organisations often face knowledge problems due to the continual and pervasive movement of staff between units and department. The Pellucid project is developing a knowledge management system to assist in such situations. This paper describes the knowledge engineering and the knowledge level modelling undertaken in Pellucid. We use CommonKADS task templates as a mechanism to identify and derive knowledge-intensive tasks related to mobility in public organisations. Assistance to employees in those tasks is provided by active hints, a conveyor of experience within an organisation.

**Keywords:** Experience Management, E-Government, CommonKADS.

## 1 Introduction

Organisational mobility is the pervasive movement or circulation of staff from one unit or department within an organisation to another. This is commonplace in public organisations, which may deliberately encourage it as a form of career development. It is clear that organisational mobility is not necessary a bad thing: inasmuch as mobile employees bring fresh ideas or experience of other areas, then the organisation can be enriched. Nevertheless, inevitably these employees will nd it harder to perform as effectively as more experienced (static) staff, due to their relative lack of speci c knowledge. Time must be spent in gaining familiarity, and although there might be training available, these are not suf cient in themselves. It is these problems that Pellucid aims to address [12].

Pellucid uses the metaphor of an intelligent assistant who looks over one's shoulder and answers questions one might have at a particular point of work [16]. The assistant detects that an employee is working in a particular process, offering knowledge resources that facilitate her/his work according to her/his expertise. To this end, the Pellucid platform integrates technologies such as autonomous co-operating agents, organisational memory, work o w and process modelling, and metadata for accessing document repositories. The platform will be installed in three pilot sites: the management of publicly funded projects in the Mancomunidad de Municipios del Bajo Gualdaquivir (MMBG) in Spain; the installation and maintenance of the traf c light plants in the Traf c and Mobility Management Department of the Comune di Genova in Italy; and the call center for management and resolution of x ed telephony breakdowns of the

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Consejeria de la Presidencia de la Junta de Andalucia in Spain. Such diversity of applications requires e xibility and adaptability as two important characteristics of Pellucid.

In this paper we describe the knowledge engineering and the knowledge level modelling undertaken in Pellucid, taking into consideration the adaptability of the system to different business processes in public organisations. The Pellucid approach consists of three phases. In the rst phase, described in section 2, we model the contextual and conceptual aspects of a generic public organisation following the CommonKADS methodology [15]. Then, speci c aspects of a particular organisation are included in a second phase by instancing them to some of the generic models and by adding domain-speci c knowledge, as described in section 3. Section 4 presents the nal phase, which produces a detailed design taking into account implementation details.

## 2 A General Model for Experience Management in Public Organisations

In CommonKADS, the development of a system entails constructing a set of models of problem solving behaviour in its concrete organisations and application contexts. The rst phase in designing Pellucid has been the development of the organisational, task, knowledge and communication models for the case of a generic public organisation.

### 2.1 Organisational Model

The organisational model describes the organisation in a structured, systems-like fashion. It includes aspects such as identi cation of problems and opportunity areas, organisational structure and resources. All these components come into play and interact when a new knowledge solutions is introduced into the organisation.

**Identifying Knowledge-Oriented Problems and Opportunities.** In the case of public organisations, we have identi ed the following problems related to mobility of public employees:

- When a worker leaves the organisation or changes to another department, there not mechanism for preserving her/his experience in the previous position.
- When a worker changes of position within the organisation, due to career progression, s/he does not usually receive training. The acquisition of the speci c experience is often left to the initiative of the colleagues or the worker.
- New workers usually receive some sort of training when arriving in the organisation. The training is often planned to communicate them the speci c rules and procedures of the organisation. Many relevant aspects of the position are normally left out.

These problems present opportunities that should be considered in Pellucid design:

- Capture the experience about operational processes of public employees.
- Leverage the accumulated expertise of employees.
- Make tasks more ef cient and reduce wasted time in searching for information.
- Other more ef cient and uniform responses to the public from the organisation.

**A General Business Process for Public Organisations.** In general, the mission of public organisations is to serve the needs of the community [5]. Those needs are represented by a portfolio of services offered by the organisation. As business process, we have selected the processing of a generic service as illustrated in Figure 1.

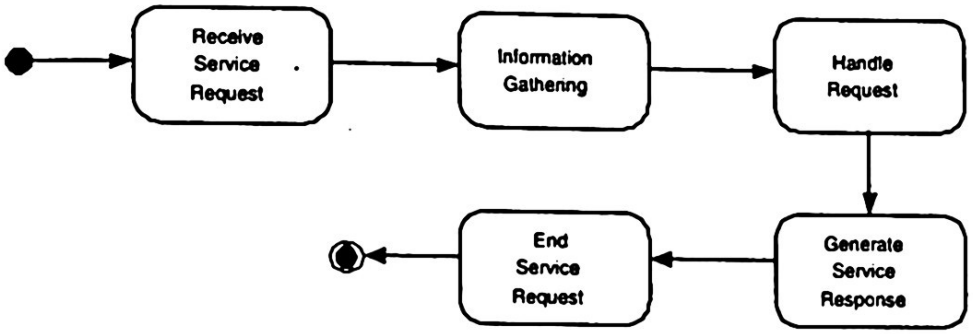


**Fig. 1.** Layout of a General Business Process

Receive Service Request is concerned with the reception of service request. Once a service is requested, the next action is to determine which information is appropriate to answer the request. Then, the information needed to process the request is collected. Handling a service depends on the service itself, but here we analyse typical tasks such as writing reports, assessment of the service, etc. Finally, a response is generated for the customer and the service ends.

**Describing Knowledge Resources.** Pellucid assumes that the business process of an organisation is automated with a work o w management system. The system also creates and maintains an organisational memory which contains knowledge resources. At any point of work, an employee may request assistance of Pellucid, which offers then a hint indicating which actions could be executed and which knowledge resources are useful. The following are example of knowledge resources used by Pellucid:

- **Service Directory.** Public organisations can be seen as service-oriented institutions. The business model we have developed is centred on solving a service request. Hence, having a directory of all services offered by an organisation constitutes an important knowledge resource.
- **Pro le of Activity.** CommonKADS tasks correspond to the tasks involved in solving a service request. These tasks are divided into sub-tasks we have called activities. It is important to store information about each activity, such as its time criticality, knowledge grade, description, etc.
- **Pro le of Employee.** The pro le of an employee contains information relevant for the organisation, since from there it would be possible to determine her/his expertise and knowledge. Important components are the competences, capabilities and skills of each employee.

- **Documents.** Public organisations are document-centred, so this is an important knowledge resource. This resource denotes all documents owned by the organisation. It is useful to indicate the different kinds of document available. We have identi ed the following kind of documents: manuals, working guidelines, work reports, assessments, meeting minutes, nancial reports (spreadsheets), emails and images.

### 2.2 Task Model

In the context of CommonKADS, a task is a subpart of a business process that represents a goal-oriented activity adding value to the organisation, handles input and delivers desired outputs in a structured and controlled way, consumes resources, requires and provides knowledge and other competences, and is performed by responsible and accountable agents. The methodology includes textual templates to specify the tasks which includes information such as goal of the task, pre and post-conditions, objects handled, timing and control among others.

We have de ned a catalogue of knowledge-intensive tasks that may be used in any of the tasks associated to the business process presented in Figure 1. This catalogue is based on the template of knowledge tasks proposed by CommonKADS in [15], which includes general tasks such as classi cation, diagnosis, assessment, monitoring, design and assignment among others. Pellucid catalogue includes the following tasks:

- **Classi cation of Documents.** Giving a document, this task allows one to know the classi cation of the document according to a topology. Such classi cation is useful in providing information/aid to users at any point in the business process.
- **Roadmap of Documents and Contacts Useful in a Process.** This task aims at determining which documents/contacts are useful in a particular process, when knowledge about that process is incomplete.
- **Monitoring Progress in Handling a Service.** Some processes are time-critical in the sense that the work should be done within a particular time. This task monitors the progress of such process, warning employees in case there is a risk of not ending the process in the speci ed time.
- **Resource Assignment.** Given the nature of a process, it could be necessary to assign some resources to it. This task suggests an employee an optimum assignment of resources to such process.

For instance, one of the most knowledge-intensive task in Figure 1 is *Information Gathering*. It requires determining the most appropriate information for the requested service and then obtaining such information. Determining the appropriate information may include generating a *Roadmap of Documents and Contacts* useful in that service. Figure 2 shows the task analysis worksheet for that task.

### 2.3 Agent Model

In CommonKADS, an agent can be human, an information system, or any other entity capable of carrying out a task. The agent model describes the characteristics of agents, in particular their competences, authority to act, and constraints in this respect.

| Task Generating Document/Contact RoadMap | | |
|---|---|---|
| GOAL | This task aims to collect all document and contacts useful in a process. We can see this task as a particular case of Information Gathering | |
| FLOW | **Input tasks:** | Receive Service Request |
| | **Output tasks:** | Handle Request |
| OBJECTS HANDLED | **Input objects:** | Service Description |
| | **Output objects:** | List of documents and contacts useful to serve service |
| | **Internal objects:** | List of activities associated to the input service<br>Context of each activity of the input service |
| CONTROL | **Precondition:** | Input service belongs to the service directory |
| | **Postconditions:** | Documents and contacts are represented by valid links to their position in the organisational memory |
| AGENTS | Information Search Agent | |

**Fig. 2.** Task Analysis Worksheet for Generating Document/Contacts Roadmap

There are three main elements in Pellucid: the employee of the organisation, a work- o w system (WfMS) representing the business process of the organisation, and an organizational memory containing the relevant information of the organisation. In general, Pellucid assists the employee at any point in the work o w system by providing useful information from the organisational memory. Agents in Pellucid re ect these components. The employee is represented by the Personal Assistant Agent (PAA), which is an interface agent serving and personalising information and suggestions to the user. There is a Personal Assistant Agent per employee in the organisation. The interaction of Pellucid with the work o w system is managed by the Monitoring Agent. The whole functionality of the organisational memory is represented by three agents: the Role Agent (RA), which acts as an interface between the PAA and the organisational memory, the Information and Search Agent (ISA), in charge of searching and retrieving information from the organisational memory, and the Capitalisation Agent, which generates new knowledge in the organisational memory. Below, we summarise the main functionalities of these agents.

- Personal Assistant Agent. This agent includes functionalities such as presenting personalised information to the user, accepting comments/rating from the user about current task or selected information resource, and supporting administration of the user pro le.
- Monitoring Agent. This agent informs Role Agents about activities performed by the WfMS. It includes functionalities such as providing interface for receiving information about work o w events.
- Role Agent. This agent includes functionalities such as pushing newly discovered knowledge to PAAs of interested users, handling queries from PAA, and delegating more complex or time-consuming queries from PAA to ISA.
- Information Search Agent. This agent includes functionalities such as receiving and handling queries, searching OM for document instances using generated full-text indexes, and retrieving document from a document repository and providing mechanism to PAA for accessing a given document.

- Capitalisation Agent. This agent creates global knowledge and reorganise historical data and knowledge data. It includes functionalities such as asserting new facts based on review of historical data from OM.

CommonKADS proposes templates for documenting the agent speci cations. By way of illustration, Figure 3 shows the speci cation of Role Agent.

| Role Agent Specification | |
|---|---|
| OBJECTIVE | Provide a user with a list of possible hints based on their current position in the business process |
| DESCRIPTION | The Role Agent generates active hints for the user based on her/his current context. Some of the hints could require complex queries, which are delegated to the Information Search Agent |
| INVOLVED IN | Context matching; Generating active hints; Sending active hints |
| COMUNICATES WITH | Monitoring Agent, Personal Assistant Agent, Information Search Agent |
| KNOWLEDG E | This agent receives events from the Monitoring Agent indicating current activity of the user within the business process. It applies heuristics to determine similar contexts, based on activities profiles stored in the organisational memory, and to genera te proper hints to the user |

**Fig. 3.** Speci cation of Role Agent

## 2.4 Knowledge Model

The knowledge model speci es the knowledge and reasoning requirements of the prospective system. It includes the domain knowledge model, which speci es the knowledge and information types we want to talk about in the system, and the task knowledge, which describes the goals an application pursues and how these goals can be realised through a decomposition into subtasks and inferences.

**Domain Knowledge Model.** We present here a fragment of the domain knowledge model and refer the reader to [11] for a more complete model. Most constructs of the domain knowledge model are similar to the ones used in modern object-oriented data models. Following CommonKADS, we use a notation as close as possible to UML.

In general, public *Organisations* have as mission to serve the needs of a community through a set of *Services* which consists of *Activities* and involves *Employees* [5]. Each activity requires *Skills* from the employee in order to be performed ef ciently . An employee is chosen to work within a particular service on the basis of a *Role* played within the organisation. However, the role of an employee may change dynamically according to current needs. The employee who is subject to frequent changes of role within the organisation is a mobile employee (see Figure 4).

Generally, each business process can be divided into smaller steps called *Activities*. To accomplish an activity, an employee undertakes some *Actions*. It is worth noting

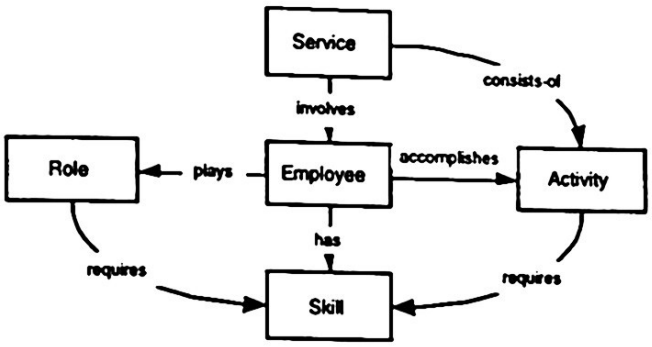


**Fig. 4.** Fragment of the Domain Knowledge

that actions are not part of the business process, since different people can accomplish an activity in different ways. An activity depends on the problem to be solved and such information is captured in the concept of *Context*. The purpose of Pellucid is to support and enhance employees' performance by providing them with the knowledge required by the activity they are performing at the time they are actually performing the activity. To do so, it is included the concept of *Active Hint*, a representation of experience within the organisation. Experience can be seen as knowing what to do in particular circumstances. The circumstances correspond to the context and the know what to do is characterised by the action and resources needed in that action (see Figure 5).

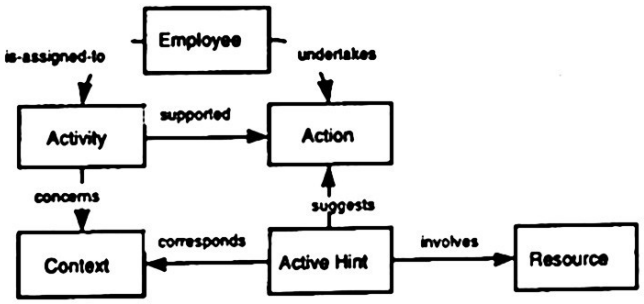


**Fig. 5.** Fragment of the Domain Knowledge

All elements modelled in the domain knowledge model constitute a general ontology for experience management. This ontology is used as a mechanism to express the main concepts of the system and their relation as well as to infer knowledge.

**Task Knowledge Model.** The task knowledge model de nes the strategies that will be used to achieve the main goal of a task. Task knowledge is typically described in a hierarchical fashion: top level tasks such as *Generate Contact/Document Roadmap* are decomposed into smaller tasks, which in turn can be split up into even smaller tasks. At

the lowest level of task decomposition, the tasks are linked to inferences — a primitive reasoning step — and input/output functions.

Let us examine tasks *Generate Contact/Document Roadmap*. The general speci - cation presented in Figure 2 gives an informal description of the goal of the task and the relation between input and output. It is worth mentioning there are no domain-dependent terms in such speci cation. This task can be seen as a particular case of an assignment task (cf. [15], chapter 6) in which we are linking (assigning) an activity to people and document resources taking into consideration some constraints such as the grade of knowledge of people — their expertise — and the relevance of the documents used. The method used to realise this task is summarised in Figure 6. In this method, decompose, determine and assign correspond to inferences. They are implemented using the ontology presented previously in the domain knowledge model. obtain and present correspond to input/output functions.

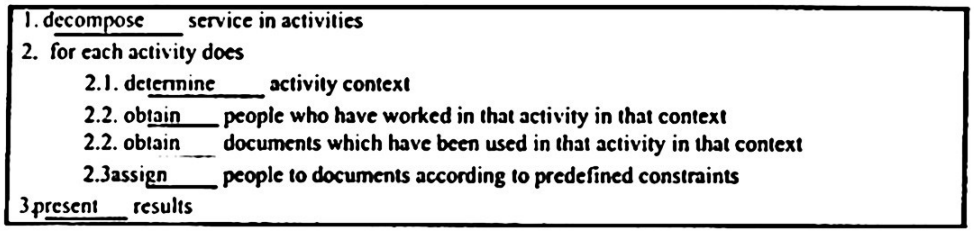


**Fig. 6.** Task Method of Generating Contact/Document Roadmap

## 2.5 On Active Hints

The idea of knowledge delivery through active user support, triggered according to the context in a work o w, was developed by the DECOR project [2]. Pellucid has borrowed the idea of active hints as conveyors of experience, and is working it out in a somewhat different direction: active hints are regarded as suggestions to the user to perform some actions that will assist her/his current activity.

An active hint is triggered in a context and includes an action, a knowledge resource and a justi cation for the hint. The context is determined by the particular activity that is carried out at that time in the work o w system. An action corresponds to an atomic act on the knowledge resource, for example use a document template, read a document or consider a contact list. The justi cation gives to the user a reason for the hint. The following is an example of a possible active hint in the context of a proposal evaluation when managing a project (see Figure 8).

**Context:** Proposal Evaluation
**Action:** Consider
**Resource:** List of People and Documents
**Justi cation:** People in the list have evaluated similar proposals in the past, and they have used the associated documents for such activity

The catalogue of knowledge intensive tasks presented previously has a dual purpose in Pellucid. They could be subtasks of the business process, for instance *Classifying a Document* could be a task of the process of managing a project, or they could be used as internal tasks to generate active hints, for instance task *Generate Contact/Document Roadmap* was used to generate previous active hint.

### 2.6 Communication Model

The communication model specifies the information exchange between the different agents. We begin with the identification of the conversation between agents, derived from the task and agent models. At this level, every conversation consists of just one single interaction and the possible answer. For instance, Figure 7 illustrates the template describing the conversation between Monitoring Agent and Role Agent.

| MA/RA Conversation | |
|---|---|
| OBJECTIVE | Inform Role Agent about an event in the workflow management system |
| DESCRIPTION | Monitor Agent informs Role Agent about an event in the workflow system. The event contains additional information added by the Monitoring Agent, indicating some particular aspects of the current context |
| AGENTS | Monitoring Agent; Role Agent |
| BEGINNER | Monitoring Agent |
| PRECONDITION | Event contain information in a predefined format<br>Occurrence of event is already stored in organisational memory |

**Fig. 7.** Conversation between Monitoring Agent and Role Agent

Next, we model the data exchanged in each conversation by specifying speech acts. All this information can be collected in the form of sequence diagrams. We do not emphasize on this part due to lack of space.

## 3 Modelling a Specific Business Process: Project Management in MMBG-Spain

The Mancomunidad de Municipios del Bajo Guadalquivir (MMBG) is an organisation created by eleven local authorities with the main objective of contributing to the social and economic development of an area with 250,000 inhabitants in the southern Region of Andalusia (Spain). The particular problem of MMBG is the wide range of tasks that must be handled by its employees. This variety of areas in the working environment requires a high degree of flexibility among the employees, and expertise is scarce and very valuable. In this situation, the need for knowledge capitalisation and for reuse of previous experiences is very critical, as it would lead to an increase of the efficiency and would allow for a better use of the human and technical resources.

### 3.1 A Business Process for Project Management

The pilot application that will be validated at the MMBG concerns the Management of publicly funded Projects among this complex organisation. This will include all the tasks to be performed from the very early stages of the project to the justi cation of the project's costs and activities, and the preservation of all the documents generated during the project execution. Figure 8 illustrates the business process for project management at MMBG.

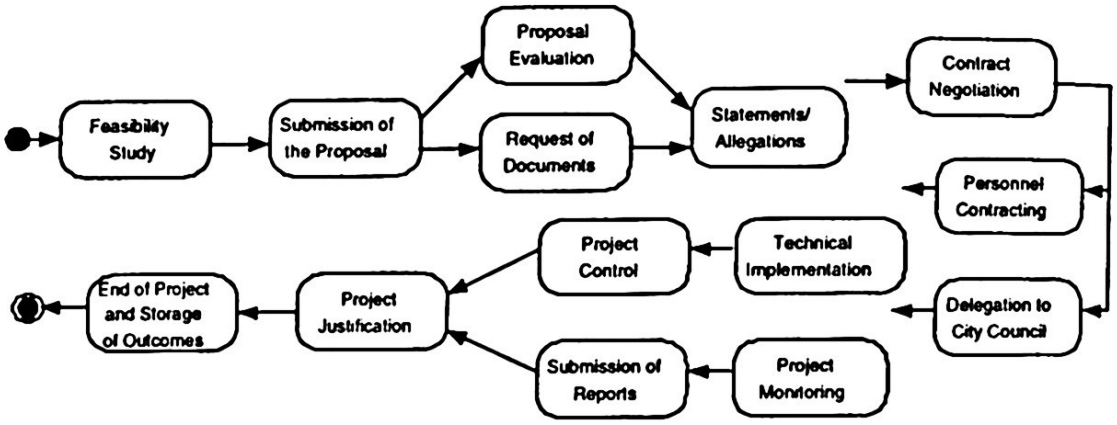


**Fig. 8.** Business Process for Project Management at MMBG

### 3.2 Identifying Knowledge-Intensive Tasks

The speci c business process of an organisation is an aid in identifying knowledge-intensive tasks within the organisation and deriving possible hints to assist employees in these tasks. For the business process of MMBG, presented in Figure 8, the most knowledge-intensive tasks are *Feasibility Study* and *Proposal Evaluation.*

Determining which tasks are knowledge-intensive is part of the knowledge-elicitation process, and includes the participation of domain experts. In our project, we have made use of techniques such as interviews and questionnaires for both identifying knowledge-intensive tasks and deriving possible hints. In a second phase, we plan to use protocol analysis techniques to validate the hints proposed to the user and to capture new ones.

### 3.3 Domain-Speci c Knowledge

Another important aspect in developing a knowledge-based system is the inclusion of domain-speci c knowledge. We have constructed domain-speci c ontologies for each of the participating sites, following techniques as the one presented in subsection 2.4. These ontologies have been merged with the main ontologies, allowing the system to reason about speci c knowledge in the organisation. This process has been assisted with the aid of the Protege tool [13].

## 4 Artefact Modelling

The artefact modelling is concerned with the design, a speci cation of the software system based on the information provided by the previous models. It can be seen as a bridge between the application domain and the resulting system. Figure 9 illustrates the general architecture of our system using the traditional Model-View-Controller (MVC) methaphor [10]. The Monitoring Agent corresponds to the *Controller Module*, capturing inputs from the work o w management system bu means of its sensors and using an event-driven control regimen. The arrows in Figure 9 indicates information o w, then the Monitoring Agent informs the Role Agent about received events and updates the Organisational Memory. The Personal Asistant Agent corresponds to the *View Module*, managing the information provided to the human user by applying personalisation techniques. The core of the system is the *Application Model Module*, which comprises the Role Agent, the Information and Search Agent and the Capitalisation Agent. This module includes the functions and data that together deliver the functionality of the application. Ontologies and dynamic data manipulated during the reasoning process are also considered to be part of the organisational memory.

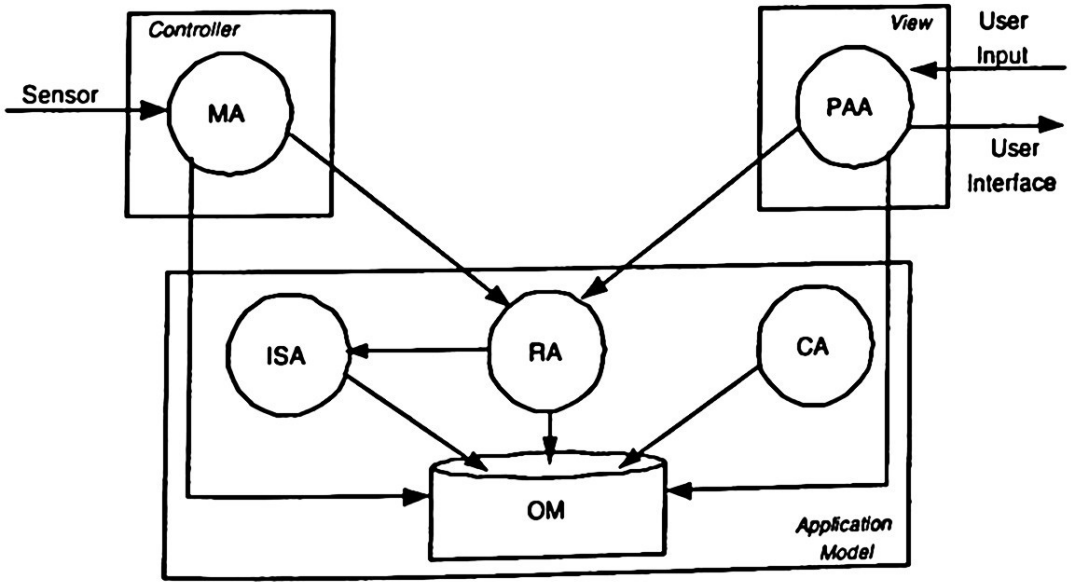


**Fig. 9.** General Architecture of Pellucid

We have selected Java as the programming language for the implementation of agents. The ontologies presented in subsections 2.4 are represented in the OWL ontology language; such transformation is carried out with the aid of the Protege tool [13]. The whole reasoning process makes use of the Jena 2 toolkit [6].

The nal step in the design is to detail the architecture's components. As a way of illustration, Figure 10 presents a fragment of the detailed design of the Role Agent.

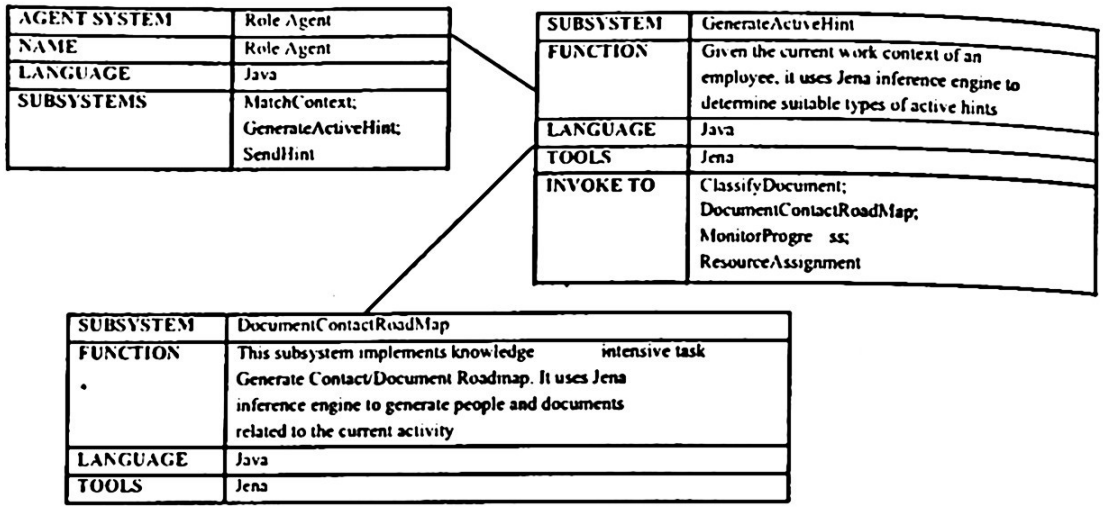


**Fig. 10.** Detailed Design of the Role Agent

## 5 Related Work

Pellucid has developed an approach highly in uenced by the CommonKADS methodology [15], adapting elements of other approaches such as management of organisational memories [8], experience management [4] and active hints [2].

Pellucid can be seen as an example of an Electronic Performance Support Systems (EPPS) [7], systems that aim to support and enhance users' performance by providing them with the knowledge required by the task they are performing at the time they are actually performing the task. Other examples of EPPS are the EULE system [14], the VirtualOf ce and KnowMore systems [1] and integration of knowledge and business processes [16].

The EULE system aims at offering assistance in the of ce work in the domain of insurance business [14]. It includes a business-process modelling framework which starts with a high-level structure of business processes that span various organizational units, and then gets broken down into more and more local views which at the same time become more detailed, until at the most detailed level EULE of ce task representations are obtained. The system is coupled with a work o w system by linking a EULE of ce tasks to working steps of a work o w. When reaching a working step that is associated with a EULE task, the user can request EULE assistance and obtain then the information missing at that speci c point.

The VirtualOf ce and KnowMore projects aim to support knowledge-intensive activities by providing automatic access to relevant information [1]. Each activity belongs to some comprehensive business process which is explicitly modelled and enacted by some WfMS. The activities are to be supported based on an available information space, which contains information sources of various types and characteristics together with suitable access structures. A central component is an intelligent assistant, which bridges between the information space and the knowledge-intensive activities and performs a process identi cation job (similar to the context identi cation job carried out by Pellucid) in which the system detects the particular circumstances of a process. The Virtual

Of ce tool integrates paper-based information into work o w using a document management system for information extraction, following a request from the work o w. The KnowMore project focuses on delivering goal-speci c information in a proactive way by analysing the incoming stream of information that the organisation receives. These works were further extended in the DECOR project [2].

The work of Staab and Schnurr in [16] is close to our work in putting an intelligent assistant to work within a business process environment. It also exploits the inferential power of ontology-based retrieval on top of the Ontobroker software, using a notion of context-based views for coupling work o w and retrieval. In building the information system, they start with an analysis process that explores the interdependence among the documents employed in the business process. Then, domain-speci c information is added by including domain ontologies describing the content of documents, and contextual information. During the execution phase, the system acts as facilitator for sharing, creating and retrieving knowledge, providing users for active help as a response to their request.

## 6 Conclusions

This paper has presented the knowledge engineering modelling undertaken in Pellucid, using the CommonKADS methodology. The main contribution of the paper lies in presenting and applying a set of knowledge-intensive tasks useful for experience management. Task typologies have been introduced previously in the literature in a more general context [3, 9, 15]. We have been inspired by CommonKADS typology, adapting some tasks for the case of organisational mobility in public organisations.

An important feature of Pellucid is the use of active hints to deliver knowledge to the members of an organisation [11]. The knowledge-intensive tasks we have proposed have been used either to solve knowledge-intensive problems within the business process of the organisation or as a mechanism to derive active hints.

Future work includes extending the tasks catalogue to include other tasks related to organisational mobility. We are currently working on the implementation of the some of the tasks using semantic web technologies such as RDF and OWL, with the aid of the Jena toolkit [6].

## Acknowledgements

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# A Web-based System for Supporting Structured Collaboration in the Public Sector

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**Abstract.** The development of effective public policies and programs concerning the big problems of modern societies is an increasingly complex task. The social problems today are multidimensional and their solution requires close collaboration among various Public Organizations from many regions or even countries. Each individual organization involved possesses pieces of information, experience, knowledge and competence about the problem. Their values, interests and expectations are often different, or even conflicting, and have to be taken into account. Similar hold for the 'high level functions' of the Public Administration, such as decision making towards the development of legislation. This paper presents a web-based system that supports collaborative activities in the above setting. Through a well-structured discourse graph, the system facilitates the wide participation and collaboration of the Public Organizations involved in the solution of social problem and provides a series of knowledge management and argumentative decision making features. The use of the system is described through a detailed example concerning a debate about state vs. non-state universities, which has recently started in Greece.

**Keywords:** e-Government, G2G, collaborative activities, IS framework, decision making, argumentation, knowledge management.

## 1 Introduction

Information and Communication Technologies (ICTs) have a huge potential for supporting and transforming the full range of contemporary Public Administration activities concerning the design, production and delivery of public services [4, 5, 9]. However, e-Government today is mainly focused on e-transactions, i.e. on offering citizens and enterprises the capability to perform electronically their transactions with the Public Administration (e.g., declarations, applications, etc.). The ICT-enabled innovation in this area is limited, mainly to the development of 'virtual public agencies' or 'one-stop e-Government', i.e. of single access points to many related electronic trans-

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actions and services, which are usually required in a particular life event or by a particular target group (of citizens or enterprises) and offered (or managed) by several different Public Organizations [9, 10, 17].

It is therefore necessary to exploit to a much larger extent the huge innovation potential of ICTs and enrich the concept of e-Government [10, 11, 12]. In particular, e-Government should be directed not only to e-transactions, but also to more critical 'high level functions' of Public Administration, such as: (i) the design, implementation, monitoring and evaluation of public policies, programs and services, (ii) the development of legislation, and (iii) the high level decision-making concerning difficult and complex social problems, granting licenses and permissions with high social impact, etc. These high level functions are of critical importance for the Public Administration and the society; at the same time, they are highly difficult and complex since they usually require close collaboration among many Public Organizations (POs), and very often the participation of citizens, enterprises and their associations as well.

In particular, the development of effective public policies, programs and services concerning the big and complex problems of modern societies is becoming more and more difficult. The social problems today are multidimensional and cross many regions or states. Also, the continuously growing international economic cooperation and interdependence gives rise to new complex problems of international nature. The forthcoming enlargement of the European Union with new member states will give rise to many complex international problems and issues. It is widely argued that the development of effective public policies and programs for such big and complex problems requires close collaboration among many POs from many regions or even countries (e.g. central governments, regions, prefectures, municipalities, local development organizations, employment organizations, social security organizations, education organizations, environment organizations, etc.). Each of these POs possesses small - but valuable - pieces of information, experience, knowledge and competence about the problem. In addition, there often exist differences among their values, interests and expectations. It is thus necessary to properly handle all these diverse but valuable pieces of information, experience, knowledge and competence, as well as their different values, interests and expectations. Effective and efficient collaboration may be a remedy to this problem. However, geographical distance and time/budget limitations do not allow this collaboration to be close enough, resulting in the design of suboptimal and ineffective public policies and programs, which are developed without the required wide participation of all competent and knowledgeable parties.

Similar hold for the development of legislation, for the decision making concerning difficult and complex social problems, and also for granting licenses and permissions with high social impact; a high level of participation and collaboration is required, but very often this cannot be achieved due to distance, time and budget limitations. Therefore, it is of critical importance to exploit the capabilities of modern ICTs for supporting and facilitating the required wide participation, argumentative discourse, interaction, synthesis and, in general, collaboration required for the abovementioned high level functions of Public Administration.

At the same time, one of the most important advantages of any organization in today's political, economic, social and technological environment is its ability to lever-

age and utilize its knowledge [14]. Such knowledge resides in an evolving set of assets including the employees, the structure, the culture and the processes of the organization. Of these, employee knowledge, and particularly tacit knowledge is identified as the dominant one, which is decisive at all mental levels and has to be fully exploited [13]. Such an exploitation refers to the transformation of tacit knowledge to codified information, which is considered as a core process for economic activity and development [1]. For the above reasons, we argue that it is necessary to adopt a knowledge-based decision-making view in the development of technologies for supporting collaboration [6]. According to this view, decisions should be considered as pieces of descriptive or procedural knowledge referring to an action commitment. In such a way, the decision making process is able to produce new knowledge, such as evidence justifying or challenging an alternative or practices to be followed or avoided after the evaluation of a decision, thus providing a refined understanding of the problem

This paper presents a web-based system that supports the structured collaboration required in the Public Sector and meets all the above requirements. Our approach allows for distributed and asynchronous collaboration and aims at aiding the involved POs by providing a series of argumentation, decision making and knowledge management features. The remainder of the article is structured as follows: Section 2 introduces the proposed e-Collaboration framework and discusses related work. Section 3 presents the features of the system and validates its use through an example concerning a discussion (electronic argumentation) about the type of universities (i.e., 'state' vs. 'non-state', 'non-profit' vs. 'profit-making') that should be allowed in the near future in Greece. Section 4 focuses on technical issues concerning the system's scoring and reasoning mechanisms. Finally, Section 5 concludes the paper by discussing the usability and applicability of the proposed system.

## 2 An e-Collaboration framework

The representation and facilitation of argumentative discourses in diverse collaborative settings have been the subject of interest for quite a long time. Many interesting systems have been developed so far, based on alternative models of argumentation structuring. Generally speaking, such systems aim at structuring group decision-making processes and helping group members in reaching a shared understanding of the issue by supporting knowledge elicitation, knowledge sharing and knowledge construction. Moreover, they exploit intranet or internet technologies to connect decision-makers in a way that encourages dialogue and stimulate the exchange of tacit knowledge. Representative systems falling in this category are Questmap [2], QOC [16], Sibyl [8], Zeno [3], Hermes [7] and Compendium [15].

The e-Collaboration framework proposed in this paper extends the one conceived in the Hermes system by providing additional knowledge management and decision-making features (see Figure 1). Discourses about complex problems in the Public Sector are considered as social processes and, as such, they result in the formation of groups whose knowledge is clustered around specific views of the problem. Following an integrated approach, we have developed a web-based system that provides POs

engaged in such a discourse with the appropriate means to collaborate towards the solution of the underlying issues. In addition to providing a platform for group reflection and capturing of organizational memory, our approach augments teamwork in terms of knowledge elicitation, sharing and construction, thus enhancing the quality of the overall process. This is due to its structured language for conversation and its mechanism for evaluation of alternatives. Taking into account the input provided by the individual POs, the system constructs an illustrative discourse-based knowledge graph that is composed of the ideas expressed so far, as well as their supporting documents. Moreover, through the integrated decision support mechanisms, discussants are continuously informed about the status of each discourse item asserted so far and reflect further on them according to their beliefs and interests on the outcome of the discussion. In addition, our framework aids group sense-making and mutual understanding through the collaborative identification and evaluation of diverse opinions.

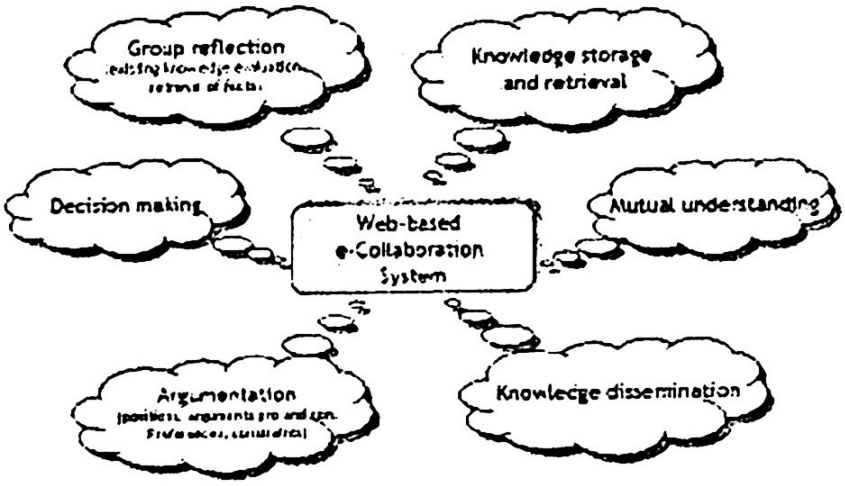


**Fig. 1.** Activities supported in our e-Collaboration framework.

Our web-based system provides a shared workspace for storing and retrieving the messages and documents of the participants, using a widely accepted document format (i.e. XML). The system's knowledge base maintains all these items, which may be considered, appropriately processed and transformed, or even re-used in future discussions. Storage of documents and messages being asserted in an ongoing discussion takes place in an automatic way, that is upon their insertion in the knowledge graph. On the other hand, retrieval of knowledge is performed through appropriate interfaces, which aid users explore the contents of the knowledge base and exploit previously stored or generated knowledge for their current needs. In such a way, our approach builds a 'collective memory' of the Public Sector community.

The basic discourse elements in our system are *issues*, *alternatives*, *positions*, and *preferences*. More specifically, issues correspond to problems to be solved, decisions to be made, or goals to be achieved. They are brought up by users representing a PO and are open to dispute (the root entity of a discourse-based knowledge graph has to be an issue). For each issue, the users may propose alternatives (i.e. solutions to the problem under consideration) that correspond to potential choices. Nested issues, in

cases where some alternatives need to be grouped together, are also allowed. Positions are asserted in order to support the selection of a specific course of action (alternative), or avert the users' interest from it by expressing some objection. A position may also refer to another (previously asserted) position, thus arguing in favor or against it. Finally, preferences provide individuals with a qualitative way to weigh reasons for and against the selection of a certain course of action. A preference is a tuple of the form *[position, relation, position]*, where the relation can be *'more important than'* or *'of equal importance to'* or *'less important than'*. The use of preferences results to the assignment of various levels of importance to the alternatives in hand. Like the other discourse elements, they are subject to further argumentative discussion.

## 3 An example case of use

This section presents the features and functionalities of the proposed system through an illustrative example. An intensive debate has recently started in Greece concerning the establishment (or not) of 'non-state universities'. So far in Greece, all universities are 'state' ones, which have been established and are being supervised by the Ministry of National Education. Also, according to the Greek Constitutional Law, the higher education should be provided only by the State, and not by any private-sector enterprises. In order to change the current situation, it has been recently proposed that initially new 'state universities' should be established, not by the Ministry of Education, but by other Public Sector Organizations, such as the big Municipalities, the Chamber of Commerce, the Church, etc. It has been also proposed that the Constitutional Law should be amended, so that it will allow higher education to be provided by private-sector enterprises as well. After such an amendment, new 'non-state universities', either 'non-profit' or even 'profit-making' ones, could be established.

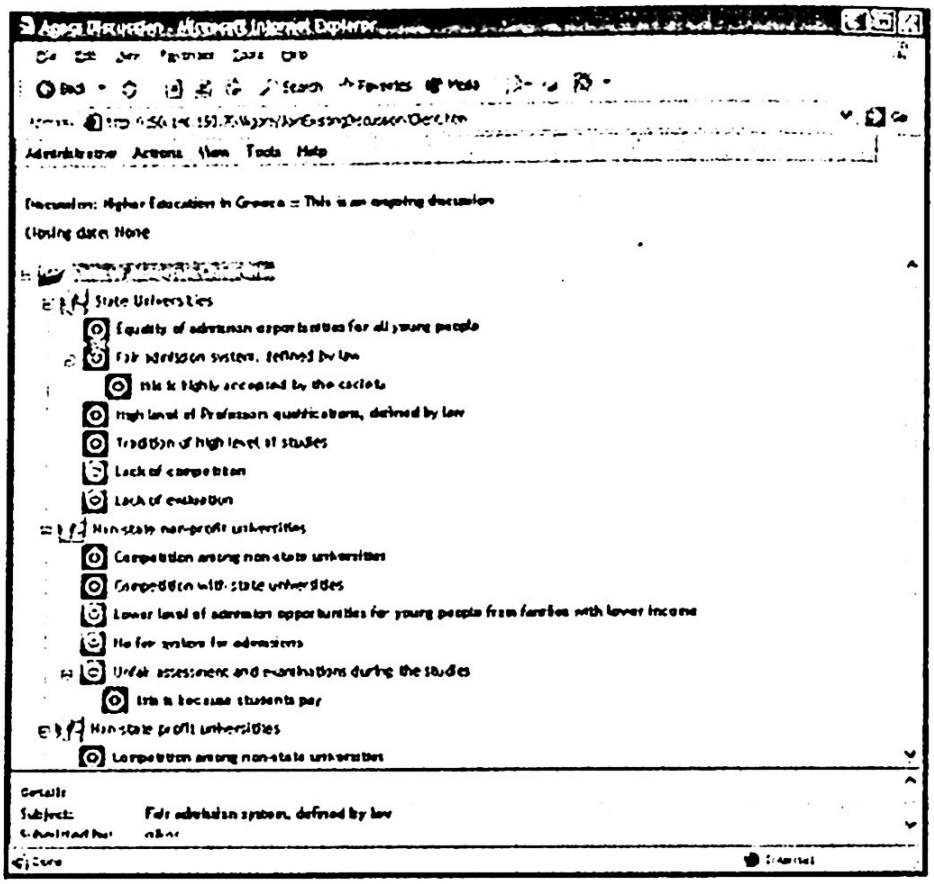


**Fig. 2.** An instance of the discourse-based knowledge graph.

In the instance depicted in Figure 2, six users (i.e., representatives from the Ministry of National Education and Religious Affairs, two state universities, the National Pedagogical Institute, and two secondary education schools) have been participating so far in the related discourse. Each of them possesses some information, experience and knowledge about the problem. As shown, our approach maps the overall collaborative process to a discourse-based knowledge graph with a hierarchical structure. Each entry in the graph corresponds to an argumentation element. Each such element is accompanied by an icon that indicates the element type. There are also icons for folding/unfolding purposes, thus enabling users to concentrate on a specific graph's part; this is particularly useful in graphs of considerable length and complexity. Each entry in the graph may contain the username of the user who submitted it and the date of submission (alternative forms in the appearance of each entry can be obtained through options provided under the *View* menu). The lower pane of the window provides more details about a selected entry of the discussion graph (users can select an entry by clicking on it).

In our case, the overall issue under discussion is "State vs. Non-state Universities", while three alternatives (namely "State Universities", "Non-state non-profit universities" and "Non-state profit universities") have been asserted so far. The users may argue about them by expressing positions speaking in favor or against them. For instance, "Equality of admission opportunities for all young people" is a position that argues in favor of the first alternative, while "Lower level of admission opportunities

for young people from families with lower income" is a position that argues against the second one. All graph entries are subject to additional (multi-level) argumentation. For instance, "this is highly accepted by the society" has been asserted by a user to further validate the "Fair admission system, defined by law" position.

As noted in the previous section, users may also assert preferences about the already expressed positions. In the instance shown in Figure 3 (compared to the instance shown in Figure 2, all items asserted so far under the second and third alternatives are now folded), a user has expressed his opinion about the relative importance between the level of professors' qualifications (see position "High level of Professors qualifications, defined by law") and the equal opportunities in admission to universities (see position "Equality of admission opportunities for all young people") through the preference "High level of Professors qualifications, defined by law *is more important than* Equality of admission opportunities for all young people". Figure 3 also shows the full information provided in the lower pane of the basic interface of the system. This comprises details about the user who submitted the selected argumentation element, its submission date, any comments that the user may had inserted, as well as links to related web pages and documents that the user may have uploaded to the system in order to justify this element and aid his/her peers in their contemplation.

Further to the argumentation-based structuring of a discourse, the system integrates a reasoning mechanism that determines the appropriate labeling for each entry of the discussion graph, the aim being to keep users aware of the discourse status. More specifically, alternatives, positions and preferences of a graph have an *activation label* indicating their current status. This label is calculated according to the argumentation underneath and the type of evidence specified for them. Activation in our system is a recursive procedure; a change of the activation label of an element is propagated upwards in the discussion graph. Depending on the status of positions and preferences, the mechanism goes through a scoring procedure for the alternatives of the issue (more technical details are discussed in the next section). At each discussion instance, the system informs users about what is the most prominent (according to the underlying argumentation) alternative solution. In the instances shown in Figures 2 and 3, "State Universities" is the better justified solution (it is shown in bold characters). However, this may change upon the type of the future argumentation. In other words, each time an alternative is affected during the discussion, the issue it belongs to is updated, since another alternative solution may be indicated by the system.

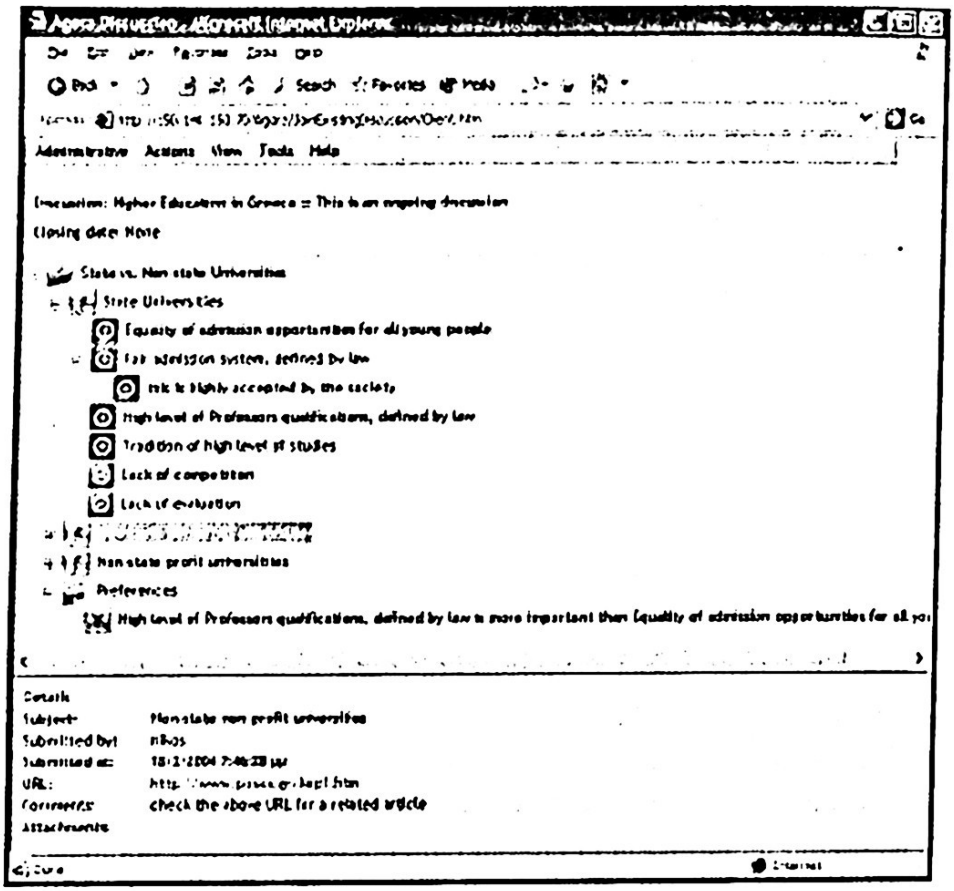

**Fig. 3.** A second graph instance.

The system also integrates e-mailing and electronic messaging features (options provided under the *Tools* menu) to further facilitate the communication among users before one asserts an argumentation element in the graph. The insertion of all types of entries in the graph is performed through appropriately designed interfaces (these are deployed upon the user's selection under the *Actions* menu).

## 4 Scoring and reasoning mechanisms

This section describes the reasoning mechanisms integrated in the system. Without resorting to formal approaches (such as qualitative probabilistic knowledge and logic of argumentation), such mechanisms determine the appropriate labeling for each entry of the discussion graph, the aim being to keep users aware of the discourse status.

### 4.1 Proof Standards

As noted in the previous section, alternatives, positions and preferences have an activation label indicating their current status (they can be *active* or *inactive*). Generally speaking, different elements of the argumentation, even in the same debate, do not necessarily need the same type of evidence. Quoting the well-used legal domain example, the arguments required to indict someone need not be as convincing as those

needed to convict him. Therefore, a generic argumentation system requires different proof standards (work on AI and Law uses the term *burdens of proof*). In the sequel, we describe the ones implemented in our system (see also [7]). In any case, we do not claim that the list of proof standards provided is exhaustive. However, additional ones (e.g. voting), which better match problem-specific needs, can be easily integrated.

? *Scintilla of Evidence (SoE):* according to this proof standard, a position $p_i$ is active, if at least one active position argues in favor of it: $active(p_i) \Leftrightarrow \exists p_j\ (active(p_j) \wedge in\_favor(p_j, p_i))$.

? *Beyond Reasonable Doubt (BRD):* according to BRD, a position $p_i$ is active if there are not any active positions that speak against it: $active(p_i) \Leftrightarrow \neg \exists p_j\ (active(p_j) \wedge against(p_j, p_i))$.

In the case of the third proof standard, each position has a *weight=(max_weight + min_weight)/2*, while an alternative with no positions linked underneath has a *weight=min_weight*. Both *max_weight* and *min_weight* are initialized to some predefined values, which may be changed upon the assertion of preferences. The score of an argumentation element $e_i$ is used to compute its activation label. If an element does not have any arguments, its score is equal to its weight; otherwise, the score is calculated from the weights of the active positions that refer to it:

$$score(e_i) = \sum_{\substack{in\_favor(p_j, e_i) \wedge \\ active(p_j)}} weight(p_j) - \sum_{\substack{against(p_k, e_i) \wedge \\ active(p_k)}} weight(p_k)$$

? *Preponderance of Evidence (PoE):* According to this standard, a position is active when the active positions that support it outweigh those that speak against it: $active(p_i) \Leftrightarrow score(p_i) \geq 0$. Concerning alternatives, PoE will produce positive activation label for an alternative $a_i$ when there are no alternatives with larger score in the same issue: $active(a_i) \Leftrightarrow \forall a_j\ in\_issue(a_j), score(a_j) \leq score(a_i)$.

In the discourse shown in Figures 2 and 3, the proof standard adopted is SoE for positions, while it is PoE for alternatives. Active positions are considered "accepted" due to discussion underneath (e.g., strong supporting arguments, no counter-arguments), while inactive positions are (temporarily) considered as "discarded" or "rejected". Similarly, active alternatives correspond to "recommended" choices, i.e., choices that are the strongest among the alternatives in their issue. Finally, the activation label of preferences is decided by two parameters: the discussion underneath (similarly to what happens with positions) and the activation label of their constituent positions. In Figure 3, the asserted preference has BRD as proof standard; thus, it is active since there is no argument speaking against it (also note that both its constituent positions are active). If during the evolution of the discussion, a new position inactivates one of its constituent positions, this will result in its inactivation (the same will happen if a new position speaks against this preference).

### 4.2 Detecting conflicts and inconsistencies

Apart from an activation label, each preference has a *consistency label* (it can be *consistent* or *inconsistent*). Every time a new preference is inserted in the discussion graph, the system checks if both constituent positions of the new preference exist in another, previously inserted, preference. If yes, the new preference is considered either redundant, if it also has the same preference relation, or conflicting, otherwise. A redundant preference is ignored, while a conflicting one is grouped together with the previously inserted preference in an issue automatically created by the system, the rationale being to gather together conflicting preferences and stimulate further argumentation on them until only one becomes active. It should be noted here that both constituent positions of a new preference have been already inserted in the discussion graph; thus, whenever a user is about to insert a new preference, the system provides him/her with a list of all possible combinations to select from.

If both positions of the new preference do not exist in a previously inserted preference, its consistency is checked against previous active and consistent preferences referring to the same element (or belonging to the same issue). Consider for instance the case, where there exist two preferences *"$p_x$ is more important than $p_y$"* and *"$p_y$ is more important than $p_z$"*. A new preference *"$p_z$ is more important than $p_x$"* would be inconsistent with respect to the first two ones, although it is not directly conflicting with either one. Inconsistency checking is performed through a polynomial ($O(N^3)$, N the number of the associated positions) path consistency algorithm (for more details, see [7]). Although path consistency, as most discourse acts described in the sequel, interacts with the database where the discussion graph is stored, the algorithm is efficient; even for preferences involving issues with numerous alternatives and positions linked to them, execution time is negligible compared to communication delay.

### 4.3 The weighting mechanism

Active and consistent preferences participate in the weighting mechanism. In order to demonstrate how the algorithm for altering weights works, we use the example of Figure 4. There exist five positions and four preferences that relate them, as illustrated in Figure 4a. The arrowed lines correspond to the *"more important than"* (>) relation (e.g., $p_1 > p_2$) and the dotted line to the *"equally important to"* (=) relation (e.g., $p_3 = p_4$). Initially (with no preferences inserted in the system), each position would have a *weight = (max_weight + min_weight)/2 = 5* (we have assumed that *max_weight=10* and *min_weight=0*). *Topological sort* is applied twice to compute the possible maximum and minimum weights for each position (Figure 4b). The new weight of each position (having taken all preferences into account) is the average of its new *max_weight* and *min_weight*. Thus, it is: $weight(p_1)=6$, $weight(p_2)=4.5$, $weight(p_3)=5$, $weight(p_4)=5$ and $weight(p_5)=4$.

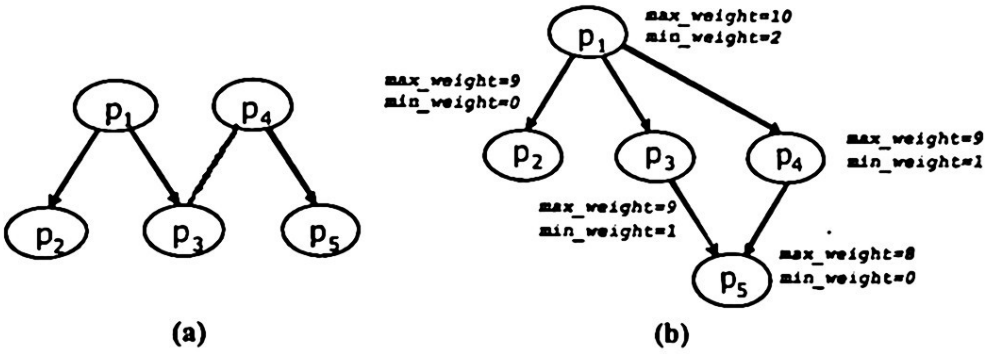


**Fig. 4.** The weighting mechanism.

The basic idea behind the above mechanism is that the weight of a position is increased every time the position is more important than another one (and decreased when it is less important), the aim being to extract a total order of alternatives. Since only partial information may be given, the choice of the initial maximum and minimum weights may affect the system's recommendation. Furthermore, this weighting scheme is not the only solution; alternative ones, based on different algorithms, can be easily integrated.

### 4.4 Discourse acts

Argumentation in our framework is performed through a variety of discourse acts. These acts may have different functions and roles in the argumentative discourse. We classify them in two major categories: user acts and system acts.

*User acts* concern user actions and correspond to functions directly supported by the user interface (these appear under the *Actions* menu – see Figures 2 and 3). Such functions include the opening of an issue, insertion of a new alternative to an issue, insertion of a new position in favor or against an existing position, preference or alternative, and insertion of a new preference to an existing issue. Editing features are also provided.

The user interface for adding a new alternative to an existing issue is shown in the top left part of Figure 5. When an alternative $alt_i$ is added to another $alt_j$ (and not directly to the issue $iss_j$ where $alt_j$ belongs), a new issue $iss_i$ is automatically created inside $iss_j$. Both $alt_i$ and $alt_j$ are now put inside the new issue and compared through a function *update*($iss_j$). *Update*($iss_j$) will be called from *update*($iss_j$) and the recommended choice between $alt_i$ and $alt_j$ will be compared against the other alternatives of the external (initial) issue. As shown, users can give a *subject* (title) of the new alternative, but also provide more details about their assertion through the *URL* (related web addresses) and *comments* (free text) panes. Moreover, they can attach multimedia documents to their discourse items.

The user interface for adding a new position is shown in the top right part of Figure 5. The father element can be an alternative, another position, or a preference. In addition to the "Add a new alternative" interface, users have to specify here the type of link (*in favor* or *against*) and the proof standard they prefer (depending on the discussion context, this option may be inactivated; that is, the same proof standard is used

for all positions). The bottom left part of Figure 5 illustrates the user interface for adding a new preference to an issue. The interface provides users with the means to consider all valid combinations of positions, thus preventing them from making errors in expressing a preference. The relation type menu includes the preference relations *more (less) important than* and *equally important to*. Finally, the user interface for editing a position is shown in the bottom right part of Figure 5. Users may there change any of the related information, as well as add new or remove previously inserted attachments.

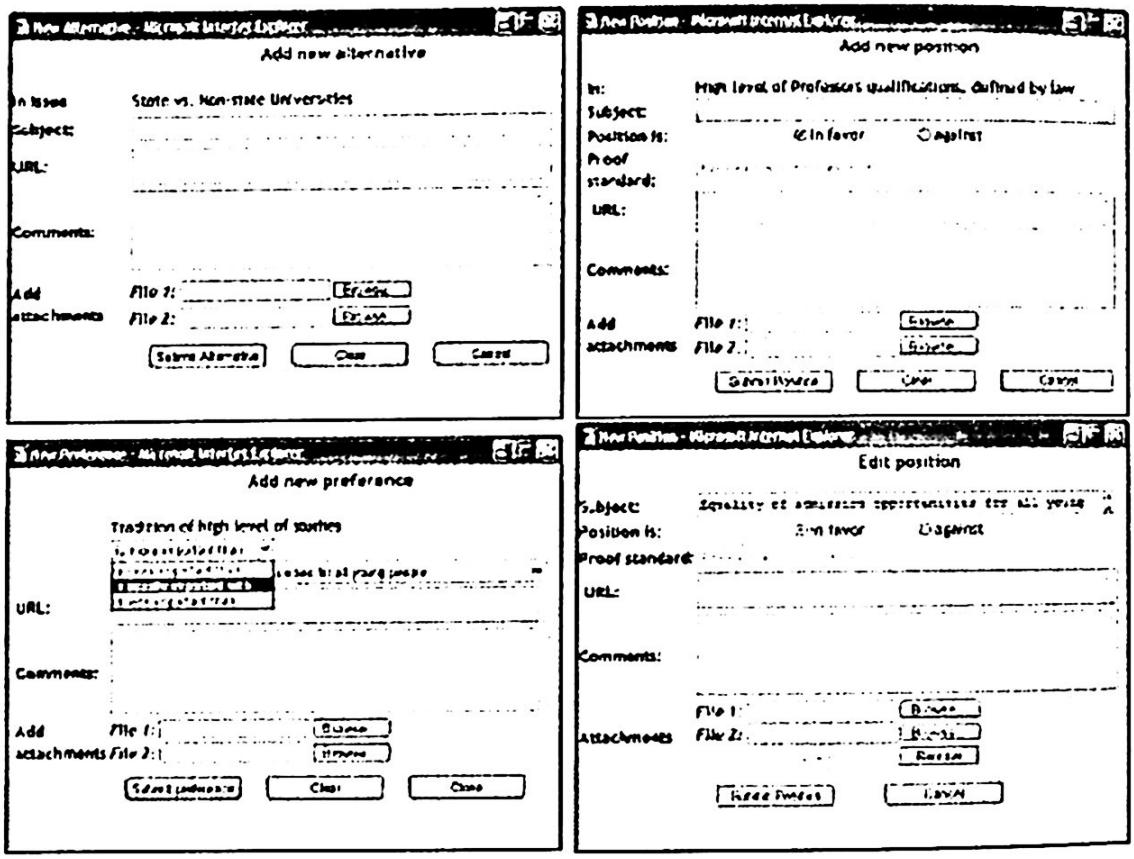


**Fig. 5.** User interfaces.

*System acts* are functions performed by the system in order to check consistency, update the discussion status and recommend solutions. These functions are automatically triggered by the user acts (that is, whenever a new item is added in the discourse graph) and are hidden from the end user (for more details, see [7]). Generally speaking, a single assertion in an ongoing discussion may update a large portion of the discourse graph. Every time there is a change, the status of the argumentation elements is recorded in the database that keeps track of the discourse.

## 5 Conclusions

A preliminary evaluation of the system described in this paper has already been made by the six users who participated in the argumentative discussion illustrated in the

previous section. The results of this evaluation are positive and encouraging: the functionalities of the system were found to be complete, correct, user-friendly and well-integrated. These results advocate that the proposed system can offer an effective and user-friendly electronic space for G2G structured multi-participative argumentation on complex Public Sector problems and collaborative knowledge creation. In this sense, it can improve the quality and reduce the cost of the collaborative activities required for the critical 'high level functions' of Public Administration.

In particular, the system can effectively support the collaboration required for the design, implementation, monitoring and evaluation of public policies, programs and services, by first enabling all the involved POs to identify the basic problems and issues, propose alternatives and discover their advantages and disadvantages. A multi-criteria decision making approach can be then followed, in order to select the optimal alternative(s) based on the insight and understanding previously gained. The proposed system can also support the collaborative development of detailed action plans for the selected optimal alternative(s) (i.e. for each proposed action, positive or negative positions as well as preferences can be expressed by the participants, etc.). During the implementation of these actions, the proposed system can be used for the collaborative monitoring of them, the identification of implementation problems and issues, and the development of alternatives for managing them. Finally, the system can be used for the collaborative evaluation of these actions by all the involved POs, and the citizens and enterprises who are their recipients. In a similar way, it can support the collaborative development of legislation and the 'high level' decision-making concerning complex social problems, granting licenses and permissions with high social impact, etc.

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# User-centered design for empowered e-citizens

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**Abstract.** This article presents the user-centered design approaches of Participatory Design, End-User Development and integrated Organisation and Technology Development as means to develop IT systems for empowered e-citizens. Empowering e-citizens to actively participate in and shape the IT systems they are using is discussed as being an essential contribution to social inclusion and cohesion and to reflect the cultural diversity and dynamics of modern societies. While Participatory Design is about actively and continuously involving the users of IT systems in the development process, End-User Development is a rather new approach to enable the end-users themselves to autonomously adapt IT systems to their diverse and changing requirements. As successful use of information technology is not only about the technology itself but just as much about the users and the organisational context of use, the integrated Organsiation and Technology Development approach deals with how all of these aspects have to be developed together to shape well-running socio-technical systems. These design approaches are illustrated with the development and deployment of a community support system for the Iranian NGO networks.

## 1 Introduction

At www.hispanics4clark.com hispanic US citizens can actively participate in promoting the presidential election campaign of Wesley Clark through a simple discussion forum based on web logs, or blogs for short. Besides this hispanic online community there are dozens of other dedicated communities to be found at the "grassroot sites" section of www.forclark.com. For example regional ones like the "Shenandoah Valley of Virginia For Clark" community as well as various other interest groups like the "Surfers for Clark", the "Disabled Americans for Clark", the "Ex-Pats for Clark" and finally the "Ex-Deaniacs for Clark" community for all those that formerly supported Howard Dean's campaign.

The 2004 US presidential election campaigns have seen blog-based support communities for all candidates, pioneered by Dean and more or less hastily replicated by other campaigns after observing the high impact with voters and striking success with raising huge funds compared to the very moderate investments in the technology. But many of the aspects of this phenomenon, recently discussed in an interview with Dean's campaign manager Joe Trippi are by no means new [10].

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Almost 20 years ago, Theodore Roszak already discussed very similar things about the then upcoming bulletin board systems [13, p. 167-172]. Many years before the web, these systems allowed distributed groups of people to discuss, develop and promote joint topics, including common political interests. While being utterly low-tech, these systems allowed — to a certain extent — for people to establish grassroots movements that might eventually aquire political influence through a broad base of participants. As Rozak pointed out these groups self-organized the way to communicate and organize things, and thus (potentially) developed their own e-culture. It is this networking possibility and the broad creative participation of people that made the new electronic medium interesting to Roszak, while he also pointed at many of the limitations and drawbacks of this mode of communication.

The lesson to be learned from this success is that there are two rather different perspectives for looking at the use of information technology in the political domain. On the one hand, e-government solutions can help governments do their job. This means providing information and services to their citizens such as websites for filing your tax declarations or browsing for new employment possibilities. On the other hand, information technology can also be used to strengthen political discourse, support social cohesion within and across communities, and most importantly promote the citizens' initiative and creativity to take political and societal effect from the bottom up[1].

In order to provide good e-government solutions, many specific technological, organisational and legal problems need to be solved, such as interoperability and integration between different services, reliable handling of electronic identities and personal information (e.g. electronic patient records), and adjusting administrative processes to take the best benefit of the new technological possibilities. But as clearly visible from the above example, low-tech solutions can have tremendous effect if they properly match users' needs. While there are difficult and important technological problems to be solved for future e-government solutions, thoroughly understanding the user community of e-citizens and supporting their active and creative participation in society through appropriately designed systems constitutes the real challenge.

This article provides some indications on how to meet this challenge by discussing the user-centered design approaches of Participatory Design (PD) and End-User Development (EUD), as well as the integrated Organization and Technology Development (OTD) approach. For all of these approaches, elucidation of user requirements by active empirical research is an important part. While not solving any specific technological problems, such user-centered design approaches are now widely believed to be essential for creating useful and usable IT systems. At Fraunhofer FIT these approaches have a long-standing tradition and they have been and are being applied in various projects, including e-government and e-democracy ones [14].

[1] The potential of this can very clearly be observed in the current use of the Internet by oppositional forces in China and the governments recurrent actions against it.

On the level of research and technological development (RTD), the goals and topics defined by the *Lisbon strategy* have been taken up as guiding principles. For both designing and deploying IT systems for inclusion and cohesion, the diverse and heterogeneous requirements of the e-citizens and the highly dynamic changes of these requirements constitute serious methodological challenges for traditional development procedures. For this reason, a strong user-centered design approach has now become a recurrent requirement for the European Commission's Information Society Technology (IST) research programm.

## 2 Participatory Design (PD)

Many years of designing IT systems show that numerous factors relating to the users and to the social and organisational settings of use cannot be formalized or made explicit (e.g. tacit knowledge, working practices). Users generally cannot fully anticipate the potential uses of new technologies, while developers do not fully understand the specific contextual characteristics of a given application domain. Additionally, introducing IT systems into groups or organisations is likely to change over time the way in which people carry out their activities. This might be brought about by the users' more thorough experience with using the system and their strengthened trust in the system's reliability and it may result in evolving requierements. Because of these "soft factors", even when putting the users at the centre of the development process a comprehensive analysis of user requirements prior to design is not feasible.

While formal analysis of requirements has to remain incomplete, Mambrey and others point out that users and designers can nonetheless communicate about the situation of use and can arrive at a joint understanding about the current appropriateness of the system and potential next steps for improvement. Consequently, users and designers can cooperatively shape the design process but they "need a mutual undestanding of the socio-cultural process they conduct within the organisation." [7, p. 389]. This cooperative development process allows to identify the actual characteristics of the concerned activities and it allows to combine the social and technological perspectives of the different actors. This active involvement of users is at the heart of the Participatory Design approach.

In order to capture the changing requirements that can arise during use and also to help in a productive take-up of a novel system, Participatory Design does extend this active user involvement beyond the initial design phase into the deployment phase of the system. Users are then supposed to try things out in order to get experience, reflect on their system usage and express their interests and intentions [7]. By way of this continuous involvement users are supposed to explore the "space of opportunities" that a novel system offers, cooperatively find appropriate ways of using it, and they should make suggestions on how to improve the system through a number of incremental redesign cycles. This extension to the design process has been called (cyclic) cooperative evolutionary system design [14, 6] and it does not only help in designing systems that meet

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the users' requirements but also to ensure that the transition of individual work practices and of the organisational environment are reasonably smooth.

The Participatory Design approach has successfully been applied and refined in various RTD projects within Fraunhofer FIT, notably in the POLITeam project that aimed at providing community and collaboration support for administration processes between the distributed German Ministries in the former German capital Bonn and the new capital Berlin [14].

Without getting into details, the concrete techniques applied during the POLITeam project include "questionnaires, action research, ethnography, simulation and prototyping" [7, p. 391]. Additionally, the techniques of *user advocacy* and *osmosis* have also been applied to "explore the users' needs during actual system use." [6]. *User advocacy* is about having dedicated people that are not involved with development establish a continuous relationship with the users to observe and learn about their requirements, usage problems etc. and letting them communicate and defend the users' position against the developers. *Osmosis* is about having members of the development team closely experience the actual working reality of the users to aquire a far richer experience than could be transmitted through questionnaires or even unstructured interviews.

The benefit of the Participatory Design approach is described by Mambrey as helping to bridge three important gaps in the design process: the user-designer knowledge gap, refering to the respective ignorance about the technological possibilities and the characteristics of the working context, the user-designer perspective gap, refering to the perspective difference between using and designing a system, and the routine-innovation gap, refering to the users' need of finding new and innovative ways for using the new technologies to the benefit of their specific application domain.

The lesson learned from applying Participatory Design is that taking the domain-specific soft factors into account when designing and deploying IT systems is crucial to their success. For this design approach to work users must be willing to actively participate and thus a "culture of participation" is highly desirable.

## 3 End-User Development (EUD): going beyond PD

Participatory Design is about constantly involving the end-users in the development process and it is also about extending the design-phase into the use-phase. Nonetheless, the users' role essentially remains unaltered: they use the system and provide feedback to professional developers that try to turn this feedback into appropriate system modifications.

Enhancing user-participation in the design process of IT-systems is part of the solution for achieving a good match between the systems' properties and the users' requirements. But given that user requirements are diversified, changing, and may even be hard to identify precisely at a specific point in time, going through conventional development cycles with software-professionals to keep up with evolving requirements would be too slow, time-consuming and expensive. So

the required flexibility really means that the users themselves must continuously be able to adapt the systems to their needs while using them. While end-users are generally neither skilled nor interested in adapting the systems they are using at the same level as software professionals, it is very desirable to empower users to adapt systems at a level of complexity that is appropriate to their individual skills and situation. This is presumably the main goal of end-user development: empowering end-users to adapt IT-systems themselves, thus letting them become the initiators of a fast, cheap and tight co-evolution with the systems they are using [8].

Systems that provide such a gradual increase in adaptation complexity with respect to the difficulty of the modification to be performed are said to follow a gentle slope of complexity. On the technical level of software systems, such a gentle slope can be achieved by a number of different approaches. To understand how this can work in principal, let us take a look at one such approach: component-based tailorability [9]. Here, an application is decomposed into a hierarchy of components that are meaningful in the domain of the end-users and the end-users can then modify the application by modifying the component structure during usage. For this to be possible the application must be executed in a special run-time environment that allows for the components to be rearranged during execution. While this may not sound very easy, domain specific decomposition and appropriate (visual) interfaces can make these modifications indeed very easy for the top-level components. When the users need more powerful adaptations they can then also rearrange the internal components of the top-level components, and so forth. Properly designed, the component hierarchy offers convenient steps of increasing adaptation power with only a proportional increase in adaptation complexity.

The concept of end-user development has recently been discussed and refined within the European research project EUD-Net[5] and it is believed to be a key element to empower people to "become active citizens of the Information Society" [4]. This is because it let's end-users use their superior domain knowledge and their creativity to adapt the systems they are using to the specific situations of use. This way, EUD complements user-centered design approaches such as Participatory Design to cope with the specificity of usage situations and the diversity and dynamics of user requirements.

Adaptability provided by EUD techniques is one way to achieve a closer match between an IT-system's functionality and the users' requirements when modifications by software-professionals are not an option. It must be noted though that adaptation indeed requires users to interrupt normal usage, resulting in a deviation from their primary task. Hence, manual adaptability should be complemented with automatic adaptivity where the system adapts itself to its users' task and situation by evaluating e. g. contextual properties and its usage history.

[5] See http://giove.cnuce.cnr.it/eud-net.htm.

Combining Participatory Design and a *shared initiative* approach between adaptability and adaptivity [3] can achieve a close and benefitial co-evolution of both users and systems.

## 4 Integrated Organisation and Technology Development (OTD)

PD and EUD have been discussed in the preceeding sections as approaches to design IT systems. As has been stated earlier such IT systems are set in a specific social and organisational context. Organisations use IT systems to carry out their processes, and frequently the one cannot be separated from the other. The organisations' processes are inscribed into the IT systems and the systems properties have determined to some extent how the organisational processes have been set up. As a consequence, changes in the organisation's processes are likely to require corresponding changes in the IT systems and modifications to the IT systems, such as enabled by technological innovations, are likely to require changes in the organisation. This "reciprocity and interdependence" between organisations and the technologies they use has been taken up in [15] to require an integrated development approach for both aspects, the "integrated organisation and technology development" (OTD).

This approach starts from the premises that organisational development in the face of constantly changing environmental conditions, such as market requirements for companies, also requires constant adaptations of the IT systems used within the organisation. A key assumption is that fast and thorough adaptations to changing external conditions cannot be implemented on managerial order, but must and should be carried out in a self-organized fashion by the people directly involved with the respective working practices. Unsurprisingly, OTD thus embraces both Participatory Design and End-User Development[6] and integrates them into a consistent approach that suggests decentralized tailoring by end-users as long as the required changes do not require professional redesign, and that suggests Participatory Design techniques if professional redesign is indeed necessary.

In the light of the OTD approach, EUD can be seen as an enabler for self-organized decentral adaptations. For the domain of political participation, as for example in the self-organized voter communities mentioned in the introduction or in local self-administration, this means that communities can be empowered through EUD to adapt the systems they are using to reflect their specific cultural and situational requirements and also to evolve with the communities changing requirements.

[6] The term EUD was not in existence at the time of writing of [15]. Instead the term tailorability was used.

## 5 An OTD example: supporting the community building process of Iranian NGOs

In a project carried out during 2002 and 2003 by the International Institute for Socio-Informatics (IISI) and funded by the German political foundation Friedrich-Ebert-Stiftung a web-based community system[7] was introduced to support the networking efforts between the hundreds of Non-Governmental Organizations (NGOs) currently developing in the Iranian civil society [11, 12]. Following the approach of integrated Organisation and Technology Development (OTD) the deployment and adaptation process of the system was carried out in a participatory fashion and this process was accompanied by supportive measures to set up socio-organisational structures within the Iranian community of NGOs to make the best use of the community system.

The network of NGOs covers many aspects of civil life in Iran. There are women NGO networks, environment NGO networks, youth and health organisations, to name but a few. These networks are organised both from the bigger cities, including the capital Teheran, and rural areas with the respective differences in technical infrastructure and skills (e. g. computer use, language). Because the project was planned to last no longer than about a year it was essential to achieve a sustainable deployment of the technology such that local NGO representatives could use and adapt it autonomously and where able to support the NGO community building process with it.

To this end the first step was to choose a number of local NGO community facilitators with sufficient computer and language skills (i. e. english) and carry out a "train the trainer" programm. Following this a number of socio-organisational structures were set up to enable and foster community processes within the NGO network such as expertise sharing, community learning, building of virtual communities of practice, and process evaluation. The main mechanism to establish these structures was carrying out workshops with NGO representatives. As stated during these workshops a major challenge was indeed the "lack of experiences with a 'culture of cooperation' in Iran." [11].

Following the OTD spirit of self-organisation, training activities were not set up in a top-down but self-organized fashion. Also, development workshops were carried out to learn how to tailor the community system to the needs of the NGO networks. As explained in the preceeding section this tailoring competence is essential to respond to the specific requirements of individual communities and also to the dynamic changes of these requirements over time. Finally, a "code of ethics" was developed with the NGO facilitators to provide some level of guidance for social conduct when using the community system.

[7] The community system used was the BSCW (Basic Support for Cooperative Work) system developed at Fraunhofer FIT which is available free of charge for non-profit purposes.

## 6 Conclusion

This article has shown that information technology can empower e-citizens to shape and control the processes that are supported with this technology. This is the case for communication and cooperation in self-organised IT-based communities which can have an important democratic function in civil societies, and it is also the case for services that governmental organisations provide to their citizens through IT systems.

Empowering e-citizens to shape the technologies they are using has the important benefits of respecting and activating the cultural and regional differences within the societies, and having the e-citizens constructively appropriate and creatively evolve the technologies. This way, the diversity and dynamics of modern societies can be reflected from the grassroots up to an extent that would be completely impossible in a top-down approach [5]. On a plainly pragmatic level this can mean that standard e-government services would simply receive broader acceptance within the population and could be used with less difficulty. Obviously, inclusion and active participation are benefits for democratic societies that go well beyond this.

These potential benefits are not intrinsic to information technology. In fact, IT can be and often still is designed in a thoroughly non-participatory fashion, resulting in exclusion rather than inclusion and introducing limitations rather than fostering empowerment. This article has dicussed the user-centered design approaches of Participatory Design, End-User Development and the integrated Organisation and Technology Development approach as ways to develop empowering IT systems. These approaches have been illustrated by the example of introducing an IT-based community system to support the Iranian NGO networks.

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# 1 Some issues on voting systems

The first proposal is a new election system called *dynamic constituency.* One of the problems in an election system is the configuration of electoral districts. The combination of districts with voting systems (majority vs. proportional) generates problems, in the sense that representation fairness is not assured. Let us firs discuss majority and proportional systems used over a district configuration.

Majority voting selects the most voted candidate per district, and the rest of the votes are, in some sense, lost. The advantage of majority voting is that it establishes a direct relation between the constituents (all electors in the district) and the elected representative. Indeed, the elected person (theoretically) represents all persons in the district, and is easier (than in proportional systems) for the citizens to direct questions, recommendations, objections, and recriminations to the elected representative. France and U.S. use majority voting for the Assembly and the Chamber of Representatives. The U.S. law intends to improve accountability of the representatives by having an election every two years; this legal provision designs a mechanism that intends to convey in a fast fashion changes in the public opinion to the representative body.

Summarizing, the main problem of majority voting is that the preferences of the public (expressed as votes) can be very different (proportionally speaking) to the preferences of the elected body. Defenders of majority voting argue that this shortcoming is compensated by its advantages: geographical representation, a more stable government supported by clear majorities, and the direct link between representative and constituents. However, a more stable government depends also on the party configuration, so majority voting does not assure this property (and proportional systems can also be argued as a good tool for government stability). Finally, the configuration of districts is critical and there is no insurance that by means social engineering an government customizes to its party needs a district configuration. The majority voting system can be improved using more fair voting systems, like approval voting, but only inside a district: the overall effect will continue to show a gap between the landscape of citizen preferences and group distribution in the elected body.

Proportional voting is a multi-winner election systems which try to ensure that the proportional support gained by different groups is accurately reflected in the election result. Some countries, like Israel, are close to a pure proportional voting systems, while other countries that use "corrected" proportional systems where majority groups receive an excess representation weight while minority groups are abated. Districts are larger and allow multiple winners while majority voting has small districts and single winner. However, geographical distribution of power, implemented as districts with large or small population may be unfair: an elected representative needs a larger number of votes than one in a low population district. Therefore, the configuration of districts has also undesirable effects in proportional systems — e.g both Spain and Israel use the

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d'Hondt method[1] for allocating seats but the district configuration in Spain has the effect of biasing proportionality in favor of large parties while Israel achieves a quite unbiased proportionality by having a single, global district. A way to compensate this effect is using mixed systems —like the *double vote* system under discussion for the future Catalonia's Electoral Law (inspired by the Germany law) where each citizen has two votes: one for a single-winner majority vote district election and another for a party-list proportional vote. Another problem with proportional voting (together with party lists) is that the direct link between the constituents and the elected person is blurred or altogether lost. In fact, the notion of constituency is difficult or impossible to effectively maintain in the proportional systems. Again, to improve the system, some countries implement mixed systems where some representatives are elected proportionally using party lists and other representatives are elected by majority vote.

Both majority and proportional voting systems can be improved using more fair voting systems, like approval voting, or designing mixed systems. However, I'd argue that all the negative effects (and the compensating mechanisms that can be introduced) are caused by the existence of electoral districts, and that they can be abolished while maintaining the notion of constituency and a direct link between citizens and the person they have elected. Moreover, geographical representation is faithfully reflected, in the sense that the preferences of the citizens depending on the interests and problems present in specific places and not others are proportionally represented. Finally, the property of having stable governments also depends, as already discussed, more on the configuration of parties than on the election system.

## 2 Dynamic constituency

The existence of digital infrastructures for e-voting in the near future allows us to rethink the possible methods for voting that avoid some of the undesirable properties of our current methods. In particular, we have argued that the establishment of districts and the particular configuration of districts leads to some undesirable properties. We can think of a method that abolishes districts while maintaining the notion of constituency and is proportional systems while maintaining the direct link between citizen and representative as in the majority system: dynamic constituency.

While district-based majority voting defines the constituency of a representative as all the residents of an electoral district, and proportional systems blur this notion, dynamic constituency considers that the citizens that voted a representative form its constituency. The digital infrastructure supports the ballot computing that previously was made at hand on electoral districts, so now is possible to have just one district for the whole territory. Moreover, the digital

[1] An alternative method is the Sainte-Lagu method of the highest average that is less biased in favor of large parties. New Zealand, Norway, Sweden, Bosnia and Herzegovina, Latvia and Bremen use the Sainte-Lagu method while Israel, Austria, Poland and Spain use the d'Hondt method.

infrastructure may be able to keep an anonymous relation between elector and representative that can support interchange of information between the (distributed) constituents and their representative.

Moreover, dynamic constituency simplifies the election system constrained by the need to allocate seats to districts. In dynamic constituency, any citizen can simply vote for the representative of its choosing, and if this candidates gets enough votes he will be elected. Moreover, the digital infrastructure can give the citizen an identification key that maintains his anonymity but allows her later to log in, identify herself, and direct question, comments, complaints, etc. to her representative in a seamless way. Thus, the representative can have an even more direct and transparent link to her constituency, and the citizens can feel more close the candidate they really voted instead of the winner of their district that they did not vote.

The voting system is also simplified: the most voted candidates are elected. Let us consider an example for illustrating this proposal: Catalonia has a Parliament with 135 seats elected by (around) 5,300,000 electors. This means that a MP is elected with 39,260 votes — and since usually only 70% of electors do vote, with 3,710,000 votes a MP needs about 27,600 votes to be elected. Once a candidate has 27,600 votes is virtually elected.

Another interesting feature that can be implemented is that of approval voting. In approval voting the citizen can vote to more than one candidate: she votes all candidates that she approves of. Since the digital infrastructure supports real-time computing of ballots it would be possible for the citizen to see the different candidates ballot at every moment. This goes against our current practice but this is just because it was not feasible before. We can argue that transparent real-time balloting may indeed attract to citizens who often abstain to try to help her preferred candidates[2].

Real-time balloting in dynamic constituency allows a citizen that approves of several candidates to vote for one of them, disregarding those others that already have enough votes to be elected. For instance, in the Catalonia parlament example, if a citizen than approves candidates A and B canvote for B once she sees that A already as 28,000 votes. However, if she really wants to be a part of A's constituency she can also vote A (although this implies that she really prefers A, for whatever reasons, to B). Although this is not approval voting it achieves the effects for which approval voting was designed: selecting a candidate in a manner that insures the minority preferences are taken into account.

Notice also that geographical representativeness is also preserved, as far as citizens prefer to vote for local candidates and the political organizations choose to locally promote specific candidates. However, minority groups may choose to globally promote a few specific candidates. For instance, considering the King-

[2] Some countries have single-day elections, some have a couple of days to cast a vote. Notice that the digital infrastructure also changes that: since balloting is automated elections can be held during several days or a week where real-time feedback show the tendencies of eager voters and attract lazy voters with the expectation of their capability to modify them

dom of Spain as a multinational state, some people would think that minority nationals such as Basques, Catalans, and Galicians would be against using dynamic constituency for electing the Spanish parliament. This is not so, since as long as Catalan electors, for instance, vote for Catalan candidates they would be elected. Nonetheless, the dynamic constituency approach with real-time ballot feedback can be adapted to a federal territorial organization. For instance, the U.S.A. can first allocate a number of seats to each state for the Chamber of Representatives and then use the dynamic constituency approach within each state candidate election; the states members of the European Union may also favor this federal distribution of seats. Although the seat distribution among states introduces a bias the dynamic constituency approach still eliminates electoral districts and helps a better representation of minority vote.

A more radical simplification can be achieved if we eliminate the idea of having a fixed number of seats in a parliament once districts are abolished. If we think about the idea of a fixed number of seats we see that it is strongly linked to the existence and number of districts. In fact, some of the perverse effects detected by the proponents of different election and voting systems comes from the fact that there is a number $n$ of seats to be allocated. Once we abolish districts and apply dynamic constituency we can just declare that any candidate with $m$ votes will have a seat. For instance, Catalonia Election law could establish that every candidate with 30,000 votes wins a seat as MP. The number of seats may vary on a certain range depending on the number of electors that abstain to vote. There is a few practical problems to adapt a Parliament infrastructure to this small variability, but the advantages of proportionality and transparency make up for these drawbacks. The transparency of European Union MP elections (that has 626 MP for 379,790,700 citizens, soon 454,018,500 citizens) could be improved with this kind of method (e.g. one MP seat for every 500,000 electors); this would allow some groups to vote for local concerns and others to organize global (albeit minority) concerns in a proportional and transparent way.

## 3 Accountability for representatives

Once the digital infrastructure supports a direct and anonymous link between constituents and representative, this technological platform can be used for several purposes: to improve information flow between constituents and representative, Internet-based forums and discussion of the representative actions and the constituents opinions, etc.

In addition to supporting information tasks, the digital infrastructure can support different accountability mechanisms that can legally defined but that are feasible only because the existence of this digital infrastructure. In particular, it is possible to implement an impeachment mechanism by which a constituent may revoke her vote for an elected representative. Specific laws may define the number of revoked votes that imply a removal from office of the representative, as well as some grace period (e.g. a representative can not be removed during the first six months of her term). The technology that supports an anonymous

direct link between constituents and representative when the citizens vote is the one that insures the viability of the citizen impeachment of representative. An improved information flow together with the impeachment mechanism achieves a good accountability relationship between representative and constituents.

The purpose of an impeachment mechanism is the same as that of the U.S. Chamber of Representatives election every two years: assure a faster feedback of the constituents evaluation of the representative actions. Clearly, impeachment is cheaper in time, effort and funding than halving the election term from 4 years to 2. In addition, impeachment in dynamic constituencies allows the citizen that revokes a vote to a representative to one of the candidates that did not reach the vote threshold to become a MP. This allows a fast change in the Parliament when there is a sweep in public opinion, both by representatives changing their actions or being removed from office. Let's consider the two scenarios we explained before: dynamic constituency with and without a fixed number of parliament seats. When this number is fixed, at the moment an impeached representative is removed from office the non-elected candidate with the higher number of votes becomes an MP. When the number of parliamentary seats is not fixed the non-elected candidate that collects dissatisfied votes becomes an MP when these votes achieve the legal threshold.

## 4 Discussion

Digital technology can be used for supporting our current methods for elections, voting, and representation; but this technological effort only has an effect on improving certain efficiency parameters, e.g. faster computation, less error-prone techniques. Certainly this is quite important, e.g. since the technological infrastructure facilitates the realization of referendums, this can increase the use of referendums and thus change the political process. Moreover, we have not discussed the technical issues to be solved to have a digital infrastructure as the one envisioned here, nor the legal and public awareness issues that should be addressed and resolved.

The claim of this paper is once a technological infrastructure for e-government in general, and e-voting in particular, is in place we can easily exploit that platform to change and improve the methods and systems used in democartic political systems. This infrastructure envisions not only quantitative changes but more importantly qualitative changes in the form of the political process. We have shown several concepts that can be employed for democratic representation: dynamic constituencies, real-time vote feedback, and citizenship impeachment. This new concepts imply rethinking established concepts —like districts, opaque vote counting, and fixed number of seats. But once the technological infrastructure is feasible, public discussion of democratic representation and accountability will enter a wider realm of possibilities and hopefully improve the quality of democracy.

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# Appendices

## A Definitions

Most definitions are taken from the Wikipedia (http://en.wikipedia.org).

**Civics** is the science of comparative government and means of administering public trusts - the theory of governance as applied to state institutions. It is usually considered a branch of applied ethics and is certainly part of politics.

**E-government** is generally agreed to derive from 'electronic government' which introduces the notion and practicalities of 'electronic technology' into the various dimensions and ramifications of government, specially the delivery of public services, where there is an 'online' or Internet based aspect to the delivery of the services, the conduct of government business where the activities of those involved in the process of government itself (such as legislators and the legislative process) where some electronic or online aspect is under consideration, and voting where some online aspect is under consideration.

**Electoral system** An electoral system is the use of particular voting systems to place some group of people in charge of administration of a legal system under pre-existing legal codes

**Voting system** Voting systems are methods (algorithms) for groups of people to select one or more options from many, taking into account the individual preferences of the group members

## B Hyperlinks

- Approval voting: http://en.wikipedia.org/wiki/Approval_voting
- Borda count: http://en.wikipedia.org/wiki/Borda_count
- Condorcet method: http://en.wikipedia.org/wiki/Condorcet_method
- Deliberative democracy: http://en.wikipedia.org/wiki/Deliberative_democracy
- Direct democracy: http://en.wikipedia.org/wiki/Direct_democracy
- Participatory democracy: http://en.wikipedia.org/wiki/Participatory_democracy
- Ramon Llull: http://en.wikipedia.org/wiki/Ramon_Llull_system
- Sainte-Lagu method: http://en.wikipedia.org/wiki/Highest_averages_method
- Voting systems http://en.wikipedia.org/wiki/Voting

# C Criteria in evaluating voting systems

Various criteria can be used in evaluating voting systems. However, it is impossible for one voting system to pass all criteria in common use. Arrow's impossibility theorem (http://en.wikipedia.org/wiki/Arrow%27s_impossibility theorem) demonstrates that the following criteria are mutually contradictory:

- The voting system should always give a result
- If a voter improves the ranking of a particular option, that option should not be disadvantaged (monotonicity criterion)
- Removing a candidate should not change the winner of an election unless that candidate is the winner (independence of irrelevant alternatives)
- Every possible outcome should be achievable
- Non-dictatorship (i.e. more than one person's vote matters)

However, not all hope is lost. Weakening one of Arrow's conditions the Condorcet method meets all the criteria. The Condorcet winner of an election is the candidate who, when compared in turn with each of the other candidates, is preferred over the other candidate. A Condorcet winner will not always exist, however. Any voting system which chooses the Condorcet winner when it exists is known as a Condorcet method, after its deviser, the 18th century mathematician and philosopher Marquis de Condorcet, although it appears that the method was already thought up by Ramon Llull in the 13th century (see http://www-gap.dcs.st-and.ac.uk/~history/HistTopics/Voting.html).

Since the most complicated part of the Condorcet method consists of resolving cyclic ambiguities when the Smith[3] set contains multiple candidates the use of Information Technology in election systems infrastructure eliminates the practical problems of Condorcet methods.

# D Approval voting

Approval voting is a voting system used for single-winner elections, in which each voter can vote for as many or as few candidates as the voter chooses. Approval voting is a limited form of range voting, where the range that voters are allowed to express is extremely constrained: accept or not.

Approval voting passes a form of the monotonicity criterion, in that voting for a candidate never lowers their chance of winning. Indeed, there is never a reason for a voter to tactically vote for a Candidate X without voting for all candidates she prefers to Candidate X. A good strategy is to vote for every candidate the voter prefers to the leading candidate, and to also vote for the leading candidate if she is preferred to the current second-place candidate. When all voters follow this strategy, the Condorcet winner is almost certain to win.

A study by Approval advocates Steven Brams and Dudley R. Herschbach published in Science in 2000 argued that approval voting was "fairer" than preference voting on a number of criteria. They claimed that a close analysis shows that the hesitation to

[3] The Smith set is the smallest set of candidates such that each candidate in the set beats (in the pairwise sense) each candidate not in the set. The Smith set is a reasonable and slightly less stringent definition of an "irrelevant" candidate of Arrow's framework.

support a 'compromise candidate' to the same degree as one supports one's first choice (as approval voting requires) actually outweighs the extra votes that such second choices get. Accordingly, preference voting is more biased towards compromise candidates than approval voting - a non-obvious and surprising result. Citizens for Approval Voting was organized in December 2002 to promote the use of approval voting in all public single-winner elections.

Citizens for Approval Voting (http://www.ApprovalVoting.org) was organized in December 2002 to promote the use of approval voting in all public single-winner elections.

## D.1 Proportional approval voting

Proportional approval voting (PAV) is a theoretical voting system for multiple-winner elections, in which each voter can vote for as many or as few candidates as the voter chooses. It was developed by Forest Simmons in 2001.

Each potential result of the election will satisfy some voters more than others. The satisfaction for individual voters of a potential result depends on how many of the successful candidates they voted for. In this particular system, if an individual voted for n successful candidates (and an irrelevant number of unsuccessful ones) then their satisfaction is taken to be (1 + 1/2 + 1/3 + ... + 1/n). Adding up the satisfaction of all the voters with the potential result gives the total satisfaction with that result. The potential result with the highest satisfaction is the decision.

If there was only one winner then proportional approval voting would become simple approval voting. Alternatively, if each voter only voted for all the candidates of a single party then the results would essentially be the same as the D'Hondt method of party-list proportional representation.

Proportional approval voting is a computationally complex method of vote counting. If there were c candidates and w winners, then there would be c!/(w! * (c-w)!) potential results to compare with each vote. If there were 20 candidates for 5 seats then there would be more than 15,000 potential results. Such elections could only reasonably be counted by computer.

# A Modal Logic for Reasoning under the Good Faith Principle

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**Abstract.** This paper describes issues encountered when trying to formalize the conception of *bona fide* as a legal interpretation method. We propose an objective trust delegation mechanism for reasoning about good faith in a multi agent environment which allows different accounts of agency.

**Keywords.** Legal reasoning, objective trust delegation mechanism, modal logics, agency.

## 1 Introduction

An act carried out in good faith is an act carried out honestly. From a juridical point of view notions such as good faith, complete trust or confidence are assumed to be fundamental legal principles. Good faith is not *a* norm, it is an *interpretation method* i.e. a criteria for rule application [1]. It may acquire several other abstract shapes e.g. *duty of loyalty, duty of cooperation, duty to inform.* It also limits another legal principles as the *freedom of contract principle* (see [2] for a legal analysis.) When the legislation needs to precise it in an indubitable and strict way, good faith explicitly raises under different manners in many norms. For example, it is usually concretely alluded in juridical institutions such as possession of profits, putative marriage, putative payment, *et cetera.* In these institutions good faith is present in the internal state of an agent, who presupposes that a given situation is real and it conforms the law. Good faith is also of crucial importance for the conduct of international relations in general and therefore recognized as an international principle according to the terms of the Vienna Convention.

In the automated legal reasoning area, different notions of trust have been defined. Linington et al. [3] conjectured the importance of the application of trust metrics to e.g. contracts and Shand and Bacon [4] also do, adopting a second order model of trustworthiness based on an extension of the Dempster-Shafer theory of evidence.

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Castelfranchi and Falcone [5] define a *degree of trust* as a combination of belief types agents might hold with regard to other agents. These three accounts to trust are subjective. Witkoswki et al. [6] propose an objective approach where agents select who they will trade with on the basis of a trust measure built on past experiences (although in our understanding the approach is *quasi-objective* as there is no authority or third party involved in the trust measurement i.e. there is no *pooling of trust.*) Throughout the paper we use the (legal) expression *good faith* and employ the term *trust* in its broadest sense i.e. as a synonym of *good faith.* Our "working definition" of good faith is thus given by the logics we construct.

We develop a theory for reasoning about presence of good faith in actions from an objective point of view, based on the idea that good faith in its wide-ranging sense is a *modality of behavior* which *modalises* any account of agency and involves a degree of interpretation. Our approach is mainly *juridical* although core guidelines are applicable to a context of a multi agent society (MAS).

We characterize in section two a modal logic simple enough for reasoning about good faith in acts. In section three we use as a basis the logic in section two to outline a more structured objective trust delegation mechanism in a multi agent logical framework [7]. Section four gives mathematical content to the principles given in section three. Section five outlines further considerations regarding good faith, collective actions and institutionalized power. Concluding remarks and lines of research are pointed out in section six.

## 2 Good Faith as a Modality

In this section we give a formal objective definition of the good faith principle keeping things as general as possible. We assume as a basis the basic modal language consisting in atomic propositional sentences A, B,... and complex expressions classically formed from these by means of $\sim$, $\wedge$, $\vee$, $\rightarrow$, $\leftrightarrow$. Actions are modeled barely, e.g. without paying attention to time or to who the agent is. We understand good faith as a modality of action, so we define an operator called $G$ which focuses exclusively on the state of affairs around the good faith exhibited in sentences. Being A an *act description* we read the expression $GA$ as 'A is carried out in (presence of) good faith' or 'A is behaved in good faith'. The logic of this $G$-modality can be described as an extension of propositional calculus (PC) with the following rule and axiom schemas:

$$(GR)\ \mathrm{A} \,/\, G\mathrm{A} \tag{1}$$

$$(GK)\ G(\mathrm{A} \rightarrow \mathrm{B}) \rightarrow (G\mathrm{A} \rightarrow G\mathrm{B}) \tag{2}$$

$$(G4)\ GG\mathrm{A} \rightarrow G\mathrm{A}\ . \tag{3}$$

The logics of $G$ is classical, i.e. closed under logical equivalence:

$$\frac{\mathrm{A} \leftrightarrow \mathrm{B}}{G\mathrm{A} \leftrightarrow G\mathrm{B}}\ . \tag{4}$$

This *G-system* is a normal modal logics [8]. Rule $GR$ (1) modalises provable sentences by stacking $G$s in front. It formalizes good faith as an interpretation rule: good

faith is presumed by the system i.e. if A is a theorem then $GA$ is a theorem. This means there is a central trust authority who makes the presumption e.g. the juridical ordering. $GK$ (2) states the logical implication closure that holds for any modal operator. It traduces a $G$-modalised formula in an implication, allowing classical reasoning inside the modal context. $G4$ (3) declares a kind of idempotence property of $G$. We avoid using any dual operator and read $\neg GA$ as ´ absence of good faith in A´ .

This is probably the most simple approach to an objective logic for good faith. Even more, it is solely in virtue of $GR$ that we could claim that this system in a wide-ranging way models the good faith principle. Stated in this straightforward manner the semantics of the $G$-system collapses to a usual Kripke model semantics for modal operators [8]. Its soundness and completeness results fall into the S4 (KT4) class of reflexive transitive frames.

## 3 Good Faith, Obligations and Agency

From a juridical point of view, the notion of good faith as an interpretation method is clearly related to the notion of *obligation*. We are therefore mostly interested in connections among good faith, obligations and agency.

As far as it is presented, a $G$-system serves for reasoning solely about the presence or absence of good faith in acts. What follows is a richer characterization which falls into the class of logical frameworks for modeling norm governed systems and multi agent environments. We attempt to model an objective trust delegation mechanism *wrt* the logic of action described by Jones and Sergot (JS) in [7], called $\Phi$. $\Phi$ is wide enough for us to show how to reason under the good faith principle in a complex environment. It has five modalities which we put together with $G$: we extend $\Phi$ with the core schemas (1)-(3) and provide bridging principles among $G$ and $\Phi$-operators. We on purpose put away the *counts as* operator ($\Rightarrow_i$) for institutionalized power and skip our comments on it until section 5.

### 3.1 Agency

Expressions of the type $E_i$A are read in $\Phi$ ´ agent i brings it about that A´ $E_i$ is a well-known basic operator for agency (see [9] for background.) Sentences like $C_i$A mean ´*i* has the ability to produce A´ . Sentences of the form $H_i$A mean ´*i* attempts to see to it that A´ . The three modalities are closed under logical equivalence.

Agents have to act (e.g. do, bring about, have the ability to, *et cetera*) for their actions being $G$-modalised. $GE_i$A, $GC_i$A, $GH_i$A intuitively mean *i* behaves in good faith. We have then the success conditions:

$$\text{i) } G(E_i\text{A}) \rightarrow E_i\text{A}, \quad \text{ii) } G(\text{C}_i\text{A}) \rightarrow C_i\text{A}, \quad \text{iii) } G(H_i\text{A}) \rightarrow H_i\text{A} \ . \tag{5}$$

### 3.2 Belief

Expressions of the form $B_i A$ are read agent $i$ believes that A . For the interpretation of juridical institutions regarding putative (supposed) constituent features (e.g. *putative father*, *putative marriage*) good faith is present in the internal state of an agent, who presupposes that a given situation is real and it conforms the law. For this kind of analysis the following introspection schemas are useful:

$$\text{i) } G(E_i A) \rightarrow B_i A \quad \text{ii) } G(C_i A) \rightarrow B_i A \quad \text{iii) } G(H_i A) \rightarrow B_i A \tag{6}$$

which represent the expected juridical conjecture on the correspondence between agent s behavior and agent s beliefs: if he or she behaves in good faith is because he or she believes in A ((6)-like schemas for further agency operators are written the same way.) Notice that no modern juridical ordering can go *further inside* an agent than outlined in (6). Furthermore, we avoid converse schemas e.g. $B_i A \rightarrow G(E_i A)$ as they would represent a strong presupposition on the correspondence between agent s subjectivity and agent s behavior. It is natural to assume that in spite of its beliefs the agent is (relatively) *free* to choose to behave in an untrustworthy manner or to act honestly.

### 3.3 Directive and Evaluative Modalities

The operator $O$ is designated in $\Phi$ to specify obligations: what agents are obliged to do. $I_i$ is a modality specifying that for a given agent $i$, something is ideal.

Next schemas link I and O with $G$. They model the idea of law presupposing good faith in acts.

$$\begin{aligned} &\text{i) } I_i O A \wedge E_i A \rightarrow G(E_i A), \quad \text{ii) } I_i O A \wedge C_i A \rightarrow G(C_i A) \\ &\text{iii) } I_i O A \wedge H_i A \rightarrow G(H_i A) \ . \end{aligned} \tag{7}$$

i.e. if it is ideal for $i$ that A is obligatory and $i$ somehow does A, then such action conforms the good faith principle (e.g. $i$ acted in good faith.) In turn we derive:

$$\begin{aligned} &\text{i) } O A \wedge E_i A \rightarrow G(E_i A), \quad \text{ii) } O A \wedge C_i A \rightarrow G(C_i A) \\ &\text{iii) } O A \wedge H_i A \rightarrow G(H_i A) \ . \end{aligned} \tag{8}$$

which take as starting point directive sentences (we put the evaluative modality aside.) In a similar way we suggested for $B_i$, schema $I_i A \wedge E_i A \rightarrow G(E_i A)$ is a strong assumption on i s subjectivity, so we avoid it. Finally, the idea that good faith is presupposed by law is captured in the following bridging principle:

$$O A \rightarrow G A \tag{9}$$

which is a general form of (8).

We can appreciate one of the advantages of an authorized and centralized good faith reasoning mechanism is that lack of trust can be improved. Undoubtedly, due to the objective approach, there is a poor degree of scalability, although e.g. previously

unknown-to-each-other parties are free to enter into a precontractual bargaining process.

Schemas (7), (8) and (9) impact mainly on the formalization of e.g. (strictly speaking) legal systems because they provide a mean for interpreting agency and therefore for applying the law. Being general interpretation rules they appear to be too strong restrictions for systems governed by norms of various kinds where good faith is not objectively considered (e.g. it is modeled as complex internal states of agents.) Formal connections among objective and subjective trust mechanisms are to be investigated.

### 3.4 Necessity

In $\Phi$ the necessity operator (say $N$) has a usual S5 (KT5) semantics. We give:

$$NA \wedge OA \wedge E_iA \rightarrow G(E_iA) \qquad (10)$$

which is a variant of (8) (similarly for $C_i$ and $H_i$.). Schema $NA \wedge E_iA \rightarrow G(E_iA)$ is clearly avoided.

## 4 Semantics for $G$, given $\phi$

Next we give a mathematical content to axioms proposed in section two and three. Semantics for $\Phi$-operators are detailed in [7]. We bring in the necessary details for making the semantics of $G$ clear. We use as a basis JS´ s definitions (which in turn recall the ones in [9]):

· $M = (W, f_N, f_{Ci}, f_{Hi}, f_O, f_{Ii}, f_{Bi}, f_G, V)$ is a traditional model structure, with $W$ a set of possible worlds, $V$ a valuation function assigning to each sentence of $\Phi$ a set of possible worlds. The $f$ members of M are functions employed in the specifications of the truth conditions for modal sentences. Function $f_N$ is a unary function selecting for each world the set of propositions (i.e. a set of possible worlds) that are necessary relative to that world. Function $f_{Ci}$ is a binary function that picks up the worlds where agent $i$ realizes the ability he has in a world to bring about A. $f_{Hi}$ selects for each world the set of propositions corresponding to the state of affairs $i$ attempts to bring about at that world. Function $f_O$ gets for each world the set of propositions obligatory at that world. Function $f_{Ii}$ gets the set of propositions ideal for $i$ at a given world. $f_{Bi}$ picks up for each world the set of propositions believed by $i$ at that world.

We introduce slightly variations on the original JS´ s model structure M: we put away $f_{\Rightarrow_i}$ and add the unary function $f_G$ we define along the way.

· $\alpha$, $\beta$ are worlds, any members of $W$.

· $\|A\|^M$ is the truth set in M for A i.e. the set of worlds in M at which A is true, i.e. $\|A\|^M =_{df} \{\alpha: M,\alpha \models A\}$.

Function $f_G$ picks up for each world the set of propositions that can be carried out in good faith in that world, written:

$$f_G(\alpha) \ . \tag{11}$$

Truth of a sentence of the form $GA$ at a world $\alpha$ in a model M is specified as follows:

$$M, \alpha \models GA \text{ iff } \|A\|^M \in f_G(\alpha) \tag{12}$$

(12) is a definition of the presumption of good faith in acts: it means that in all worlds where A is true, it happens $GA$ is also true.

Let X and Y be any subset of $W$. For the function $f_G$ we adopt the followings constraints:

$$(cf_G) \text{ if } X \in f_G(\alpha) \text{ and } Y \in f_G(\alpha) \text{ then } X \cap Y \in f_G(\alpha) \ . \tag{13}$$

$$(tf_G) \text{ if } X \in f_G(\alpha) \text{ and } Y \in f_G(\alpha) \text{ then } \alpha \in X \ . \tag{14}$$

$$(4f_G) \text{ if } X \in f_G(\alpha) \text{ and } Y \in f_G(\alpha) \text{ then } \{\beta: \beta \in f_G(\beta)\} \in f_G(\alpha)\} \ . \tag{15}$$

From definition (12) and conditions $(cf_G)$, $(tf_G)$, $(4f_G)$, the validity of schemas (1)-(4) immediately follows.

The validity of the success condition (5i.) is secured by adopting the following constraint:

$$\text{if } \{\beta: \beta \in f_{Ci}(\beta, \|A\|^M)\} \in f_G(\alpha) \text{ then } \alpha \in f_{Ci}(\alpha, \|A\|^M) \tag{16}$$

given the constraint (for $E_iA$ expressions): $M, \alpha \models E_iA$ iff $\alpha \in f_{Ci}(\alpha, \|A\|^M)$ [7].

The validity of the success conditions (5ii.) and (5iii.) are secured by adopting the following constraints:

$$\text{if } \{\beta: f_{Ci}(\beta, \|A\|^M) \neq \varnothing \ \} \in f_G(\alpha) \text{ then } f_{Ci}(\alpha, \|A\|^M) \neq \varnothing \text{ and} \tag{17}$$

$$\text{if } \{\beta: \|A\|^M \in f_{Hi}(\beta)\} \in f_G(\alpha) \text{ then } \|A\|^M \in f_{Hi}(\alpha),$$

provided the truth conditions for $C_iA$ and $H_iA$ are [7]:

$M, \alpha \models C_iA$ iff $f_{Ci}(\alpha, \|A\|^M) \neq \varnothing$ and $M, \alpha \models H_iA$ iff $\|A\|^M \in f_{Hi}(\alpha)$.

The introspection schema (6i.) is validated by building the constraint:

$$\text{if } \{\beta: \beta \in f_{Ci}(\beta, \|A\|^M)\} \in f_G(\alpha) \text{ then } \|A\|^M \in f_{Bi}(\alpha) \ . \tag{18}$$

Schema (6ii.) is validated by adopting the constraint:

$$\text{if } \{\beta: f_{Ci}(\beta, \|A\|^M) \neq \varnothing\} \in f_G(\alpha) \text{ then } \|A\|^M \in f_{Bi}(\alpha) \ . \tag{19}$$

And (6iii.) is secured by:

$$\text{if } \{\beta\colon \|A\|^M \in f_{H_i}(\beta,)\} \in f_G(\alpha) \text{ then } \|A\|^M \in f_{B_i}(\alpha)\ . \tag{20}$$

Schema (7i.), which links I and O with *G*, is validated by adopting the constraint:

$$\begin{aligned}&\text{if } \{\beta\colon \|A\|^M \in f_O(\beta)\} \in f_{I_i}(\alpha) \text{ and } \alpha \in f_{C_i}(\alpha, \|A\|^M)\\ &\qquad \text{then } \{\beta\colon \beta \in f_{C_i}(\beta, \|A\|^M)\} \in f_G(\alpha)\ .\end{aligned} \tag{21}$$

Next, schema (7ii.) is validated by the condition:

$$\begin{aligned}&\text{if } \{\beta\colon \|A\|^M \in f_O(\beta)\} \in f_{I_i}(\alpha) \text{ and } f_{C_i}(\alpha, \|A\|^M) \neq \varnothing\\ &\qquad \text{then } \{\beta\colon f_{C_i}(\beta, \|A\|^M) \neq \varnothing\} \in f_G(\alpha)\ .\end{aligned} \tag{22}$$

and (13iii.) is validated by adopting the constraint:

$$\begin{aligned}&\text{if } \{\beta\colon \|A\|^M \in f_O(\beta)\} \in f_{I_i}(\alpha) \text{ and } \|A\|^M \in f_{h_i}(\alpha)\\ &\qquad \text{then } \{\beta\colon \|A\|^M \in f_{H_i}(\beta)\} \in f_G(\alpha)\ .\end{aligned} \tag{23}$$

The validity of (8.i) is secured by:

$$\begin{aligned}&\text{if } \|A\|^M \in f_O(\alpha) \text{ and } \alpha \in f_{C_i}(\alpha, \|A\|^M)\\ &\qquad \text{then } \{\beta\colon \|A\|^M \in f_{C_i}(\beta, \|A\|^M)\} \in f_G(\alpha)\ .\end{aligned} \tag{24}$$

For (8.ii) and (8.iii) we adopt the following truth conditions:

$$\begin{aligned}&\text{if } \|A\|^M \in f_O(\alpha) \text{ and } f_{C_i}(\alpha, \|A\|^M) \neq \varnothing\\ &\qquad \text{then } \{\beta\colon f_{C_i}(\beta, \|A\|^M) \neq \varnothing\} \in f_G(\alpha)\end{aligned} \tag{25}$$

and

$$\begin{aligned}&\text{if } \|A\|^M \in f_O(\alpha) \text{ and } \|A\|^M \in f_{h_i}(\alpha)\\ &\qquad \text{then } \{\beta\colon \|A\|^M \in f_{H_i}(\beta)\} \in f_G(\alpha).\end{aligned} \tag{26}$$

Schema (9) is secured by:

$$\text{if } \|A\|^M \in f_O(\alpha) \text{ then } \|A\|^M \in f_G(\alpha)\ . \tag{27}$$

Finally, (10) is validated by:

$$\begin{aligned}&\text{if } \|A\|^M \in f_M(\alpha) \text{ and } \|A\|^M \in f_O(\alpha) \text{ and } \alpha \in f_{C_i}(\alpha, \|A\|^M)\\ &\qquad \text{then } \{\beta\colon \beta \in f_{C_i}(\beta, \|A\|^M)\} \in f_G(\alpha)\ .\end{aligned} \tag{28}$$

## 5 Good Faith, Other Accounts of Agency, Institutionalized Power

The given formal approach to good faith is general enough to deal with several accounts of agency, as it is likely to be expected from a legal (juridical) perspective. It is not our purpose to investigate here different accounts of agency (specific bridging principles need to be built) but we can e.g. use $G$ as a tool for reasoning about presence of good faith in coordinated actions. For example, as illustrated in [10] the expression $E_{\{i,j,k\}}$A means that agents $i, j, k$ collectively bring about that A. If we assume individual behavior can not be identified, clearly the semantics of expressions of the form $G(E_{\{i,j,k\}}A)$ falls into the semantics already exposed.

A brief comment on the *counts as* ($\Rightarrow_s$) operator. A $\Rightarrow_s$ B sentences express the idea that, in institution $s$ (e.g. a church), given A we have B (e.g. provided witnesses and special words said, a couple counts as married.) Therefore $\Rightarrow_s$ is an institution-sensitive good faith operator. Already argued by Gelati et al [10], we think that the type of reasoning involved in institutional and normative domains are essentially the same. We write thus an equivalent expression for A $\Rightarrow_s$ B i.e. $GA \rightarrow$ B.

## 6 Concluding Remarks and Lines of Research

We point out the following:

· Good faith as a legal interpretation method is objective and wide-ranging. We defined an objective ($\Phi$-derived) trust delegation mechanism for making better the juridical understanding of different accounts and regulations of agency.

· Meaningful relations among good faith, other accounts of agency and institutionalized power are actually being addressed.

· We are also motivated by the hypothesis that a wide number of plausible state of affairs over which we can reason about presence of good faith are inconsistent. Reasoning objectively about good faith in acts should also handle reasoning with inconsistency: behaviors can be logically contradictory, however, opposite actions can be behaved in good faith.

· Connections between objective and subjective trust models for reasoning under the good faith principle are actually being adressed.

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# Creating Dialogue in an Effective Democracy - the Danish Case

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**Abstract.** Today the potential of eGovernance technology goes beyond simple eGovernment service delivery, and includes an unrealised potential for wider interaction with the citizen. For the Danish Government a key element in the work with eGovernance is dialogue - between authorities, but also between authorities and citizens, i.e. end-users. Therefore the Government has developed an application called DanmarksDebatten (The Denmark Debate). DanmarksDebatten is a citizen-oriented opportunity to have a geographical-determined, issue-determined and institutions-determined overview and entrance to present dialogues/debates about public issues as well as a decentralized adaptive service offered to every public institution with a wide array of integration opportunities. DanmarksDebatten brings debate opportunity where the citizen demands it as well as a coherent national overview. For the public administration and politicians DanmarksDebatten offers a unique opportunity to engage with their users or their electorate.

## 1 Interactive Policy-making and Citizens-oriented eGovernment

For the Danish Government a key element in the work with eGovernance is dialogue - between authorities, but also between authorities and citizens, i.e. end-users. Hereby the Danish Government recognizes that the very same technologies used in eGovernment can be used to improve our democracies, to help bridging the increasing gap between politicians and public officials and the citizens.

The Danish Government has announced that its' IT policy should be measured against the yardstick of how well it contributes to furthering individuals' opportunities for active participation and contributory influence.

J. Padget, R. Neira, J. Diaz de León (Eds.). e-Government and e-Democracy: Progress and Challenges

For this reason, the National IT & Telecom Agency under the Ministry of Science, Technology and Innovation developed an Internet application that allows collecting information from citizens about their views on any policy. It is more specifically an online consultation tool. This tool is called DanmarksDebatten (The Denmark Debate) [1].

Communities of service are a major IT policy goal for the Danish Government. DanmarksDebatten is a nationwide XML-based ASP-type of service, that the National IT and Telecom Agency offers to any central and local public institutions wanting to expand their dialogue with the citizens/users.

DanmarksDebatten is a dialogue-oriented Internet-based tool to support these efforts via qualifying input from citizens and elected representatives. If there is no dialogue, which means less opportunity to learn about the citizens' requirements, the public sector is less adaptable. This may in turn lead to increased expenditure on investments and activities based on previous, not future, needs.

## 2 Background

An important reference point for the Danish Government's IT and telecommunications policy is the individual citizen. In theory, information technology can provide greater flexibility, increased transparency and more choice in everyday life for the individual citizen. But for many citizens it can be difficult to see these benefits in practice. All too often, IT projects in the public sector have not been able to focus on the individual citizen and a digital divide between citizens and government has been the result.

With DanmarksDebatten the National IT and Telecom Agency wanted to shift the focus from a strictly technical approach towards a greater focus on the citizens' need and citizens' knowledge – we wanted to *rehumanize* the eGovernment project through eDialogue. As part of what we refer to as the citizens-oriented eGovernment, DanmarksDebatten - strives to put the individual citizen in the centre.

### 2.1 Objectives

The main objective of DanmarksDebatten is to establish a democratic forum, where citizen, public administration and politicians can engage in debates. The vision has been to create one common platform for all public debates taking place within the public sector, be it on local, regional or national level.

The objective is to facilitates a geographic, issue-specific and administration-/institution-specific overview over ongoing debates about public issues. In this way DanmarksDebatten, over the next three years, will analyse and explore the Internet's potential in terms of strengthening democracy and enhancing information and dialogue between citizen, politicians and government.

With DanmarksDebatten political and administrative decisions can be qualified, not only in terms of enhancing democracy but also from what could be called an economic point of view. When aiming at making government more responsive we also mean striving towards *balancing citizens' demands and governments supply* - meaning reducing the need for stock and overcapacity by responsiveness.

While the National IT and Telecom Agency facilitates the technical system, DanmarksDebatten is based on the participation of the local and national government. The individual institutions are responsible for running/facilitating and moderating the different debates. Every debate can be customized to the local needs and appears in most cases as an integrated part of the individual institution's homepage.

DanmarksDebatten offers transversely search facilities (horizontally and vertically) and is accessible where and when the citizen is desires a debate.

## 3 A Democratic Decision Process Support Tool

DanmarksDebatten is both a national portal offering a unique overview over ongoing debates as well as one coherent entrance and platform for dialogues between citizens, between citizens and administration and between citizens and politicians. DanmarksDebatten is also a decentralized, adaptive system offered to all public institutions as well as non-governmental organizations and local and national media. DanmarksDebatten offers a wide range of integration opportunities, ranging from a simple pop-up solution with standard design, over XML-integration to an xml-based iframe solution with an individual, adjustable style sheet for every institution.

Compared to other deliberation systems, DanmarksDebatten is a unique service that stimulates what we have called 'the situational engagement'. Based on the assumption that the citizen will be more motivated to engage in a debate when they address a public website with a specific purpose the individual institutions can, through XML-feeds and/or via an (i)frame-solution, give the citizens the opportunity to engage in an eDialogue where, and when the citizens wants it.

Public authorities and elected representatives may use DanmarksDebatten to qualify their decisions - to present an issue from all angles.

The City of Aarhus chose to use DanmarksDebatten for a public exchange of ideas in relation to the framework for traffic investments and initiatives in central Aarhus in the coming years [2]. In Funen County, the Education and Cultural Affairs Committee decided to put the question of student fees at the adult education center (VUC) up for debate [3], and the Danish Digital Task Force did the same with the issue of efficiency gains on digitalisation projects.

### 3.1 The Situational Engagement

Recent studies suggest that citizens today tend to centre their (democratic) engagement on issues that directly relates to their everyday life at the expense of overall (inter-) national and ideological issues [4,5,6]. As a consequence DanmarksDebatten aims at creating a framework for debates where and when the citizens wants them. The vision of DanmarksDebattens 'situational engagement' can be explained by the following example:

If a family can see from the municipality's website that the waiting time to get day nursery for the crèche is six months, the municipal authorities may on the same page invite the family to discuss the municipality's future childcare policy. There may be links to various sources of background information as well as links to similar debates at local, regional or national level, where the family may find inspiration or voice its opinion. From a discussion of municipal childcare policy the family may thus rapidly proceed to e.g. a debate on government family policy. Debates are linked and made accessible, whether they take part at national, county or municipal level. This gives citizens an opportunity to navigate the various public debates on the Internet, and the public authorities and elected representatives on the other hand can gain valuable information on the citizens' preferences, values and attitudes. DanmarksDebatten is thus both a national debate portal and a local *eDialogue tool.*

### 3.2 The technical solution

DanmarksDebatten is an ASP service. This means that the National IT and Telecom Agency hosts the system used by the authorities for debates with citizens, while the authorities themselves are responsible for the debates, including the appointment of moderators and debate owners. Debates may be adapted to local requirements, and in most cases they are presented as an integral part of the relevant authorities' websites. This is possible because the authorities can place their own design on top of the template supplied by the National IT and Telecom Agency.[1]

DanmarksDebatten applies the XML standard,[2] which is supplemented with a classification system from OIO - Offentlig Information Online (public information online)[4]. This means that the web pages with public information and debates registered with the OIO link service are categorized by standardized types and topics. Categorizing debates by topic makes it easier for citizens to search the web for relevant debates. This central system is updated regularly and will be transferred to a web service in the near future.

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[1] Integration to specific websites is possible through either an XML/REST-type web service or an old-fashioned frame solution for those not yet familiar with XML.

[2] XML is a mark-up language used to structure data so that it becomes recognizable and thus searchable

The National IT and Telecom Agency offers personal and telephone assistance during the initial phases of a debate. The Agency also provides a set of recommendations for preparing, starting up, running and concluding debates, as well as a technical manual.

### 3.3 Resources and accessibility

Development costs, including salaries, rent, pilot phase etc. sums up to a total of 160.000 euros. Also in terms of man-hours the project has turned out to be very modest, to some extent because we had internal access to extensive knowledge when it came to democratic theory and practice, especially in the area of eDemocracy. Also in-house knowledge about community-building and project management have been valuable assets.

In terms of accessibility the project validates as XHTML 1.0 Transitional according to W3C standards as well as the WAI standards at Priority 1.

## 4 An Open public Issue System

An important element while working with metadata is the issue element. To ensure interoperability and coherence DanmarksDebatten uses the open public issue system OIO, and as the first Danish public service ever it has implemented all of its three levels. The open public issue system enables DanmarksDebattens unique possibility to search for debates horizontal as well as vertically.

By offering both a national portal as well as decentralized integrated solutions DanmarksDebatten offers multiple access for its users. Following this there is also no limits in terms of scalability except from server capacity. By using the open public issue system, and by being a web-based service the project offers a high degree of interoperability.

Also by offering a standard solution on one hand and a more customized solution on the other, DanmarksDebatten strikes a fine balance between customized turnkey solutions and standardized solutions on the other.

## 5 Implementation

The project was kicked-off by an initial pilot period where twelve individual institutions participated. This was done in order to test the system's practical usability and quality, and to test the need for any further software development.

The National IT and Telecom Agency provided help and guidance during the entire pilot process and will continue to do so in the future. Also a paper with guidelines for "The good eDialogue" has been produced and is provided to any new institution

signing up. The paper offers advice and good practice in regards to good debate ethics, moderation, dialogue strategy, and e-democracy in general.

A communication-strategy template has also been developed and is provided along with consultant assistance on this matter. However, the individual institutions are responsible for supporting their own users and for making sure that the dialogue between citizens and government officials is stimulated.

Furthermore, a nationwide digital network for eDemocracy has been established. The members of the network also meet physically at specially arranged seminars four times a year. One of the goals for the network is to produce a white paper on eDemocracy.

Based on the positive experiences from the initial pilot period, the project has just recently been extended for a period of three years during where it is to prove its raison d'être. During this period, studies will also be carried out in order to document values and gains generated from the project.

### 5.1 Implementation management

DanmarksDebattens debate module is offered free of charge to any public institution interested. Be it local municipalities, counties or national governmental bodies, public sector research institutions etc. Also non-governmental organization and media can apply.

The debate module, used for conducting discussions of a specific topic, can be integrated on any public website via a simple frame implementation or via an XML-based web services.

Every institution signing up is given access to a simple personalized content management system allowing them to prepare the debate by creating consultation documents, applying links to background information or to similar debates, adjusting integrations values in a simple style sheet, creating XML-feeds etc., etc..

The users (citizens) are offered an e-mail service that announces new debates as well as they are offered the possibilities of subscribing to newsletters on issues/debates of their own choice.

### 5.2 System export

A public/private partnership agreement has also been made between the developer (Mondo A/S) and the National IT and Telecom Agency allowing for the system to be exported to third countries at a very favourable price. In Europe, the concept, a copy of all functionality on "DanmarksDebatten", implementation of the system, including design and translation into a specific country's language is priced 50,000 euros.

In the near future we aim to include the service into OeresundDirect [5] - a cross-boarder project between Denmark and Sweden in the Oeresund Region - hereby trying out the project's pan-European potential.

## 6 Results and impact

As the project has only just been launched and marketing efforts just recently have been initiated (in March 2004) and given that empirical research studies are yet to be conducted, it is still too early to say anything substantial about the project's results and impact. However, what we can do is to highlight some of the trends we have seen so far.

Until now marketing efforts have been limited to an email sent by the Minister for Science, Technology and Innovation to every Mayor and public sector director in Denmark followed by subsequent follow-up phone calls. Despite these rather modest marketing efforts, 50 public authorities at local, regional and national level have already signed up (as of March 2004). Amongst these, the most successful implementations have integrated DanmarksDebatten on their own website using the frame solution. This has given the debates a more local underpinning and has generated very positive feedback from the individual institutions.

What we also have seen so far is that there seems to be a fairly even distribution amongst those institutions using the debates as a basis for specific political decisions and those using the debates as a more general eDialogue tool. A few examples might illustrate this:

In the county of Funen they used DanmarksDebatten to discuss a new adult education program and subsequently they let the same discussion form the foundation for the decision and implementation of a new payment system for students. The Municipality of Vaerloese used DanmarksDebatten to qualify their decision on what to do with a former military airbase that they were taking over from the government. In the Municipality of Aarhus (Denmark's second largest city) they first ran an overall debate on how to manage the inner city traffic problems and the input from this debate was then used to form a traffic plan. This plan is, at this very moment being debated again via DanmarksDebatten. Lastly, the national eGovernmental Task Force has used DanmarksDebatten to run a debate on why so few eGovernment project leads to actual measurable effectiveness.

Also, it seems like the majority of the debates are being organized under the OIO-issues 'Environment and physical planning', 'Traffic and Transport' and 'Governance and democracy'. Both 'Environmental and physical planning' and 'Traffic and Transport' cover debate issues that probably are considered very relevant for the citizens in the citizens' day to day life, in so far as they deal with subjects that are both physically and mentally close to the citizens - bear in mind the debate about the 'Inner

city traffic plan" and the debate about what to do with the former military airbase. Also, another characteristic of these debates, apart from them being locally anchored, is that they all have had a tight time schedule. The period you were allowed to debate was very clearly defined. This seems to have had an effect on the citizens' credence towards the actual debate and the institution behind it. Also the institutions' willingness to follow up on a debate seems to be of importance when it comes to citizens' confidence and hence willingness to participate in a debate.

The majority of the debates organized under the OIO-issue 'Governance and Democracy' almost exclusively concern the future organization of municipalities, which probably is due to the forthcoming municipality reform.

Lastly, as seen in the examples above, institutions using DanmarksDebatten have, as yet, to fully utilize the potential of 'the situational engagement'. This could amongst other be explained by immature it-systems not being able to handle XML and web-services' but also by the fact that many institutions still need to think of dialogue as an important part of their communication strategy.

## 7 Learning points and conclusions

In general terms, what we have learned so far is that, if citizens are to be engaged online, rational incentives for the ordinary citizen to enter into dialogue needs to be present. Facts must be made clear and stated in an understandable form, and the issues at stake broadcasted widely. Another challenge is to develop administrative means and a sufficient back office, consisting of resources, funding, and personnel, to tabulate and assess the responses received from the citizens.

Success with eDialogue requires careful planning, well-defined themes and clear goals. Likewise, one cannot expect the citizen to engage in constructive and valuable dialogues, and respect other citizens' right to do the same, if there is no one there to guide them. Therefore an (pro) active and committed debate moderator is a necessity.

The following being inspired by a web based e-facilitation course arranged by the Hansard Society [9] in the UK and mixed with our own empirical and theoretical studies on the issue of eDialogue, list respectively the citizens' and the public administrations', politicians' and decision makers' objectives for eDialogue. It also presents a short checklist useful to bear in mind when preparing a debate.

The Citizens' objectives:

- to extend their knowledge about a given political issue
- to express their own point of view
- to exchange their views and opinions with each other
- to know that someone is actually listening

The public administrations', politicians' and decision makers' objectives:

- to listen and communicate better with the citizens
- thereby representing and reflecting the citizens' views and opinions better
- and qualifying the democratic process by creating a more open and transparent process.
- to become more effective when it comes to decision making, both in political and economic point of view.
- to increase their responsiveness and adaptability.

When preparing a debate we have found it useful to bear the following checklist in mind:

- A clear objective - what is the purpose of the debate and how do you plan to use the outcome afterwards?
- Relevance - what is the relevance for you and for the participants
- Recruiting participants - create a participant profile, use existing networks and partner with local media. "Timing is everything".
- Adaption period - make sure that the citizen feels comfortable and has access to any help or guidance that they might need
- "What's in it for me" - make sure, that the citizens' know what the outcome of their participation will be.
- Only run time-limited debates and remember to maintain the interest as well as the visible overview by making small summaries every now and then.
- When closing a debate - remember to express your appreciation for the received contributions and be keen on announcing any related activities regarding the same issue - be it town hall meetings, workshops etc.
- Results and feedback - remember to brief the participants about any outcome of their efforts.

Lastly, but not least, to create dialogue in an effective democracy, one needs to think and establish participation and partnership between all of the stakeholders in government and the citizenry alike.

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# Part III

# Legal and Identity Issues

# Legal and Social Issues in Electronic Voting. Report on the Catalan Essays during the Elections of November, 2003

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**Abstract.** This paper provides an overview of the three e-voting systems that have been tested during the last Catalan election (a remote voting one, a touch-screen system and a third application with an electronic ballot). It has been the broadest pilot experience in Spain, managed by three leading Spanish companies, and the authors have been external observers. They summarize the data obtained focusing on the main legal and sociopolitical considerations.

## 1 Introduction

Catalonia is a Spanish autonomous land with a census of 5307837 people and the pilots were developed within the framework of its seventh parliamentary elections. The Catalan electoral law doesn't allow electronic devices. At Spanish level, only the Basque Country has an e-voting Act, passed in 1998, although there has been no real application yet (Fernández Riveira, 2001).

The three pilots had a non-binding character and were authorized by the Central Electoral Board that, according to the received explanations, insisted that the procedures of electronic vote should specify, in a very clear way, its complementary character to the traditional system and the invalidity of these suffrages. Anyway, the recent creation of a speci c Commission in the Spanish Senate shows that there is nowadays an increasing institutional interest.

These essays were the continuation of others carried out during the same parliamentary elections in 1995. Then, under the monitoring of the company *Odec*, there has been a more restricted essay with only one e-voting procedure. Two polling stations of different sociological pro le were chosen: an urban one in Barcelona -Enxample- and another rural in Anglès, a village near Girona. The polling method consisted in the recording, with a touch-screen machine, of the electoral option in a magnetic card that was introduced later into a traditional ballot box (Cano Bueso, 2001).

## 2 Remote Vote

This option was provided by *Scytl*, a Catalan company whose origin is the research developed since 1994 in the University of Barcelona where "the only two European

J. Padget, R. Neira, J. Díaz de León (Eds.). e-Government and e-Democracy: Progress and Challenges

doctorates on electronic voting security have been granted" (Scytl 2003a, [3]). These academic results gave rise to the creation of a spin-off that, in the last years, has developed and applied technologies of remote e-voting in different areas: the internal elections of the Catalan Police or, in a binding format, the presidential elections of the IEEE IT Spanish chapter (Scytl, 2003b, 13).

### 2.1 The Process

Using the census of Spanish citizens living abroad the electoral administration sent a letter of introduction to the voters registered in ve countries (Mexico, Argentina, United States, Belgium and Chile). The letter contained the following data: a) indication that such data were destined for a non-binding e-voting pilot; b) country of the elector's residence –i.e. Argentina–; c) electoral district in which he has to cast his vote –i.e. Tarragona–; d) voter credential in strict sense, that is, an alphanumeric code (i.e. i0f7-442f-5ky8-qx9x) that gives information about, among other elements, the district in which the suffrage must be counted. The document was similar to an envelope, like those used by banks to provide a personal pin. Everybody could identify the electoral administration as well as other elements except the alphanumeric code that, obviously, was inside the credential.

It was an anonymous one since there were no data about the voter's identity. Although this is positive, it must be kept in mind that, if the credentials were sent by ordinary mail –no speci c indication was provided about this during the polling day–, nobody can guarantee, even using the of cial addresses, that the receiver has really been the person legally enabled to vote. Changes of addresses, a postal error or its reception by a relative can easily facilitate the vote of an unauthorized person. A possible solution could be a personalized delivery, with an adequate identi cation, using existing postal methods or, much better, a delivery restricted to the administrative of ces.

The voter identi es himself typing the code. He can use any computer with Internet and a java enabled browser. When there are repeated errors, the voter is requested to contact the company –not the electoral administration– with an electronic mailbox providing the error code appeared on screen. However, neither a telephone nor a real postal address are offered. Even admitting the dif culty to solve these problems agilely, it will be useful to extend to the utmost the possibilities of contact between a voter with problems and the organizers. Probably neither the phone nor the postal address will settle all the problems, but they will mitigate, at least partially, the weak position of a citizen who, wishing to vote, encounters speci c technical dif culties.

These solutions are very important since the usability is a key element. The citizen should nd an easy system to vote and different ways to solve any problem. In the Catalan essay, there have been some little dif culties with a confusion between the characters "l" and "1" of the personal code and with citizens who did not have a java enabled browser (Scytl, 2003c, 10-11).

The blockage of the system can also have other consequences. Does it apply to a speci c machine or only to the individual code of an user? Both possibilities have their risks. Affecting to a speci c equipment and considering the hypothesis of places with scarce points of connectivity, other citizens could nd unexpected and maybe insuperable obstacles. Trusting to vote in a speci c place, they could not because somebody

previously rendered useless the equipment. On the other hand, the fraudulent use of a random code, coincident with a real one, could obstruct likewise the vote of a legally enabled person.

Anyway, after the identi cation, the computer application shows the different candidatures of the voter's constituency. As it is known, the electronic appearance of this information should respect scrupulously the equality among all the political parties. *Scytl* offers a good interface, with the candidatures well ordered and with the same measures. Therefore, it guarantees a fair election.

The voter can also view the candidates' list of each party. Comparing the computer solution suggested by *Scytl* with the philosophy underlying our representative system, where a parliamentary seat belongs to an individual candidate –not to the political party–, we notice that the application shows the candidature's logos and requires a second movement to view their speci c names. Such a design strengthens the leadership of political parties since, at least in a symbolic level, the voter rst has to think in terms of parties rather than candidates. In the traditional system, however, he receives both data in a more or less simultaneous way.

Following this comparison between traditional and electronic systems, blank votes and especially null ones usually poses some problems. If, from a democratic point of view, both options enrich citizen participation, every electronic system should be designed in such a way that voters could, as actually do, cast both types of votes. Blank ones do not pose great problems since they are similar to the rest with the only particularity of the space destined for the candidature not being lled in. *Scytl* includes such an option with a blank square that completes the exhibition of all the candidatures.

Anyway, the Spanish Electoral Act says that a blank vote is, at least in the elections for the Congress –not for the Senate–, an envelope without a paper ballot ["sobre que no contenga papeleta" (art. 96, Spanish Electoral Act –LOREG–, section 5)]. Therefore, this vote is neither another paper ballot, like those of each political party, nor only a blank paper. It is the absence of any paper ballot. Although the legislation is logically thought for the traditional voting and its modi cation may be foreseen if the electronic voting is nally introduced, we should not forget the current de nition of this type of suffrage in order to reduce the changes generated by the electronic voting.

Null votes pose more questions since they can not be limited to cases of error. They must also include those consciously cast (vid. art. 96LOREG, sections 1 to 4). The deliberate invalidation of a vote entails a valuable democratic behavior that we should not exclude and therefore e-voting systems should include procedures that resemble the conventional null votes. The simplest solution, to add another electoral option, does not re ect with accuracy the democratic potential of null votes because they are not supplementary options, like blank votes. They are wrong, although deliberate, manipulation of valid votes –i.e. comments added in speci c ballots–. How can such spontaneity be included in the electronic voting procedures? A speci c null vote option is one solution, although imperfect. Regrettably, *Scytl* includes neither this possibility nor more advanced options.

After con rming the vote, the *Scytl*'s system gives a receipt where the elector is informed that the process has successfully ended. There is also an identi er of the vote as well as a control code. The receipt does not specify, however, the electoral option.

Such a solution offers certain advantages since a document with the voter's ideological orientation could encourage corruption. The fact that nobody, nor the voter himself, can certify the orientation of his vote provides complete safety, even having received previous pressures (Mitrou 2002, 19). It is also true, however, that the absence of a more detailed receipt rules out an alternative control with traditional methods and therefore the system's reliability depends on the internal computer protocols.

### 2.2 Technical Details

The organizers emphasized some technical features of the *Scytl*'s system that guarantee the safety of the process. For instance, during the polling day, the system does not show partial results, only turnout data. It also avoids the use of the abstentionist voters' codes by people with privileges of access.

In accordance with the received explanations, its key element is the separation among "critical and non-critical [computer] modules" (Riera Jorba, 2003, 5). The rst ones are two modules located in the extremes: the voting agent and the Electoral Board agent. Taking into consideration that is very dif cult to guarantee all the process, it could be enough to audit these critical modules in order to provide con dence to the citizenship. The voting agent is a small applet. It puts the information of each suffrage in digital envelopes that are stored until the end of the polling day. Nobody can open them since only the Electoral Board has the key. The system also accepts several technological platforms like PDAs or touch-screens.

These remarks about the technical features have great importance since, in case of remote voting, there is no paper trail and the control and transparency of the computer's source code used by the organizers becomes the only solution. *Scytl*'s managers af rm even that "the current technology can and must go further, and provide audit trails that are safer and more dependable than paper-based ones" (Riera Jorba, 2003, 8). It is again the recurrent debate between the necessary control of these codes and the private interests of the companies.

In the Catalan essays, neither *Scytl* nor the other two companies offered detailed explanations about their codes and therefore it is impossible to know whether they respect the legal and democratic requirements of every election. Anyway, *Scytl* entrusted the control to an Electoral Board that, without knowing the internal computer details, should guarantee the credibility of all the process.

### 2.3 The Electoral Board

It consisted of ve representatives of the political parties with parliamentary presence in Catalonia and two members of the Catalan electoral administration. Each one of them had a fraction of the key that opened the digital ballot box –a completely disconnected computer– and there was enough with a minimum of ve fractions to obtain it. A technician began the process storing the electoral data in the digital ballot box, he typed his code and each member of the Board, once introduced his smart card –in the future with ngerprints– in a reader, also typed his own password. The electoral results were

obtained immediately, but they have not been shown to the observers because the Catalan Government wanted to be the rst to offer these data to the citizenship in a press conference.

### 2.4 Socio-Political Considerations

There is a misleading low level of participation: only 730 citizens cast their e-vote and there was 23,234 possible electors. Therefore, there was a scarce 3.14 per cent of participation[3] However, in the ordinary elections, the turnout among citizens living abroad is usually quite more reduced than the one obtained in Catalonia. Normally about 20 per cent of these electors usually vote. Therefore, if we take the number of electors that normally vote as a reference, 15.23 per cent of them agreed to participate.

However, the results are low and they are quite far from those obtained by *Demotek* and *Indra*. There is usually a mythological idea according to which the simple possibility to vote through Internet should result in a spectacular increase of the participation. Not only this condition of panacea with regard to the improvement of the electoral participation is unfounded (LGA, 2002), but the data obtained in some –not all– sectorial elections have shown depressing values [i.e. elections to the General Assembly of the University of Barcelona (Reniu, 2003)].

It is interesting likewise to consider in each country the weight of the pilot voters as for the traditional ones. Although this measure only informs us of the degree of coincidence among the participation results in both types of vote, we nd really surprising data. In the Mexican case, the pilot voters amply double –226.47 per cent– the traditional ones. The existence of some engaged Catalan institutions in Mexico, the dispersion of the Catalan community and maybe the Mexican social context itself, where the effectiveness of the postal service is far from the Catalan standards, could be an initial explanation.

On the other hand, the distribution of the remote votes shows that they are divided into two great groups. Those living in America grant mostly its support to *Convergència i Unió* (CiU) as well as to *Esquerra Republicana de Catalunya* (ERC). Perhaps the nationalistic bias of these results is due to the distance, which undoubtedly would highlight the patriotic feeling. Those living in Belgium put the *Partit dels Socialistes de Catalunya - Ciutadans pel Canvi* (PSC-CpC) in the rst place of its preferences, in a more similar way to the conventional polls. Anyway, the non-binding character may entail a feeling of experimentation that explains the existence of some votes of protest or with a certain folkloric component (i.e. votes received by *Estat Català* in Mexico).

## 3 Touch-Screen Machines

The second system, based on touch-screen machines, was managed by *Indra*, a Spanish company specialized in the information technologies, simulation and automatic maintenance systems and defence technological equipment. The rst one includes the relationship between computers and public administrations and, in a more speci c way, the

[3] The detailed results and a longer paper are available at Barrat i Esteve (2004).

improvement of the electoral processes. *Indra* has a long experience since 1978, with the Spanish constitutional referendum, and with further electoral processes in Spain and abroad. There have also been several e-voting experiences like the internal elections of the Spanish Police –*Guardia Civil*– or other elections in the United Kingdom and Argentina –Ushuaia–.

### 3.1 The Process

The identi cation is developed in a traditional way. After the exhibition of an identity document, the President delivers a smart card with which the citizen, once introduced it in the touch-screen machine, would be able to cast his vote. These cards have also an internal control system that invalidates themselves once used. In Canyelles, one of the ve villages with e-voting pilots (with Torres de Segre, La Fatarella, Llers and Creixell), the responsible stored these nulli ed cards and we could check how the ballot box refused them. The cards can also be reset and used in subsequent elections.

In this case, *Indra* decided not to deliver the cards, but, in a binding election, the solution could be different. If such cards store electoral data, perhaps they could be used as receipts and delivered to the citizens, more or less like in the *Scytl*'s system. On the other hand, following the *Demotek*'s point of view, they could also be introduced in a conventional ballot box controlled by the polling station. The electoral safety will increase, but obviously there will be no paper trail.

Touch-screen machines need a protected space around them in such a way that each citizen could cast secretly his vote. A limited perimeter around the electronic ballot box or even an individualized polling booth could be useful. Following this question, there were surprising results in Torres de Segre (157 blank votes / 47.01 per cent). Comparing these data with the other four villages or with the of cial results, we will notice that they are abnormally high. However, compared with the results of *Demotek* in the same village, we will observe that there are also many blank votes (9.77 per cent).

Either some members of the Town Council and the *Indra*'s responsible in this village told us that the incorrect position of the touch-screen, orientated to the president of the polling station, jeopardized the secret of the vote and favored that many people decided, at least for the case of *Indra*, to cast a blank vote. The electronic polling station was in a small room and the responsible, after a rst decision that posed some problems, decided to put the ballot box in its center, although the President and other members of the polling station could see how the citizens were casting their votes. This decision increased the turnout, but several citizens, above all aged ones, decided to cast a blank vote.

Finally, as *Scytl* and *Demotek*, *Indra* accepts only blank votes, not null ones. In relation to the screen design, we can reproduce here the same remarks mentioned in the previous section.

### 3.2 Socio-Political Considerations

As for the results, Canyelles stands out because it has the greatest abstention, either in absolute –66.41 per cent– or relative terms, that is, in relation to the of cial results –almost thirty points of difference–. Creixell has the same characteristic, but we can

nd there another trend that will be also present in the other villages: the *Partit Popular* (PP) obtains an e-vote score lower than the of cial one and, on the other hand, ERC and *Iniciativa per Catalunya Verds - Esquerra Alternativa* (IC-V) have higher results in the e-votes. The experimental pro le of the election could explain this behavior: the e-votes re ect the real desires of the voter before being in uenced by other strategic considerations.

## 4 Paper Electronic Ballots

The last system consists in a ballot box that is able to scan paper ballots and to develop an automatic counting. It was managed by *Demotek*, a Basque company where institutional –Direction of Electoral Processes and Documentation of the Basque Government–, economic –Ibermatica, Ikusi, Hunolt and Euskalteland– and academic actors –University of the Basque Country, Ikerland and Robotiker– work together (Demotek, 2004a). They developed different systems of e-vote trying always as much as possible to respect "la forma actual de votación" (Demotek, 2004). Either *Ikusi* or the University of the Basque Country have already use this system in their own internal elections (Demotek, 2004).

### 4.1 The Process

There is no change in the rst step since the *Demotek*'s system, like *Indra*, accepts the traditional identi cation rules.

The voting system is based on a paper electronic ballot: a ballot with a speci c electronic device that facilitates its automatic reading. The citizen does not change a lot his behavior since there are, as in the traditional polls, ballot papers for each candidature. The voter will be able to check simultaneously the logo of the chosen party as well as the individual candidates. The only novelty consists in that, instead of introducing the ballot in an envelope, it has to be folded and introduced in the ballot box.

The ballot box has two slots. The rst one is a control mechanism that avoids the introduction of an incorrect ballot. In these elections there were four electoral districts and each party had a different list in each one. Therefore, this slot checks that the ballot belongs to a speci c polling station. Once the ballot has been veri ed, the ballot box opens automatically the other slot and it is the President who introduces the ballot into. Finally, every ballot box has a reader, placed under the second slot, that scans the paper ballot, identi es the candidature and generates, at the end of the polling day, an automatic counting.

The blank vote was foreseen, with a paper ballot similar to the previous ones in which no candidature appears, whereas null votes were not accepted. In accordance with the received explanations, this second suffrage could become a *reserved vote*. If somebody wrongly strikes out a ballot, the president could qualify it as a reserved vote and therefore it would be transferred to a higher Electoral Board for its de nite counting. However, such an option would only be feasible with a manual counting and refusing consequently the main advantage of this e-voting method.

Finally, the results can be transmitted using GSM standards and, as safety controls, every president of a polling station has either an opening or a closing card that will erase the electoral data in order to use the same ballot box in future elections.

### 4.2 Auditability

Although *Demotek* offers the easiest system of control since a traditional counting is always feasible, such a solution should be an exception whereas the automatic counting should become the ordinary application of this system. Therefore, we encounter again the same obstacle. How can we guarantee the credibility of that system if we do not know its internal code? How can we guarantee that there has not been no manipulation in any of the installed ballot boxes?

Anyway, Catalonia has closed candidatures that do not allow speci c marks on the ballot. Therefore, the optical reader is safer than those used in other electoral systems where the citizens' marks may be dif cult to scan (Jones, 2003, 8).

In accordance with the provided explanations, *Bearing Point* is auditing this system and it is foreseen likewise, although not in non-binding essays as the Catalan one, a control by the members of the Electoral Board. This option intends to be a balanced solution in such a way that, without revealing the source code, some selected institutions would be able to check it in order to provide con dence to the citizenship.

### 4.3 Socio-Political Considerations

This is the system with less changes for the voter, although it offers low versatility since its goal is to accelerate the counting, but not to decentralize it. Basque political parties also appreciate its compatibility with the electoral mailing that is usually carried out during the Spanish electoral campaigns. The political parties use to send each citizen their own ballot as well as the speci c electoral envelope and other political information. Therefore, the citizen will be able to go to the polling station with the envelope just closed. Touch-screen machines and remote voting systems have no paper ballots and it is more dif cult –not impossible– to carry out the described electoral mailing. This is the real reason that let the Basque Parliament to start the modi cation of the existing e-voting Act. We cannot forget that parties are the key actors in this process and they should be engaged in the spread of the e-voting systems.

*Demotek*'s results are very similar to *Indra*'s ones. Turnout, even presenting some noticeable percentages, always keeps at a distance of the traditional voting system and the PP is sub-represented whereas ERC and IC-V are over-represented. However, using *Demotek*'s electronic ballots, we detected that citizens could have some dif culty in correctly identifying the political option for which they want to cast their vote. This a logical conclusion in the light of the vote dispersion observed towards political parties different to the ve big ones: CiU, PSC-CpC, ERC, PP and IC-V.

Anyway, the three pilots –*Scytl*, *Demotek* and *Indra*– seem to point out the same thing: e-voting new technologies are not a panacea for the democratic process. They are positive novelties, but they are not a panacea. Either in these essays or in other previous experiences in Spain (University of Barcelona) or in other countries (LGA, United Kingdom), turnout is the main challenge that e-voting, above all remote one, has to face. Therefore, the e-vote cannot be the only magical solution to overcome democratic problems like current abstention or other things, like the digital gap, that are core elements of any e-democracy project: "utilizar el voto como una varita mágica que va a solucionar los problemas actuales de desidia a la hora de votar o la mala

percepción que los usuarios tienen de la política es como mínimo irrelevante y hasta puede convertirse en contraproducente" (eDemocracia, 2004, 8).

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# How Electronic Voting Can Escape Arrow's Impossibility Theorem

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**Abstract.** This paper discusses possible voting procedures as they are described in classical collective choice theory and shows some of their limits. No classical voting procedure can be at the same time democratic, decisive and rational. Because of this result, seeking a way to aggregate electronic votes stemming from various individuals that satisfy these three properties is vain when candidate rankings alone are taken into account.
To overcome these limits, this paper introduces preference based voting procedures, states the conditions such an aggregation function should satisfy (much in the same way as Arrow did but in a fuzzy setting), and explains how voters could naturally derive degrees of preference among candidates so as to lead to feasible electronic voting procedures.

**Keywords:** electronic voting, social choice theory, arrow's theorem.

## 1 Introduction

Social choice theory, elaborated by economists and social scientists [1], aims at studying voting procedures, i.e., where voters have to choose among candidates. Each voter ranks the candidates according to his/her preferences. In order to obtain a global ranking of the candidates, the individual rankings are aggregated. The way to aggregate the rankings is devised according to the properties one may want the voting procedure to satisfy.

This paper discusses possible voting procedures as they are described in classical collective choice theory and shows some of their limits. No classical voting procedure can be at the same time democratic, decisive and rational. Because of this result, seeking a way to aggregate electronic votes stemming from various individuals that satisfy these three properties is vain when candidate rankings alone are taken into account.

To overcome these limits, this paper introduces preference based voting procedures, states the conditions such an aggregation function should satisfy (much in the same way as Arrow did but in a fuzzy setting), and explains how voters could naturally derive degrees of preference among candidates so as to lead to feasible electronic voting procedures.

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## 1.1 Some Classical Results

### Terminology

Arrow has proposed conditions every voting procedure[1] should satisfy [5]. He also proved a very important theorem. Before recalling it, let us specify the terminology used in the following.

An individual vote is the ranking of all the candidates by decreasing order of preference for the elector. It is not the exclusive expression of the preferred candidate. The notion of individual corresponds to what is called sometimes *weak preference*. One writes $x \succsim y$ to mean that an individual prefers candidate $x$ at least as much as candidate $y$. This weak preference relation can be split into two sub-relations: $x \succ y$ means candidate $x$ is strictly preferred to candidate $y$ ($y \not\succsim x$), and $x \sim y$ means the voter is indifferent between the two alternatives ($x \succsim y$ and $y \succsim x$). By definition weak preference is a complete asymmetric pre-order.

### Arrow's Impossibility Theorem

A voting procedure is a function that provides a collective ranking from the individual rankings given by the voters. For instance, (1) the *plurality* rule takes into account the number of times a candidate is at the top of any individual ranking. The greater this number, the higher the candidate is in the global ranking. (2) The *intensity* rule gives a candidate as many tokens as the number of candidates he/she outranks in an individual ranking. The tokens a candidate receives for each individual ranking are added and this total score determines the position of the candidate in the global ranking. (3) In the *majority* rule, candidate $x$ is preferred over another candidate $y$ if and only if the number of individuals ranking $x$ before $y$ is at least as large as the number of individuals ranking $y$ before $x$. In the case of a panel of two candidates these voting procedures are equivalent.

**For three or more alternatives possible ambiguities arise; i.e., none of these voting procedure is completely satisfactory.**

### Properties of a Voting Procedure

Arrow tackled this issue by stating the properties a voting procedure should satisfy when there are at least three candidates $x$, $y$ and $z$:

**Completeness** The voting procedure ranks each candidate pairwise (i.e., it does not exist two candidates for whom one does not know the weakly preferred one): $x \succsim y$ or $y \succsim x$.

**Transitivity** In the final collective ranking the preference relation must be transitive: if $x \succsim y$ and $y \succsim z$ then $x \succsim z$.

[1] The term *voting procedure* is widely used in everyday life. K. Arrow calls them *social welfare functions* [2]. Some call them *group decision functions* [3] or *collective choice rules* [4], because Arrow's terminology may be mistaken with a function measuring welfare.

**Unrestricted domain** The voting procedure is defined whatever the individual votes are.

**Unanimity** If each individual prefers candidate $x$ to candidate $Y$, the collective ranking must then prefer $x$ to $y$.

**Independence of irrelevant alternatives** The collective ranking of any pair of candidate only depends upon individual rankings of the candidates from this pair. For instance, if one is to find out whether a group of people prefers coffee or tea, individual preferences between tea and coke must not influence this choice.

### 1.2 Ideal Voting Procedure

After having defined and justified these properties, Arrow showed in the theorem bearing his name, that the only voting procedure that verifies them is the dictatorship (i.e., one individual imposes his choice on the others) in the case of three or more candidates.

In electronic voting, because of this result, seeking a voting procedure that satisfy these five properties is vain. It will consist in selecting a particular vote and rejecting the others if one *only* takes into account the ranking induced on the candidates. So as to avoid the conclusion of Arrow's theorem, one may want either to abandon or weaken one or several properties and find a voting procedure compatible with this new set of axioms. Unfortunately, relaxing the initial properties make the voting procedures counterintuitive or little decisive (e.g., they allow preference intransitivity in the collective ordering), as long as they are not anti-democratic. The ideal voting procedure thus does not exist.

The right of veto of an individual is defined as the possibility to object to a strict collective preference that is different from his/her own. A voting procedure that would allocate a right of veto to each voter in order to distribute in an egalitarian way the power, would rarely be decisive since two opposite preferences on a pair of candidates result in indifference or conflict. An oligarchy is a set of voters that has, as a group, the power to impose on the remaining voters, its strict and unanimous preference for any pair of candidate. Moreover, each oligarchy member, as an individual, has the power to impose its veto against a strict collective preference different from his own. When an oligarchy contains only one individual it is a dictatorship. The more members it contains, the more egalitarian the power distribution. However, an increase in the size of an oligarchy increases indecisiveness at the same time.

## 2 Aggregating Electronic Votes

Let us analyze the problem of aggregating electronic votes. An elector's vote is a list of ranked candidates. Each elector may have an opinion on a candidate that differs from the others or even have no opinion at all on certain candidates. Consequently, candidate rankings given by voters do not necessarily contain the very same candidates even though some of them may be encountered in several lists.

### Preference Intensity Vectors rather than mere Partial Pre-Orders

Arrow's impossibility theorem proves that it is not sufficient to bring into play rankings in order to obtain satisfactory preference aggregation modes (i.e., different from dictatorship and nevertheless meeting the five properties stated in Section 1.1). The expressive power of preference intensity vectors being greater than mere partial pre-orders, one may hope to somehow escape the theorem's conclusions by adding to the preference rankings an intensity measure.

This approach meets Yager's [6] for whom aggregating a group of preferences becomes possible when a ranking scale, more meaningful than a mere pre-order, is introduced. He also expresses preferences by means of fuzzy sets that convey to what extent candidates satisfy a voter. This enables a vote to be represented by a ranked and valued list of candidates. Those valuations can be obtained owing to the gradual —fuzzy— character of the elector.

### Votes as Discrete Fuzzy Sets

Let $\Delta = \{\delta_1, \ldots, \delta_m\}$ be a finite non-empty set of alternatives that are to be evaluated by a board of experts $A = \{A_1, \ldots, A_n\}$.

Each expert is supposed to rank every alternative according to a continuous scale that is, by convention, the unit interval $[1, 0]$.

Let $x_{ij}$ be the rating for alternative $\delta_i$ given by expert $A_j$. For instance $\Delta$ a set of artists the board of examiners $A$ has to rank according to their skills, by using (as often) a numerical grading scale. Each expert comes up with a ranking $F_j$ that may be considered as a fuzzy set whose membership function $\mu_{F_j}$ such that $x_{ij} = \mu_{F_j}(\delta_i)$. $F_j$ is the discrete fuzzy set of alternatives preferred by expert $A_j$, $x_{ij}$ may be seen as the matching degree between $\delta_i$ and some ideal alternative according to $A_j$.

In a vote, candidates are ranked by decreasing order of degree $(x_{ij})$ to which the voters advocate them. This coefficient grades the interest for a candidate $\delta_i$ by a voter $A_j$. By definition $x_{ij} = 1$ conveys maximal preference, $x_{ij} =$ rejection and $x_{ij} = 0.5$ indifference about candidate $\delta_i$. With this definition the vote of an elector $A_j$ can be represented by a discrete fuzzy set $F_j$ on $\Delta$. Figure shows an example of such a preference ranking.

Once the candidate rankings are replaced by fuzzy sets as just defined, it interesting to carry Arrow's properties (among others) over to this formalism order to find the fuzzy voting procedures that satisfy them.

This study has been carried out in a systematic manner on Arrow's properties and also on different conditions which a voting procedure may satisfy.

## 2.1 Axioms

The problem of electors who vote then becomes a problem of finding a function for aggregating $n$ fuzzy subsets on the set $\Delta$ of possible candidates into a fuzzy set $F$. It is thus a matter of finding $f$ such that $f(F_1, F_2, \ldots, F_n) = F$. Let see some of the conditions an aggregation function $f$ should satisfy.

All possible axioms are not required with the same strength, and do not pertain to the same purpose. They can be classified into three groups:

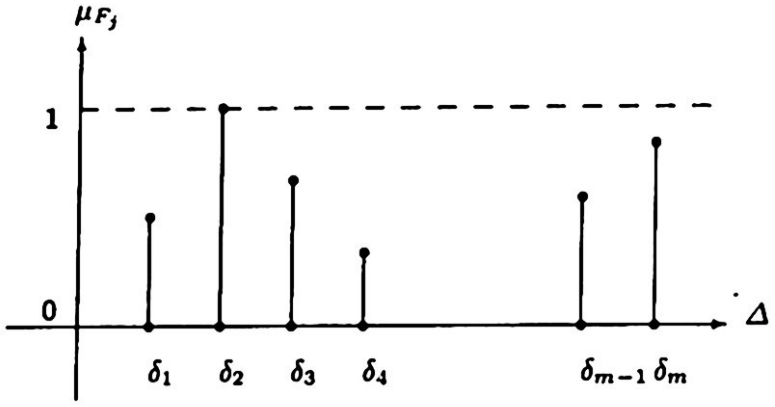


Fig. 1. Discrete fuzzy set of candidates advocated by voter $A_j$

1. *Imperative conditions* whose violation lead to obviously counterintuitive aggregation modes.
2. *Technical conditions* that just facilitate the representation on the calculation of the aggregation function.
3. *Optional conditions* that naturally apply in special circumstances but are not necessarily universally accepted. They are acceptable as long as they do not lead to impossibility results, or restrict too much the range of admissible aggregations.

## Imperative Conditions

Insofar as a democratic aggregation is assumed, the imperative conditions are:

***Unanimity in rejection, acceptance and indifference:*** If every voter is indifferent with respect to a candidate then the final candidate ranking follows this general consensus ($\exists\delta_i,\ \forall j,\ x_{ij} = .5 \Longrightarrow \mu_F(\delta_i) = .5$), the same is true for acceptance ($x_{ij} = 1 \Longrightarrow \mu_F(\delta_i) = 1$) and rejection ($x_{ij} = 0 \Longrightarrow \mu_F(\delta_i) = 0$).

***Positive association of social and individual values (in its non-strict form):*** If an individual increases his preference intensity for $\delta_i$ then the social preference for $\delta_i$ cannot decrease. It means that if $F_j'$ and $F_j$ are such that $\mu_{F_j} \leq \mu_{F_j'}$ (i.e., in fuzzy set terms, $F_j \subseteq F_j'$) then $f(F_1 \ldots F_j \ldots F_n) \subseteq f(F_1 \ldots F_j' \ldots F_n)$. In other words $f$ is monotonic with set-inclusion.

***Minimal democracy:*** No one has absolute veto nor is a dictator in every situation.

***Neutrality with respect to alternatives:*** The aggregation function does not depend upon the alternatives. If $\delta_i$ and $\delta_{i'}$ are such that $x_{ij} = x_{i'j}, \forall j \in \{1,\ldots,n\}$ then $\mu_{f(F_1 \ldots F_n)}(\delta_i) = \mu_{f(F_1 \ldots F_n)}(\delta_{i'})$.

***Neutrality with respect to the intensity scale:*** Assume that the alternatives are rated in terms of *distaste* intensities instead of preference intensities. Then the social distaste pattern should be built from individual distaste function with the same aggregation function as preferences. Indeed

distaste and preference are just a matter of naming the assessment criterion (i.e., choosing the *good* or the *bad* alternatives) and the aggregation function should not depend on this name.

***Continuity*** An infinitesimal modification in the individual preference intensities only induces an infinitesimal modification in the collective preferences.

### Technical Condition

One technical condition would be the *independence of irrelevant alternatives* (see Arrow's fifth condition in Section 1.1) which requests that the social preference intensity for $\delta_i$ only depends on the individual preference intensity for $\delta_i$, and not for $\delta_{i'}$, $i' \neq i$. Together with the neutrality of alternatives it enables the aggregation function to be represented by a mapping $\phi : [0,1]^n \longrightarrow [0,1]$ such that

$$\forall \delta_i,\ i = \{1,\ldots,m\},\ \mu_F(\delta_i) = \phi(x_{i1}, x_{i2}, \ldots, x_{in}) \stackrel{\text{def}}{=} x_i$$

## 2.2 Fuzzy Voting Procedures

If this last technical condition is added to the imperative ones then the qualified class of fuzzy set operators for voting-like aggregation procedures is the class of *symmetric sums* that has been fully studied in fuzzy set theory by Silvert [7] [8].

On the whole, the results investigated here can be compared to those that have been found following Arrow. Namely in classical voting theory, no voting procedure can be at the same time democratic, decisive and rational. Here, rational means "obeying Arrow's axioms". Moreover, three voting rules satisfy only two of these requirements:

- *simple majority* is democratic and decisive,
- *unanimity* is democratic and rational,
- *dictatorship* is decisive and rational.

In the fuzzy set setting the following families of aggregation operations are many-valued counterparts of these three rules. The *median* and the *minimum* operations match with the unanimity rule, the *arithmetic mean* matches with the majority rule, the *maximum operation* and the *associative symmetric sums* match with more or less tough dictatorships.

### Associative Symmetric Sums

These functions admit the following properties:

- Negative individual opinions result in reinforced social negative opinion and the same for positive opinion, while contradictory opinion compensate. If $x_{ij} < 0.5 < x_{ik}$ then $\phi(x_{ij}, x_{ij}) < x_{ij}, \phi(x_{ik}, x_{ik}) > x_{ik}$ and $\phi(x_{ij}, x_{ik}) \in [x_{ij}, x_{ik}]$.

- Social choice is forbidden by the existence of extreme conflict between any two individuals in a society. If $\exists x_{ij}, x_{ik}$ such that $x_{ij} = 0, x_{ik} = 1. \forall k \neq j$ then $\phi(x_{i1}, \ldots, x_{in})$ is undefined. Arrow's third axiom (*unrestricted domain*) is thus violated.
- An indifferent vote does not modify the collective choice, $\phi(x_{ij}, x_{ik}, 0.5) = \phi(x_{ij}, x_{ik})$.
- Any individual has a right of veto against others when they do not oppose him/her completely. If $\exists x_{ij} = 0$ and $x_{ik} < 1, \forall k \neq j$ then $\phi(x_{i1}, \ldots, x_{in}) = 0$.
- Any individual can be a dictator if other individuals do not completely reject his/her choice. If $\exists x_{ij} = 1$ and $x_{ik} > 0, \forall k \neq j$ then $\phi(x_{i1}, \ldots, x_{in}) = 1$.

Associativity belongs to the set of optional conditions and is not always desirable because it leads to weighing the opinion of a group of $n-1$ individuals in the same way as the opinion of the $n$th individual. This state of fact is not acceptable when individual veto or dictatorship is rejected.

An example of such a function is:

$$\phi(x_{i1}, x_{i2}, \ldots, x_{in}) = \frac{x_{i1} \cdot x_{i2} \ldots x_{in}}{x_{i1} \cdot x_{i2} \ldots x_{in} + (1 - x_{i1}) \cdot (1 - x_{i2}) \ldots (1 - x_{in})}$$

This class of functions satisfy all of Arrow's properties (rationality, decisiveness and democracy).

**Note:** In the fuzzy set setting one can also derive aggregation operations that are many-valued counterparts of the three rules given in Section 1.1.

### Means

These functions are the counterparts of the majority rule. They admit the following properties:

- *Impotency:* This is a strong unanimity condition that does not enable reinforcement effect in preference intensities. If $x_{i1} = x_{i2} = \ldots = x_{in} = x_i$ then $\phi(x_i, \ldots, x_i) = x_i$.
- Adding or withdrawing an indifferent vote modifies the global result by approaching or getting away from the collective indifference. If $x_{ij} < 0.5$ (resp. $x_{ij} > 0.5$) then $\phi(x_{ij}, 0.5) \in [x_{ij}, 0.5]$ (resp. $[0.5, x_{ij}]$).

The typical operation of this kind is the arithmetic mean:

$$\phi(x_{i1}, x_{i2}, \ldots, x_{in}) = \frac{x_{i1} + x_{i2} + \ldots + x_{in}}{n}$$

which is a well known utilitarian aggregation [1].

**Note:** The only associative symmetric sum that is a mean is the median:

$$\phi(x_{i1}, x_{i2}, \ldots, x_{in}) = med(min_j(x_{ij}), max_j(x_{ij}), 0.5)$$

but this function is not very decisive since it leads to indifference as soon as there is some contradiction in the group of voters, i.e., as soon as $\exists x_{ij} \leq 0.5, x_{ik} \geq 0.5$. This rule is the counterpart of the unanimity in social choice theory [9].

### Minimum and Maximum

These operations respectively express the right of veto and the right of dictatorship for any individual. They are thus anti-democratic although they do respect the *minimal democracy* axiom.

With the minimum operation, collective acceptance is hard to reach but collective rejection is attained as soon as there exists an individual rejection. In other respects, the veto (resp. dictatorship) effect attached to the minimum (resp. maximum) can be softened by defining the collective rejection (resp. acceptance) as the rejection (resp. acceptance) by a certain number of individuals. This number can be given in an approximate way by means of fuzzy quantifies.

**Note:** The median and the minimum operations match with the unanimity rule, the arithmetic mean matches with the majority rule, the maximum operation match with dictatorships. Thus, in the context of the voters previously identified, one can attach a —possibly weighted— maximum operation to the class of dictators, either an arithmetic mean or an associative symmetric sum to the class of democratic agents (depending on the role one may want indifference —preference degree of .5— to play), and a —possibly weighted— minimum operation to the class of veto agents.

## 3 Summary

No classical voting procedure can be at the same time democratic, decisive and rational. This is mainly due to the fact that only candidate rankings are taken into account. It turns out that mere partial pre-orders do not have enough expressive power. On the other hand, by using preference intensity vectors, votes can be conveyed by means of discrete fuzzy sets. Therefore, it becomes possible to implement electronic voting procedures that escape Arrow's impossibility theorem. This amounts to determining fuzzy aggregation functions that follow the set of Arrow's (fuzzy) conditions.

The class of functions that satisfy Arrow's general properties (rationality, decisiveness and democracy) is the set of associative symetric sums that are easy to implement in an electronic voting setting.

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# Online voting: a legal perspective[1]

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**Abstract.** Casting a vote for the European Parliament from a cybercafe in Chile, a cruise ship in the Atlantic Ocean, a weekend cottage in the Alps or plainly at home from your laptop computer? This article tackles this question from a legal point of view. It examines the basic principles surrounding online voting. Are the conditions for democratic elections – such as the freedom to vote without undue influence or coercion of any kind, the secrecy of the vote, the integrity, reliability and security of the ballot box, the verifiability and audit ability of the voting process and the principle of one person, one vote – sufficiently met or do we run into legal obstacles? Does the introduction of an electronic or even online voting process jeopardize the principles of non-discriminatory access to the election process? And what about the anonymity? How can one guarantee that a vote over the Internet is cast by the legitimate voter, all the while guaranteeing his privacy? The last chapter of the article briefly touches the current state of affairs within the European Union. Is the introduction of online voting merely a science fictional feature or really within reach?

## Introduction

Online voting easily captures people's interest as being a modern and contemporary alternative for traditional elections: the vote can easily be cast and efficiently processed, the results are rapidly available, archiving is less troublesome, etc. Online voting is also an appealing alternative for citizens residing abroad and for voters who are ill or disabled.

Despite the many obvious benefits of implementing online voting, the topic is riddled with pitfalls that must be carefully dealt with for such an election system to be

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successful. In particular, issues of voting privacy, security and integrity belong to the core of the voting process and must be addressed in any electoral system.

Online voting is doing a fine job trying to throw off its negative image, all the while being gratefully supported by more or less successful (pilot) projects all over Europe. In anticipation of the elections within the European Parliament of the European Union, scheduled for June 2004, the issue acquires more and more the attention of the public. But still, some convincing arguments could persuade critics to take another look at online voting.

# 1. What is an Online Voting System?

## 1.1. The Notion of an Online Voting System

Elections may be organised in many different ways. Paper based elections make use of paper ballots, while automated elections make use of some kind of voting machines, which automate the voting and/or tabulation procedures. When computers are used as voting machines, we talk about electronic voting.

Electronic voting systems may be further divided into off-line and online voting systems.

In an *off-line* voting system the computer is to be seen as a stand-alone computer, whereas in an *online* voting system, the computers are connected in a (closed or open) network. If the Internet functions as network, the term 'Internet voting' is sometimes being used.

As for Internet voting, two main types can be distinguished: polling place Internet voting and remote Internet voting [1].

A *polling place Internet voting system* uses Internet voting computers at traditional polling places, staffed by election officials who assist in the authentication of voters before the ballots are cast. This system doesn't require a digital authentication for the authentication can be done physically, similar to traditional or electronic elections. When the voter is authenticated, he can cast his vote anonymously. A *remote Internet voting system* uses unsupervised Internet voting computers to cast a ballot over the Internet, using a computer not necessarily owned and operated by the election personnel. This system requires electronic (for instance digital) authentication: the voter will need a personal key (password, digital signature) to identify himself as legitimate voter. Authentication is indispensable to guarantee the one man, one vote principle. However, the link between the authenticated voter and the cast ballot must be cut, so as to disable any tracing back.

Undoubtedly an Internet voting system should be introduced gradually. In this respect, an implementation in four stages is highly recommended: (1) Internet voting at voters' polling place, (2) Internet voting at any polling place, (3) remote Internet

voting from county-controlled computers or kiosks and in a last phase (4) remote Internet voting from any Internet-connected computer.

### 1.2. Internet Voting Compared to Absentee Voting

*Postal voting* is the most widespread form of *early or absentee voting*. In many ways Internet votes can be thought of as the electronic equivalent of paper absentee ballots. Both allow ballots to be cast remotely, basically from anywhere in the world, and at any time convenient to the voter within a certain time span before the actual election day. While the two methods inevitably give rise to similar concerns about lost ballots or call for similar mechanisms in order to prevent or detect double voting and to guarantee ballot secrecy, there are still some significant differences. For instance, e-voting systems can immediately provide the voter with feedback concerning the reception and acceptance of his ballot, whereas in case of absentee ballots sent through the mail there is no automatic indication to the voter that the vote has arrived, or arrived on time. The most important difference however is that e-voting raises security issues that have no analogue in the absentee ballot system.

## 2. Basic Principles

The question whether online voting could conform to the basic election rights, as laid down in international and regional convents and in national constitutions, will need to be explored further.

Allowing people to cast their vote online, via electronic communications networks, could jeopardize the following basic requirements, characteristic of genuine elections.

### 2.1. Equal, Non-discriminatory Access to the Election Process

The principle of non-discrimination and equality is a basic right in a democratic society. It ensures the right of every citizen to enjoy his rights and freedoms without discrimination. According to this constitutional requirement, every eligible voter can participate in the election process and nobody can – directly or indirectly – be excluded or discriminated.

#### 2.1.1. Regulation

The rights of non-discrimination and equality are generally and internationally recognised. Since these rights are embedded in international convents, they enjoy absolute priority over national law.[2]

[2] Article 2.1. of the International Convent on Civil and Political Rights states: "*Each State Party to the present Covenant undertakes to respect and to ensure to all individuals within its territory and subject to its jurisdiction the rights recognised in the present Covenant, without distinction of any kind, such as*

**2.1.2. Generally.** The principle of equality and non-discrimination prescribes that equal situations should be treated equally and unequal situations should be treated unequally, if such an approach would turn out to be necessary to enable everyone to enjoy their rights and freedoms without discrimination.

Nevertheless, this does not exclude certain categories of people to be treated distinctly, on the condition however that the criterion for the distinction is *objective* and *reasonable*. This has to be evaluated bearing in mind the goal and consequences of the proposed treatment. In short, the principle of equality is violated, if the distinct treatment is not reasonably proportional to the aimed goal.

The principle prohibits the government to unreasonably limit the rights and freedoms of one category of persons in comparison to the rights and freedoms of other categories. At the same time it carries with it the obligation to take positive action in order to ensure equality.

As far as elections are concerned, the government has to make sure that everyone is equally given the opportunity to participate in public elections. Consequently, the government not only has to avoid enacting laws which unreasonably discriminate certain categories of persons, but also has to ensure *equal accessibility* to the voting process. Government thus has to take active measures to enable absent, ill and disabled people to vote.

Equal access basically requires an easy access to the ballot box for all eligible voters, without discrimination against disabled persons, elderly, computer illiterates, etc. Existing voting systems tend to be poor at accommodating the needs of disabled voters. For example, blind voters have to trust election officials to read the ballots and enter their votes. Electronic voting systems on the other hand, are capable of supporting a diversity of interfaces to the voter [2]. However, the use of an online voting system may not result in complicating the access to the elections for a (large) part of the population. User-friendliness in its largest sense is a precondition for any (online) election system.

As regards the principle of equal accessibility, a distinction has to be made between the different types of online voting systems, namely (1) voting at a supervised poll site using electronic equipment, (2) voting at an unsupervised electronic kiosk and (3) remote online voting using the voter's equipment.

When online voting is allowed at the existing official *poll sites*, there will occur no difference in accessibility compared to traditional voting for these poll sites are equally accessible to all citizens. However, equality could be at risk, if some citizens

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*race, colour, sex, language, religion, political or other opinion, national or social origin, property, birth or other status.*"

Article 2 of the Universal Declaration of Human Rights states: "*Everyone is entitled to all the rights and freedoms set forth in this Declaration, without distinction of any kind, such as race, colour, sex, language, religion, political or other opinion, national or social origin, property, birth or other status. Furthermore, no distinction shall be made on the basis of the political, jurisdictional or international status of the country or territory to which a person belongs, whether it be independent, trust, non-self-governing or under any other limitation of sovereignty.*"

are compelled to use the online voting system, while others can resort to traditional voting. If the online system proves not to comply with the standards for democratic elections in the same way as traditional voting systems (e.g. the online voting system doesn't offer the same security guarantees), there could indeed be an unreasonable discrimination between those who have access to a system that complies with the requirements for democratic elections and those who don't have access to such a system.

The implementation of a *remote online voting system* entails even more risks. In this scenario, votes aren't cast at traditional poll sites, but at any random location. Undoubtedly it would be discriminative if voting in public elections were allowed *only* from a PC at home or at work, and not at public places (official poll sites and 'kiosks'). This would unreasonably eliminate a large number of people who do not have access to a computer (or mobile phone[3]).

When a system of remote online voting *co-exists* with a poll site or kiosk online voting system, it becomes tricky to evaluate the equal accessibility. Though all voters are equal, they are treated distinctly: people who have Internet access (at home or in the workplace), are allowed to vote using those facilities; people who do not have the advantage of such access, are compelled to vote at a kiosk or poll site. In order to enhance equal access, election authorities should make every effort to grant all citizens, without distinction, easy access to the public terminals. Extending the voting period from only one day to more, consecutive days and the placement of voting machines all over the constituencies (in libraries, supermarkets, groceries, post offices, banks, etc.) could serve this purpose.

## 2.2. The Principle of Democratic Elections

With respect to (anonymous) online voting, the principle of democratic elections can't be ignored. Numerous international and national legislations prescribe the right to democratic elections.[4]

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[3] Techniques have been developed to enable voting from a (specially adapted) mobile phone. E.g. the CyberVote project, for more information consult the official website at http://www.eucybervote.org.

[4] Article 25 of the International Covenant on Civil and Political Rights prescribes the following: "*Every citizen shall have the right and the opportunity, without any of the distinctions (...) and without unreasonable restrictions:(...) To vote and to be elected at genuine periodic elections which shall be by universal and equal suffrage and shall be held by secret ballot, guaranteeing the free expression of the will of the electors; (...)*"
Article 21 of the Universal Declaration of Human Rights states the following: "*(1) (2) (...) (3) The will of the people shall be the basis of the authority of government; this shall be expressed in periodic and genuine elections which shall be by universal and equal suffrage and shall be held by secret vote or by equivalent free voting procedures.*"
Article 3 of this Protocol to the Convention for the Protection of Human Rights and Fundamental Freedoms deals with the right to free elections: "*The High Contracting Parties undertake to hold free elections at reasonable intervals by secret ballot, under conditions which will ensure the free expression of the opinion of the people in the choice of the legislature.*"

**2.2.1. The Freedom to Vote, without Undue Influence or Coercion of any Kind / Secrecy of the Vote.** In order for elections to be free and fair, the elector has to be able to cast his vote without influence or coercion of any kind for this may distort or inhibit the free expression of his will. Voters should be granted the opportunity to form their opinion independently, without pressure of any kind, free from coercion, inducement or manipulative interference, without violence or even the threat of violence.

Secrecy and freedom are strictly related principles for secrecy is the precondition of the voter's free political decision. In democratic elections the link between the vote and the voter must be irreversible, so as to ensure the free casting of the votes [3]. Secrecy could be seen as a 'conditio sine qua non' for the non-coercibility of the vote. Only when the voting takes place in secret and the ballot remains secret during the voting process, one can guarantee that the voter is not coerced into casting a particular vote. In traditional voting procedures, the secrecy is 'physically' protected, whereas e-voting may make the virtual voting process extremely vulnerable to violations of this principle.

*A. Secrecy.* Anonymity and secrecy should be observed during the whole election process: (1) during the casting of the vote, (2) during the transfer of the vote from the client to the server and (3) after the transfer of the vote by the server.

*(1) During the Casting of the Vote*

In order to prevent the voter from being unduly influenced when casting his vote, absolute anonymity is required. This requirement however, can only be fully guaranteed in controlled physical circumstances in which the vote is cast. In traditional elections, voters are obliged to cast their vote in private voting booths at official poll sites. Similar material circumstances can only be established in a poll site or a kiosk online voting system for these conditions cannot be implemented and enforced in a remote online voting system. Currently it remains technically impossible to control the circumstances in which the remote votes are cast. Obviously, this can lead to abusive practices: the buying and selling of votes, coercion by family members or by employers or colleagues, etc. This raises serious concerns about the compliance of such an election system with the freedom to vote.

Concerns also relate to the problem of the authentication of the voter. A watertight, one hundred percent secure electronic authentication from a distance is not yet feasible. At the moment, existing technology is unable to guarantee that the voter, authenticated by the system, and the voter who is actually casting the vote, are one and the same.

Regarding these objections, some proponents of a remote online voting system point to exceptions provided for in existing election systems, to press home arguments. They refer to a number of traditional electoral systems which allows voters, ill, disabled or residing abroad, to cast an absentee ballot through ordinary mail. In that case, the non-coercibility has been compromised, in order to serve a higher purpose,

being the right to vote. However, it is to be seen as an exceptional procedure – applicable only to voters who are ill, disabled or residing abroad – created to enable specific categories of people to equally exercise their right to vote. As it is an exception, which serves a legitimate purpose, it can in principle not be generalised in order to become the general rule. On the other hand, it shows that there would be no legal impediment to introduce a remote online voting system for absent, ill or disabled persons. The system would only have to be at least as safe as the existing vote by mail systems.

Another argument in favour of a remote online voting system is that the freedom to vote is experienced less absolute in today's society. Although people nowadays have less scruples about their political preferences, the requirement of the freedom to vote is mainly kept alive to avoid anomalies (illegitimate influence), which will always exist. On the other hand however, an automated voting system would facilitate fraud on a larger scale than is possible today.

Finally, one cannot overlook the role of the Internet with regard to political advertisement and propaganda. The Internet is an ideal medium to enable people to cast an 'informed vote'. After all, the Internet offers enormous possibilities to diffuse the opinion of candidates and their parties and therefore becomes a major source of information on which electors can found their preference. This way the Internet can enhance the 'quality' of the vote and consequently the quality of democracy. Nevertheless, the situation is different when political advertisements pop up on the voting site without prior demand of the voter – like is often the case with commercial messages. Traditional election systems prohibit advertising in the polling place itself. Any Internet voting system should therefore make it technically impossible for such advertisements to appear on the voting website.

*(2) During the Transfer of the Vote*

During the voting procedure – that is, from the moment the encrypted ballot goes online to be transferred – no one, not even the official staff, may be able to link a particular vote with a particular content to a particular voter. This requirement is closely related to the security issue and can therefore be addressed on a technical level in particular by using advanced encryption methods: the system should implement secure technical measures, which would make it impossible for the secrecy of the vote to be breached. In a remote online voting system (possibly also in the kiosk voting system), these technical challenges are most daunting, since the system should not only authenticate eligible voters distantly, but it should also cut the connection between the voter and the ballot.

*(3) After the Transfer of the Vote*

The content of the ballots cast has to remain secret until the moment of tabulation. Therefore, as soon as the cast vote has been received by the system, it must be made technically impossible to find out the content of the vote. If this were possible, the non-coercibility would be jeopardized for votes could be bought, sold or coerced.

Once the vote has been cast, encrypted, sent and received by the system, it would be the safest never to reveal the content of the vote, not even to the voter himself. One could however consider enabling the system to send a confirmation of the receipt of the vote, including the content of the vote. However, this confirmation may never be communicated on a durable medium, like a printed receipt, or in a digital form, which could be saved on a carrier of any kind. This solution doesn't violate the secrecy requirements but allows the voter to correct mistakes before sending his final vote. In addition to increasing the voters' confidence, it also enhances the verifiability and reliability of the system.

Taking into account the foregoing, following requirements could be distilled from the principle of secrecy [4]:

- The secrecy of the vote has to be guaranteed during the casting, transfer, reception, collection and tabulation of the votes;
- None of the actors involved in the voting process (organizers, election officials, trusted third parties, voters, ...) should be able to link a vote to an identifiable voter;
- There must be a clear and evident separation between the registration and authentication procedures on the one hand and the casting and transfer of the vote on the other hand;
- No voter should be able to prove the content of his vote. The confirmation of the vote, after the transfer of the ballot, enforces the confidence in the system while ensuring the rights of the voter, but may under no circumstances relate to the content of the vote.

*B. Freedom and Non-coercibility.* Undue influence of the voter should be prevented. Cryptography can serve this purpose, however, it can only guarantee secrecy from the moment the vote is encrypted. It cannot guarantee the secrecy of the vote prior to that moment. Neither can a system prevent the secrecy of the vote to be violated in case an elector votes from a PC at home or at work, from a computer at an informal public place or kiosk, or even from a mobile phone. Freedom and non-coercibility can only be fully guaranteed if the material circumstances in which the vote is cast, can be controlled. These ideal material circumstances can be attained when Internet voting is only allowed from official polling places and presumably also when it will be allowed from unofficial public places and kiosks. But when Internet voting will be possible from home or workplace or from a mobile phone, these material circumstances clearly cannot be implemented or enforced. This can give rise to abusive practices: the buying and selling of votes, coercion by family members ('family voting') or by employers or colleagues, etc.

It is to be recommended to enact laws that provide obligatory and enforceable rules with regard to the material circumstances in which a vote has to be cast, and sanctioning the practice of illegitimately influencing a voter.

**2.2.2. One Person, One Vote.** The universal and equal suffrage is another basic principle of democratic elections: each elector is entitled to only one vote. It also

implies that every vote is counted equally. Naturally there may be no possibility to alter or remove a validly cast vote in the course of the voting process.

The principle entails 4 principles: (1) only legitimate voters can be allowed to vote; (2) each legitimate voter can vote only once; (3) every legitimately cast vote has to be counted once and (4) a legitimately cast vote may not be able to be altered in the course of the voting process.

The first two principles concern authentication, the last two principles refer to security and reliability.

As regards authentication, this can be divided into *physical and digital authentication.*

The first one signifies that the voter is identified, based upon one or more physical characteristics like gender, face, fingerprint, eye-structure, signature, handwriting, DNA-structure, etc.

The latter is performed by using a personal, secret code, which can be a number incorporated in a magnetic card or a chip-card, or a simple letter and/or figure combination, etc. Naturally the voter has to receive the code and the matching password in advance.

This transfer can take place in two ways: *off-line and online.*

Off-line, the code is provided after physical authentication of the voter: based on his physical characteristics, it is controlled that he is indeed the person he claims to be and that the code has not yet come into his hands. In the future, it would be possible for example to provide every citizen, after physical authentication, with an identity card with a chip or magnetic strip built in, containing the personal code (his 'private key'), which can be used for authentication in public and private life, in combination with a secret, personal password. This private key could then also be used for authentication in Internet elections.

The personal identification code can also be provided online. Nevertheless, authentication then is unreliable for it is based on non-verifiable elements. In any case it is essential for the private key to be kept on a safe carrier. A magnetic strip isn't safe enough, because its content can be read too easily. Therefore, the private/public key pair authentication should be used according to the methods and standards of the existing and future Public Key Infrastructures (PKI).

From a legal point of view it is worth mentioning that the law considers a digital signature of equal value to a handwritten signature. This is explicitly provided in Directive 99/93/EC of the European Parliament and the Council of 13 December 1999 on a Community framework for electronic signatures [5], which states in article 5 that "*Member States shall ensure that advanced electronic signatures, which are based on a qualified certificate and which are created by a secure-signature-creation device, satisfy the legal requirements of a signature in relation to data in electronic form in the same manner as a hand-written signature satisfies those requirements in relation to paper-based data and are admissible as evidence in legal proceedings.*"

Thus there is a tendency to recognise the digital signature technique as a legally valid authentication method.

that an electronic ballot is not forged or modified surreptitiously; (3) *vote privacy*: assuring that no one can find out how any individual voter voted; (4) *vote reliability*: assuring that no Internet ballot can get lost; (5) *non-duplication*: assuring that no voter can vote twice; (6) *defence against denial of service attacks* on vote servers and clients and (7) *defence against malicious code attacks* on vote clients.

**2.2.4. Verifiability and Audit Ability of the Voting Process.** Voters, independent officers, representatives of the political parties in competition and independent observers – including media reporters – must be able to control polling and tabulation. This could require the individual ballots to be recorded permanently on indelible media to allow for a recount should that be necessary.

The integrity and trustworthiness of a voting system is greatly enhanced by having an audit trail recording each ballot cast. Audit trails with very high integrity can be obtained when the audit trail is created directly by the voter, as with a paper ballot. However, electronic voting systems are indirect. They interpose a layer of mechanism between the voter and the audit trail, risking the possibility that the mechanism is not faithfully capturing the voter's preferences [8].

**2.2.5. Voter's Confidence in the Voting System.** In order to enhance voters' confidence in the online voting system, it could be recommended to make the source code publicly available, in order for citizens to be able to study the software and verify the reliability and security of the system. On the other hand however, open sources can make the election system more vulnerable to hacking attacks and therefore compromise the security of the system. A solution may be to open the source only to a select group of experts, like for instance the election committee that manages the election and/or independent advisors.

## 3. Online Voting Systems and Anonymity

How can one guarantee that a vote over the Internet is cast by the legitimate voter while guaranteeing his privacy at the same time? In order for one computer to send data to another – as is the case in any Internet voting system – both computers must know the unique address of the sender and the recipient of the data. This unshakable tenet of the Internet contrasts sharply with the requirement of the secret ballot in elections.

The secrecy of a voter's ballot choice should be preserved and every reasonable technical means should be used to prevent anyone from violating ballot privacy anywhere along the path from the vote up to the election results. It's easy to understand the critical importance of a secret ballot, defined as a way to cast a vote "in such a manner that the person expressing such choice cannot be identified with the choice expressed." A private, anonymous ballot protects the process from votes being bought or sold, and protects you from coercion.

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A system is *private* [9] if neither the election authority nor anyone else can link any ballot to the voter who cast it and no voter can prove that he/she voted in a particular way.

Home-based electronic voting which, by its very nature, is unsupervised, represents a threat to the core values of freedom and fairness which underlie democratic elections. There can be no guarantee of the freedom from external influence by third parties during the casting of votes at home. This constitutes an inherent risk of any form of remote voting. To face this risk, measures should be taken on the policy and regulatory levels, in order to impose compelling and enforceable measures against coercion and to sanction illicit behaviour. Uncoercibility and the prevention of vote buying and extortion can be ensured by an e-voting system designed so that no voter can prove that he/she voted in a particular way (untraceability on the part of the voter [10]). In democratic elections, the link between the ballot and the voter must be irreversibly severed to ensure that votes are cast freely. Voters must be unable to prove how they voted, in order to reduce the risk of coercion or vote selling. For if voters cannot prove how they voted, buying votes becomes a worthless endeavour in that potential vote buyers would not know what they are buying.

However, academics highlight the need to maintain a paper trail of how each individual voted, in case the votes would need to be counted manually in the event of a recount. The presence of such an audit trail would inevitably entail the tracing back of each individual to their vote, thereby compromising their anonymity. There will always be a trade-off between the two [11]. The e-voting system should be designed in such a way as to make vote control and recount technically feasible, without re-identifying the voters.

A possible solution to the threat of coercion is to develop a publicly accessible infrastructure, in public and controlled physical sites, thus allowing voters to exercise their rights free of the coercion of any third party. This solution however, outweighs the advantage of mobility, in that there are restrictions on the location from which a voter can cast his vote [12]. Immediately after the sending of the ballot to the server and without waiting for feedback from the server, or immediately after the moment that the voter clicks on the 'cancel' button, all records of the vote must be deliberately erased from the voter's computer.

Despite the risks, a lot of people want a home Internet voting solution. The ability to vote from home seems to be very convenient and attractive to Web-connected households, potentially increasing voter turnout for future elections. Although, it would be essential, especially in the first phases of any Internet voting introduction, to retain centralized polling places for those who would not have access to computers otherwise.

Voter anonymity can be achieved by masking the identity of each voter so that no reverse association can be made. However, such an approach makes accountability

much more difficult. One-way hashing functions or even public-key encryption may be useful for providing later verification that a particular vote was actually recorded as cast, but no completely satisfactory scheme exists guaranteeing voter anonymity, consistency of the votes tabulated with respect to those cast and correct results.[6] Any attempt to maintain a bi-directional online association between voter and votes cast is suspect because of the inability to protect such information in this environment [13].

Encryption, through the use of digital signatures and digital certificates, requires a public-key infrastructure (PKI) to identify and authenticate millions of voters. Even with PKI or some other form of security in place, there is no guarantee that a person's vote will remain anonymous. Digital signatures don't solve the anonymity problem. There's still the risk that a vote filed with a digital signature could be tracked and identified by a government authority.

## 4. Current State of Affairs within the European Union

### 4.1. Belgium

In Belgium, the first introduction of the possibility to vote electronically, i.e. during the municipal elections of 2000, has given rise to quite a lot of legal claims concerning the lack of transparency of electronic voting. One court claimed electronic voting to be illegal in the context of international law. Although the court admitted that it was not competent to prevent the elections from being held, it ruled that a system in which flaws and fraud can only be detected by the established power at the moment of election and not by an independent authority, violates the rights guaranteed by the International Convention of December 19, 1966 on civil and political rights.

Bearing in mind all the obstacles blocking the way to a well functioning electronic voting system, one could consider having recourse to Internet voting. Voting through optic reading of the paper ballots has been put forward as a way of enhancing the processing of the results, while safeguarding the trust of the voters; however, the system does not tackle the fact that voters need to be present themselves at the polling station. Internet voting, by contrast, can serve as a mobile system in which there are no restrictions (other than the logistical ones) with regard to the location from which a voter can cast his vote.

At the end of February 2003, the Belgian Government decided to expand the possibility of electronic voting over the whole country as from the municipal elections of 2006.

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[6] The CyberVote project claims to be one of the most innovative and secure systems available. For additional information consult the official website at http://www.eucybervote.org.

### 4.2. United Kingdom

Voting by mail is the most common form of early or absentee voting. In the UK, postal voting has proven to be a success in terms of improving voter turnout. Postal votes can be obtained on demand as a result of changes introduced by Section 12 and Schedule 4 of the Representation of the People Act 2000, which entered into force on February 16, 2001[7].

During the last couple of years, the UK has expanded its programme for e-voting experiments (in particular voting via the Internet, SMS, touch screen kiosks and touch telephones). The UK Electoral Commission[8] stated in its evaluation report of the electoral pilot experiments conducted in May 2002 that it had not found any evidence of an increased risk of fraud. "However, further testing is clearly deemed to be highly necessary to tease out a number of practical issues, to foster public confidence and to further develop the security of e-voting mechanisms".

The 2003 electoral pilot program was a partnership between the Office of the Deputy Prime Minister, the Office of the E-Envoy, the Electoral Commission and the Local Government Association (LGA). The project enabled over 1.5 million voters to cast their vote electronically by phone, SMS, and the Internet. An additional channel was available to voters because for the first time, voting was possible using interactive digital television (iDTV). During these experiments, voters were able to vote before the normal polling day. Instead of a polling card, they received IDs to prevent multiple voting and they were provided with information packs explaining how the system operated. Four municipal authorities did not even offer the traditional voting methods, so that voters who didn't dispose of the e-voting equipment had to resort to postal voting.

Despite some minor problems, the operational problems were overcome and the potential vulnerabilities arising from the procurement process did not cause material problems during the election period. There is clearly a balance to be obtained between security, convenience and accessibility. In general, the election was carried out competently, meeting a good commercial standard. However, the risk of malicious attacks was low as the systems were recently developed, the implementation varied widely across the different pilots and the relative uptake of electronic voting is still less than traditional methods. Therefore, in the Electoral Commission's opinion, the motivation and capacity of potential attackers was likely to be low. Evidently, as the e-voting programme will progress towards the Government's objectives, the threats will increase and a number of significant issues will have to be addressed accordingly.

[7] http://www.hmso.gov.uk/acts/acts2000/20000002.htm.
[8] http://www.electoralcommission.org.uk/about-us/researchpub.cfm.

### 4.3. Switzerland

Under the impulse of the federal Government, three cantons – Neuchâtel, Zürich and Geneva –took their first steps in the area of online democratic elections in 2002.[9]

Whereas Geneva and Neuchâtel tailored their systems exclusively to the personal computer, Zürich took into account that, in the future, citizens may rely more on mobile phones, personal digital assistants or other mobile devices. Consequently, Zürich envisaged a polling system in which all problems relating to reliability, security, encryption and privacy are solved for a very wide range of different hardware configurations, operating platforms, software applications and transmission protocols.

In March 2001, the Geneva State Council officially launched the *'Geneva Internet Voting System'* [10]. In a comparative international perspective, the current Internet voting project in the Canton of Geneva stands out as one of the few serious attempts to implement binding governmental voting procedures. The aim of the project was to offer an additional way of casting a ballot. The Internet Voting System didn't intend to replace the existing ballot forms – the traditional ballot box or postal voting – at least not in the near future. Recently, the state of Geneva has taken the e-voting project interoperability and accessibility to the next level through the integration of biometric and voice recognition technology.

A recent Internet voting experiment during a referendum in Anières (Geneva) in January 2003 turned out very successful. However, the project strictly focused on voting on yes-no issues so that complications in respect of electoral procedures have not been dealt with.

### 4.4. Estonia

In Spring 2001, the Minister of Justice of Estonia proposed the introduction of electronic voting in future elections.[11] Since voting is not compulsory in Estonia, the government hopes to attract greater participation in elections and political debates by this move to online voting, especially among younger people. According to the plans, citizens will be allowed to register as e-voters and sign their ballots electronically using a digital signature, which would enable voting via Internet at home. However, Internet voting will not eliminate traditional voting; it is merely an additional way of voting.

The current Election Act provides for the possibility to vote electronically at the latest in the year 2005, on the one condition that all crucial technical issues are solved by that time. The focus is mostly on safeguarding against fraud. Although security is a major concern, it is believed that a combination of digital signatures and smart card

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[9] http://socio.ch/intcom/t_hgeser12.htm.
[10] www.geneve.ch/chancellerie/E-Government/e-voting.html.
[11] http://www.vm.ee/eng/kat_175/2972.html.

identification will be sufficient to eliminate fraud. In order to vote electronically, voters need to have a digital signature certificate, which is programmed in their electronic ID card. This card was introduced in 2002. Internet voting would take place only on advance polling days. This will be easy, as many Estonians are already used to voting during advance polling days.

### 4.5. Conclusion

This short overview demonstrates that in the near future and provided that the scheduled trial experiments are successful, Internet voting will not be limited to certain non-binding or informal local elections, but that it will be tested during some major elections. There is no question about it that the results of such major experiments will be of crucial importance with a view to the use of the Internet as a means of voting in the near future.

## Conclusion

Implementing an online voting system offers a lot of advantages. Firstly, it may increase voter turnout by making the elections more convenient and more accessible to disabled voter. Secondly, online voting can be made more interactive and relevant by allowing voters to see photos and statements by the candidates next to the ballot. Finally, electronic voting can bring the population closer to the concept of a 'direct democracy', wherein the citizens themselves can participate more actively in the creation of laws [14].

The right to vote is only one part of the democratic process, but it remains a civil right deeply embedded in constitutions and is considered to be one of the primary foundations of democracy. Hence, e-voting is not like a common electronic transaction. An e-voting procedure will only be acceptable under the condition that it safeguards the constitutional principles associated with the voting process, as there is equality, freedom, secrecy, transparency and accountability.

It is important to realize that submitting one's identity for purposes of assuring voting eligibility can easily serve as a way to identify what vote an individual has cast. In addition, the vote-recording process is invisible to the voter; thus there is no reliable way of ensuring that propriety is kept. By their very nature, electronic operations on data are invisible to the user, and experts in the field confirm that the technology simply does not exist to authenticate transactions while ensuring total anonymity of the voter [15]. Therefore, even if a voting program states that it keeps identification information separate from voting information, an individual voter would have no way to confirm this. The difficulty lies in convincing voters that their privacy is maintained at all times.

To this end, the public must be kept apprised of the manner by which the Internet is protected from outside influences, including national and international hackers as well

as individual voters who might try to cast more than one ballot. Additionally, it is imperative that all voters are assured that their right to a secret ballot is protected and guarded by government officials who themselves are kept aware of who has voted, but purposely are kept ignorant of how individuals voted. This is the fine line that those who administer Internet voting must walk – audits must be possible, fraud must be impossible and the secrecy of ballots must be ensured at all times.

The legal framework should provide for ballot security, while at the same time ensuring that no individual ballot can be identified as being marked by a specific voter [16].

For the moment it seems unlikely for the anonymity of the vote to be fully guaranteed in a remote (online) electronic voting system, in which voters would be allowed to vote from any PC connected to the network (a PC at home or work for instance). While electronic voting from home should perhaps forever remain too risky a fantasy, electronic poll-site voting may provide, even in the near term, worthwhile improvements to paper-based voting technologies. A remote online voting system requires distance authentication of the voter and it does not allow control as to the circumstances in which the vote has been cast.

Today, no sufficient technical solutions exist for the situation in which the secrecy of the vote cannot be guaranteed in a remote online voting system, unless measures are taken on policy level and laws are drafted and enacted which impose compelling and enforceable measures and which sanction illicit behaviour.

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# E-COGNOCRACY: COMBINING E-DEMOCRACY WITH KNOWLEDGE NETWORKS

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**Abstract.** We propose a new approach, *e-cognocracy*, to enrich the democratic government system with the Internet-based knowledge basis of a society. This is not a technique for voting systems to represent the parties in a democratic assembly or an e-voting procedure. It is rather a procedure to add a new dimension of knowledge to the democratic system using the Internet. This creates a new quality in the process of decision-making and consists in the creation and diffusion of the society-based knowledge. And it helps to make decisions using a scientific quantification, analysis and resolution of problems. This system of *ecognocracy* will allow the participation of all interested citizens in the process of solving highly complex problems. Such a process can also be called "participatory decision-making".

**Key words:** democracy, decision-making, knowledge society, evoting, e government.

## 1 Introduction

Over the last decade, we have witnessed a social transformation that is the result of the development of new technologies. The emergence of the Internet (web) has transformed the behavior of individuals and organizations in the developed democracies. It is almost impossible to imagine any business or social organization that is not perpetuating their messages by using the Internet.

This new life style of the knowledge society induces a change of paradigm, motivated by the evolution in information and communication technologies (ICT) that is being introduced at great speed in all the spheres of our daily life. During the last decade

and essentially as a result of the political guidelines of the European Union[1], these new technologies are being incorporated into many public administrations, into politics and, generally, into the governance of European citizens[2].

Obviously, the use of the new technologies in the governance of the citizens (*e-governance*) could be limited, as is the case in other areas of business activity, to mere technical assistance in the achievement of certain objectives, in this case to facilitate the election of the democratic representatives of individuals (*e-voting*). However, modern economy is based on the so-called "Knowledge Economy", in which knowledge is seen as the product resulting from any production process, and not a side-product as some might concede. Thus, in the post-industrial society, the new technologies that work for the benefit of democracy, particularly through the Internet, must not be limited to a merely supporting role.

Turning to electronic democracy, we regard the creation and diffusion of knowledge through public discussion as the central role of the web, i.e. the inclusion of mature citizens in the public or political decision-making process. The use of knowledge in a social decision process is in the spirit of the proposals of modern scientific philosophers such as D. Diderot[3] and J. Habermas[4].

Taking advantage of the democratic system as a vehicle of social involvement and of the web as a vehicle of communication, we present a new democratic system in the following that allows us to remedy some of the limitations of the traditional democratic system and to encourage the cognitive or fundamental process of living systems (Capra, [3]) - a process that characterizes the existence and perpetuation of the species, particularly of the human being. True electronic democracy consists of involving[5] citizens (something that goes beyond mere participation and discussion) in the generation and diffusion of knowledge.

The paper is organized as follows. After this brief introduction, we reflect in Section 2 on a number of the new aspects of traditional and electronic democracy. We consider various possibilities that are brought about by the new electronic technologies and that are increasingly available for the public service of democracy. In Section 3 we discuss our new views for a democratic system based on knowledge. In the last section we list our conclusions.

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[1] see e.g. the EU's Sixth Framework Program,

[2] see the priority lines 1.1.2 *Information Society Technologies* and. 1.1.7 *Citizens and Governance.*

[3] "The search for knowledge is the route to satisfaction". http://www.kirjasto.sci.fi/diderot.htm

[4] "Science and democracy share one style of thinking".

[5] The idea of direct involvement or implication is used indistinctly in this paper.

# 2 Electronic Democracy

## 2.1 Traditional Democracies

Democracy is understood as the political system in which the people exercise their sovereignty through representatives in government and parliaments and with the aim of improving their own conditions. Under this political system, and by way of universal suffrage, the people nowadays have the right to elect and control their governments on a periodical basis.

In its origins, democracy was more of a political concept defended by one camp (the democratic camp arose in opposition to the aristocratic) than a determined type of social organization. Thus, in ancient Greece the direct participation of everyone in the Popular Assembly was encouraged by the limited size of the population and by the fact that initially only those who qualified as citizens took part in the decision process.

The traditional democratic system which is aimed at organizing the governing of a society has certain limitations of the following kind:

- The participation of the citizens is limited in the majority of cases to the moment of actually electing the representatives on Election Day. Even then, in the absence of open lists, this process is often restricted to the choice of a specific political party. As such, it is a single act and not, as should be expected in self-organized dynamic systems, a continuous process of participation and improvement.
- The static voting procedure implies a low level of internal democracy as only a very limited number of a political party's members actually controls the nomination of the electoral lists. Such a process might be efficient regarding time, but it is unlikely to reflect the opinion of the voters adequately. The free choice of the citizens is distorted, because there is an a priori filtering of the candidates by party representatives. In such circumstances, the voting is limited to a *pro-rata* exercise between the candidates fixed by the party "functionaries".
- The current democratic system gives no consideration to those individuals who do not vote, whilst those that deposit a blank ballot paper, usually as a protest against the system, are viewed as part of that system. Indeed, these votes are taken into account to reinforce the role of the majority groups. The system tries to perpetuate itself over time, establishing barriers to entry[6] (minority groups) and carrying out a feed-back exercise with the creation or generation of new "figures" or political leaders and their legitimation.

[6] When speaking of the generation of knowledge it is a mistake to forget the minority groups, given that the "discovery" of truth and knowledge is usually a specific act, carried out by an individual and not by a group.

- Political parties can abuse the confidence placed in them by their voters. After Election Day, parties can pursue objectives that are not declared in their electoral manifestos. These are hidden interests that sometimes govern the behavior of these parties, or at least of some of their members. In certain extreme situations, it could even be a minority group whose goals are clearly in conflict with those of the majority of the party representatives (or deputies in the chamber) who actually decides on sensitive questions.
- In the present democratic elections, control over the activities of politicians is limited to control their mandate: This is done by casting a vote in regular intervals at the occasion of an election. Many citizens find this unappealing, given that today we are creating a global society that has the potential of a much broader basis of knowledge. Political interventions can be conducted through the Internet if the preference structures of individuals are rapidly changing or slowly evolving (this characterizes the dynamic character of preferences). Except for Switzerland, the only Western direct democracy, control over the democratic system is exercised at election days that are regularly spaced over time.
- Societies without democracy might have disadvantages in competition in the long run and there might even be *social opportunity costs* from not using the full spectrum of democratic participation. The new possibilities of e-democracy can be used for more ambitious objectives than simply electing representatives. Thus, most present democratic systems can be viewed as static since they are not using the dynamics of democratic discussions and participations, such as individual responsibilities, dialogue, the search for and the dissemination of knowledge, the strengthening of ethical and moral values, or learning and education.

## 2.2 Internet and Democracy

During the last decade, we have witnessed a dramatic change in our society by two events: first, the information basis has changed through the Internet; second, the value system of western societies is more driven by ecological concerns and sustainable economic growth.

Technological development has been incorporating itself in all these social ambits. In the particular case of democracy, there have been a number of proposals aimed at using the web to facilitate the election process of democratic representatives (*e-voting*). In this case, aspects relating to security and confidence in the communication and treatment of information are essential for the system in order to have any credibility. To encourage such a social perception, it would be highly appropriate if the web allowed individuals to verify the traces left by the voting process. In this regard, it would be sufficient if the citizen could confirm that the vote cast indeed corresponded to the option chosen.

Furthermore, the web can be used to make democratic decision processes more transparent. Internet access improves political communications and the accessibility of political representatives and parties for their citizens. Some smaller nations in Europe are already taking advantage of the new possibilities. The government of Estonia prepares and governs their weekly sessions through connected laptops.

But also the control of governments can be made more democratic through the Internet. It enables the voter to check and learn about the agenda of the parliamentary sessions regularly and "on-line". Similarly, the interested voter can inform him- or herself on the meetings of representative bodies. Parties in the era of Internet-searching voters have already adapted to the new information challenges: political parties have installed on-line information and offer communication between citizens and their political representatives. A recent election for presidency in Austria (in April 2004) has shown that candidates keep their supporters and voters informed by a diary which was kept up to date every day during the election campaign.

When we speak of the search for knowledge, this should be understood as the search of substantial or relevant knowledge for each new decision case. Such information takes into account that the relevant knowledge of any "small world" decisions is closely related to the knowledge of "large world" decisions. Internet based searches for decision helps will show that many smaller problems are immersed in a larger world with larger problems, i.e., that a deeper knowledge usually helps to clarify one's process of making a decision.

Thus, a modern democratic system should develop decision-making tools that will allow us to study the patterns of political behavior of all the groups involved. The extraction and diffusion of common knowledge is closely related, as Habermas [7] indicates, to the ideal line of thinking in modern democracies.

## 3 E-cognocracy

We discuss a new democratic approach that is based on the use of the Internet and reflects the evolutionary nature and a certain holistic view of our society. We would like to give the name "*e-cognocracy*" to this approach which can be characterized by the following points:

1. Citizens can choose between different styles of how to participate in democratic systems. This will continue the existing practice of placing votes of confidence for a political party : traditionally by urn voting, recently by *e-voting*; or citizens involve themselves directly in the solving of problems, contributing opinions and ideas that will allow for an improvement in our knowledge of the process of decision-making followed by the system (e-cognocracy).
2. Parliamentary seats will be distributed in two parts: (i) one occupied by the traditional political parties as is usually the case (the parties' part) and (ii) the other part is reserved for those citizens who wish to be directly involved in

the democratic process (the citizens' part). The percentage assigned to these two parts of the parliament is a critical parameter of the new procedure: A significant part of a successful public implementation will depend on the political attention as how this threshold parameter is selected. In principle, a value in the interval between 60% and 80% for the parties' part and the rest for the citizens' part seems to be reasonable. There is no reason why these values should be static, as is the case with preferences, given that they can be adapted in line with the interest shown by the citizens in this form of participation. In any event, it is suggested that there is a minimum of 50% for the parties' part.

3. Not all the themes have to be solved by a mandatory participation of all the citizens. As we know from some existing legal systems, criminal charges can be tried by a popular jury in certain circumstances, but in others not. Something similar could be possible here. The selection of topics and questions that will be discussed and decided in the process of *e-cognocracy* is another important aspect of the proposal. Both, the number and frequency of the questions that will be posed for decisions by a specific group, as well as the type and contents, will be crucial elements of the political system. The political culture of a country will have an important role in the implementation of such a new democratic proposal.

4. The direct involvement of citizens in political decision-making is orientated towards the improvement and diffusion of social knowledge. Also the proposed topic and the wish of expanding knowledge relative to the scientific method will be important for the resolution of the problem. In order to begin such a new political process, consideration could be given to the proposals made by the traditional parties, and thereafter, with the help of a "*facilitator*", that is to say, by a specialist in scientific decision-making. Thus, it would be possible to propose and prepare decision problems, and to extract the knowledge relevant to the political learning process.

5. This relevant knowledge of the problem refers to patterns of behavior, preference structures, stylized facts and trends. As a starting point in the search for consensus between the parties (political parties and groups of involved citizens), we could think in terms of obtaining an initial preference structure which reflects what is common in the opinions of the actors involved, that is to say, the nucleus with respect to some attribute considered in the problem (for example, the consistency referred to in Moreno-Jiménez et al., [15]).

6. The resolution of the problem will eventually consist in the ranking of a set of discrete alternatives, from amongst which either the best alternative or a set of alternatives would be selected. To deal with these types of situations it is necessary that we employ a multi-criteria framework that allows for the resolution of problems with multiple scenarios, criteria and actors, and in which the incorporation of the intangible and subjective aspects is fundamental to the resolution of the problem.

*E-cognocracy* is characterized by the following points:

a) It allows for the direct involvement of the citizens, thereby potentially endorsing their participation in the democratic system.

b) It improves the control of the political system, it could reduce unintended influences and dependencies on minority groups, as there will always be a margin of votes to be won in each problem and moment in time. This will lead to more extensive coalitions between groups which, in turn, will favor more centrist and majority-supported positions.

c) It improves the overall knowledge of the system, strengthens the discussion and the debate of ideas and leads to more negotiations and search for consensus processes. Although the final solution is directed towards more centrist and less extreme positions from a practical point of view (the world of realities), this is not the case from a theoretical point of view (the world of ideas). Here the improvement of knowledge can emerge from postures that are in total confrontation, which, in turn, will favor learning, given that a larger conceptual spectrum is thereby made available.

d) It brings together people interested in a continuous knowledge "formation" process. One of the objectives of Rawlsian social justice [21] is the equality of social opportunities. Of course, there will be individuals who do not wish to participate in the system, and it is questionable whether they should be obliged to do so. Such continuous formation processes should allow for equality of opportunity for all those who show an interest in it.

e) It permits the easy expansion and diffusion of knowledge, as well as the creation of certain minimum ethical standards and the consideration of more sustainable lifestyles. All this is favored by the actuality and interest of the themes being debated, which will help in spreading the ideas and values that emerge from the discussion.

f) The proposal is not a new one to discuss or alter representations in democratic systems, but follows the line of the approval voting of Brams and Fishburn [2] which could be extended to a more general situation where the intensity of the approval is involved. This approach imposes rather a radical change to the orientation given to these systems. Thus, instead of searching for the election of representatives, what is sought is the creation and diffusion of knowledge derived from scientific decision-making in the government of the citizens.

g) The multi-criteria framework proposed to deal with the specific part (direct involvement of the citizens) allows the voter to be incorporated in the decision process through values and judgments. Here we should note that the objective treatment of the subjective will challenge scientific research on such procedures. As Bernard Roy [22] points out, this scientific character will be given by the rigor, transparency and accessibility of the method applied.

With respect to the two basic processes (*e-discussion* and *e-voting*, which constitute e-democracy), *e-cognocracy* adds a third one, *e-cognition*, which is oriented towards the extraction and diffusion of knowledge (learning) in the decision making process. Following the constructive approach, or the European school of decision analysis (Roy, [22]), we incorporate a new step in the traditional resolution process of multi-criteria models in order to learn about the processes and procedures involved (this can be viewed as the "value added" of knowledge).
Obviously, when it comes to the use of computers and the Internet in any process of decision-making, a number of questions arises with respect to data-security in the web and the security of the system, something that can be nowadays solved by new technical standards like the electronic signature[7]. Properties such as authenticity, integrity, and confidentiality should be perfectly guaranteed through the use of appropriate tools such as the PKI (Public Key Infrastructure)[8]. In this sense, Simon French [5] suggests that the necessary attributes of this type of system are competence, objectivity, justice and consistency.

## 4 Conclusions

If there is one key factor in the cultural and social transformation through which mankind has been passing during the last quarter of the 20th century, then it is the development of new electronic technologies. This new type of influence that information and communication technologies are having on the behavior of individuals, organizations, or systems transforms our society.
To analyze the major societal challenges in Europe, the Sixth Framework Program of the European Union has established several priority research lines which are currently explored by trans-national research projects[9]. The results of these projects will contribute directly to realizing European policies for the Knowledge Society[10], as was agreed by the European leaders at the Lisbon Council of 2000, the Stockholm Council of 2001, and reflected in the e-Europe Action Plan[11].

Following this line of thinking, and in accordance with the new challenges for the Knowledge Society of the 21st Century, this paper has formulated the general ideas for a new democratic system, called *e-cognocracy*. As well as allowing for a greater integration of the citizens in their own governance, and in accordance with the most recent evolutionist theories, the aim of this proposed system is to direct the citizens' efforts towards one of the essential activities of human living systems: the creation and diffusion of knowledge referred to the decision making process followed by the system, and the procedures employed by it in the scientific resolution of the problem under consideration.

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[7] Several European states (e.g. Austria) have already introduced such laws to encourage e-business and e-voting.

[8] www.gao.gov/new.items/d04157.pdf

[9] 1.1.2 Information Society Technologies (IST); 1.1.7 Citizens and Governance;...

[10] www.masie.com/masie/researchreports/elearning0700nate2.pdf (by B.R. Ruttenbur et al.)

[11] http://www.cimu.gov.mt/documents/e_europe.pdf

In the context of the Knowledge Society and of e-governance, this new democratic system, *e-cognocracy*, offers a new platform for the direct participation of the citizen in governance. This new organizing approach is oriented towards the education of society in values related to participatory and spatially distributed democratic and science-based decision-making.

In this sense, it is necessary to develop new decisional tools, such as scenario planning, advanced visualization, web accessible group support systems and general decision-making tools, etc., that improve the transparency of the process. More attention must be given to the articulation of individuals' conflicting interests, the communication between the actors involved in the resolution process and the effectiveness, efficacy and efficiency of the negotiated processes.

Our views are based on four main characteristics. First, they incorporate the new developments of the science of decision-making, that is to say, the inclusion of the subjective, the intangible and the emotional, with special emphasis being placed on the human factor. Secondly, they use the multi-criteria decision-making paradigm as its methodological support (see Moreno and Polasek [18]).. Thirdly, as operational support, our approach offers a series of decisional tools which are implemented in interactive decision support systems and connected in networks. It allows taking advantage of the potential offered by the new technologies to facilitate the tasks faced by individuals and systems as regards their own management and government. Finally, it favors the development of socially recognized and pursued values, such as knowledge, freedom, peaceful coexistence, formation, participation, self-governance and European integration (meaning the elimination of geographical, cultural, political and technological barriers).

In this sense, the research line followed in this paper opens the way to one of the areas of multidisciplinary collaboration with the brightest future in the ambit of the knowledge society, that is to say, the integration of decision support systems, multi-criteria techniques and citizens' e-governance. In summary, we seek to develop tools which - orientated fundamentally towards the human factor and its full participation in the Information Society - make it possible for all individuals to gain access to a multitude of services and applications and, in general, to knowledge. This requires the integration of communication and computer networks in a context of barrier-free technologies and easy-to-use human interfaces.

Obviously, there are many questions, both technical and philosophical-methodological, which remain open and need further detailed consideration. From a technical point of view, the decisional tools (including data mining, artificial intelligence, simulation, prediction, visualization...) are employed in knowledge management (Tissen et al. [23]). The spectrum is quite wide: it runs from its extraction up to its representation and, finally, its exploitation, and must be studied in greater detail than is possible in this purely precursory, motivating and introductory work.

From a more philosophical point of view, there is a fundamental element in the success of any social innovation process such as the one that is proposed here. If, in general, a society and its leaders are often resistant to structural changes, then they

will be also less enthusiastic about a system change that involves two important pillars of powers: representation and knowledge.

The implications of an *e-cognocracy* system have a direct effect on politicians, since *e-cognocracy* tries to change the quality of the democratic representation and the transparency of the decisions. This process involves the creation and diffusion of public knowledge that is characteristic of *e-cognocracy*. This element could have an unfavorable impact on the group which must finally present and approve, if this is the case, the proposal. The fact that our politicians must approve a new political procedure that has a direct effect upon their future position will have a big impact on the acceptance of the new system.

This process should be accompanied by a program that will educate citizens, their leaders and, in general, the society at large, in order to support the feedback in self-organized dynamic systems. The use of public knowledge in an enlarged political process of political participation and decision-making is the road towards social progress, which we considered as an evolutionary step in a life-long continuous process of learning.
For this purpose, we suggested in Moreno and Polasek [18] the multi-criteria framework as a way to deal with the modeling and resolution of complex problems. Similarly, in the context of one of the most widely used multi-criteria techniques, namely the analytic hierarchy process (AHP), we propose some decisional tools (*analytic* and *informatic* tools) orientated towards searching for the relevant knowledge associated with the decision making process and the procedures employed within it. This process of knowledge transmission will be reflected in political behavior, trends, education, and decision making, and can be the starting point of a consensus-oriented negotiation process. It could be a new way to solve problems of high complexity more effectively than in our current democratic system.

We would like to end our essay with the motto:

***There is no democracy without freedom; there is no freedom without knowledge.***

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# *e*Government and Identity Management: a Signature Coding Method for PIN generation

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**Abstract.** This paper evaluates some of the technological factors that could help to reduce the impact of *e*Government in current society. Then, ergonomics are used to provide some guidelines to design systems that could be easily accepted by users. We focus on security, which is one of the main concerns of Information Society Technologies (IST) users. Regarding ergonomics, we discuss different security options and propose a design based on biometrics, specifically on signature verification. Some preliminary tests to support the proposed design have been succesfully conducted and are also presented in the paper.

## 1 *e*Government and Identity Management

In recent years, the impact of technology in society is increasing. Particularly, Internet has become one of the most important links between people and technology in the last decade. *Nielsen* reports in 2002 state that a 40 % in average of people in developed countries is connected to the web. It might be of interest to note that on top of the statistics are some European contries, like Sweden (67,86 %) or Denmark (62,99 %), over countries like US (59.85 %) or China (59,55 %). It is also estimated that the percentage of connected people in countries below a 40 % will increase exponentially in the following few years.

Because of the influence of Internet, one of the best examples of the Information Society Technologies (IST), people have quickly adopted new ways of communicating both in business and in personal life. However, it has been extracted from search patterns and browsing statistics that Internet users are becoming less and less patient [12]. Nowadays, society expects information and services to be online and available around the clock in our homes, schools, libraries and work places. Government is responding to these new demands.

*e*Government is the use of IST in public administrations to improve public services and democratic processes and to support public policies. Government agencies are meant to work together to use technology so that they can better provide individuals and businesses with government services and information. Most efforts on the subject have been focused on establishing common standards

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across government, delivering services more effectively and providing ways for agencies to work together using technology. Basically, *e*Government is expected to deliver enhanced services to individuals in terms of efficiency, time and cost and to provide a better environment to build a knowledge-based economy and sustained prosperity. [3]

An increasing effort is currently being dedicated to *e*Government. Thus far, pilot experiences [3] have shown promising results, as residents are increasingly participating in online discussions and opinion polls about key local issues. Pilot experiences in e-voting [1] have also pointed out that IST may increase participation, particularly among young people who, traditionally, abstain from vote more that their elders. At this point, it has become clear that *e*Government is not a fashion item, but a major step forward in communications that has been accepted internationally. Hence, it is important that the government helps minimise the gap between people and IST.

*e*Government is particularly expected to be of key importance for mobility. EU-citizens are expected to travel from one Member State to another, and they will want to access and interact with public services that they are entitled to without complexities, delays and bureaucracies. Examples include access to medical services, tax submissions and rebate, access to social security services, electronic voting, pensions, identitification with authorities, etc. The government must consequently provide easy access to their rights anytime, anywhere. The mechanism for accessing those rights and meeting the obligations should be simple, straightforward, easily understandable and accessible anywhere anytime within the Member States. Citizens should also be ensured that their privacy and personal data are secure and protected, and will not be divulged into or passed on to anybody else without their authorisation.

One of the main issues to be solved in *e*Govenrment is Identity Management. Identity Management [4] is an identification mechanism to grant privacy and security to users [2]. Currently this is done mostly by paper. Electronic Identity will complement or perhaps even replace the paper-based identification by electronic means, which brings in huge advantages of availability of the information anytime anywhere. However, implementation of this raises a number of technological and organisational issues, such as security, privacy and data protection, interoperability, forms of identity management, authentication by the citizens, access of services, etc. The European Commission has been requested to propose a coherent approach to advance identity management for *e*Government.

This paper focuses on Identity Management for *e*Government applications. Authentication is not a new problem. However, if it is related to *e*Government, there are several considerations that might constraint the design of these sys-

[3] The indicative budget allocated to the Thematic Priority "Citizens and governance in a knowledge-based society" for the duration of FP6 is EUR 225 million.

[4] Identity Management is, in fact, one of the research areas proposed in FP6 for research in eGovernment. See
*http //europa.eu.int/information_society/programmes/egov_rd/focus/*

tems. Thus, we first analyse the factors that could have a negative impact on spreading eGovernment, specifically in the European Union (EU), from a technological point of view. Regarding these factors, several considerations related to technological design are presented in section 2. Section 3 discusses on different security options. According to the criteria presented in section 2, we focus on biometrics and, more specifically, on signature analysis. We explore current trends and describe their pros and cons. Section 4 presents a proposal to use signature for verification and automatic generation of digital PINs. In order to prove the feasibility of our proposal, a basic system is briefly outlined and tested in the same section. Finally, conclusions and future work are presented in section 5.

## 2 The Digital Divide, Ergonomics and Cognitive Engineering

eGovernment may be preferred by people to access government services and information for a variety of reasons: i) it may be difficult or expensive to visit a government office; ii) printed material may not be easy to obtain and keep updated; iii) traditional information might not be easy to share; and iv) queues may be avoided and time may be saved. Even though this is obviously an advantage for people living in remote areas and busy people as well, there are still some sectors of society who might be reluctant to use eGovernment. Polls (e.g., [8]) seem to point out that the most relevant factors, from the user's point of view, to adopt or not IST are cost (20 %), privacy (19 %), security (13 %) and content reliability (9 %). These polls obviously show a general concern about authentication. However, these polls usually focus on Internet users rather than on general society. From this point of view, it is also very important to take into account that some groups may be disadvantaged to benefit from IST. One risk usually associated to IST is that it may accentuate existing social divisions, a fact known as the Digital Divide (DD) [5].

The DD has been reported to present four main dimensions: political, social, economical and geographical. Politically, governments are required to grant universal access to the Information Society to citizens. Socially, DD is a function of age, gender and occupation, where the division obeys mostly to existing IST skills in population groups. Economically, it is obvious that underdeveloped countries can not deal with IST as well as rich countries. Finally, the lack of infrastructure in some areas may be a strong disadvantage to use IST. However, the greatest divide has been reported to come from education [5]: people less educated have fewer chances to use IST. Bridging the DD in well developed countries has been a challenge, but it is far more difficult in the rest of the world. Less developed countries, especially those in the south, are often plagued by limited infrastructure, low income and literacy levels, and restrictions on free expression and democratic participation. [5] Hence, strong policies are going to be

[5] See *http : //www.digitaldividenetwork.org/*

required to reduce the DD in terms of availability and affordability. Availability can be understand in terms of infrastructure, but also in terms of response to the user needs. Affordability covers not only costs but also the skills needed to access the technology.

It is a proven fact that people are adaptable. They can tolerate mild deviations from optimal designs of the equipment they use and the environments in which they work. However, there is a limit to this adaptation. Beyond such a limit, there is a cost, which can be estimated in terms of efficiency, discomfort, frustration and dissatisfaction. These problems can be avoided if an ergonomics approach is used. The word ergonomics derives from the Greek words 'ergon' (work) and 'nomos' (laws). It is an area of science concerned with the fundamental understanding of interactions among humans and other elements of a system, and the application of appropriate methods, theory and data to improve human well-being and overall system performance. Ergonomics is also referred to as human factors or human factors engineering. Given the importance of ergonomics in current technology designs, it is only natural that ergonomic factors are also used to reduce the Digital Divide. The key to ergonomics is to keep a user-centred framework [11]: it is necessary to consider persons at the centre of interest and analyze their surroundings in terms of the equipment being used, the features of the physical environment, and the social context. A user-centred approach to design and evaluation has many advantages, including: i) improved reliability ; ii) products that are easier to use; iii) better efficiency; iv) greater user comfort; v) faster learning times; vi) fewer errors; and vii) easier maintenance.

Experience with new technology has shown that increased computerization does not grant improved human-machine system performance. Poor use of technology can result in systems that are difficult to learn or use and even may lead to catastrophic errors [7]. This may occur because, while there are typically reductions in physical workload, mental workload has increased [14]: in many environments computerization has shifted the users's role from manual control of simple systems to supervisory control of highly complex, automated systems. This strong reliance on the user skills is a typical failure of design. The user's limited attention resources are shifted to the interface in order to identify desired data, configure working parameters and provide a proper feedback. Cognitive research provides insight and guidance in areas such as the effects of practice on performance, rational decision-making, and expert problem-solving in the user interface. Specifically, cognitive engineering is an interdisciplinary approach to the development of principles, methods, tools, and techniques to guide the design of computerized systems intended to support human performance [15]. A fundamental goal of cognitive engineering is to translate knowledge of human information-processing characteristics into principles and techniques for human-computer interface design [10], so that systems that are easy to learn, easy to use, and result in improved human-computer system performance. In terms of security, cognitive engineering aims at identifying unique features in the user

that he/she can provide in a simple, straight way. Thus far, most efforts have been centred either on PINs, smart cards or biometrics.

## 3 Biometrics for Identity Management: Dynamic Signature Verification

As discussed in the previous section, the simplest way of bringing people close to IST regarding ergonomics is to bring interfaces as close as possible to already widely accepted systems. Nowadays, the most commonly accepted identification systems to grant access to the right information or service are PINs, passwords and signatures. Smart cards are also under study. However, various competing and proprietary technologies in smart card markets pose problems for institutions interested in large-scale deployment, as there is risk of technology obsolescence or over-reliance on a single vendor. Besides, tokens, such as smart cards, magnetic stripe cards, and physical keys need to be carried and can be lost, stolen, or duplicated. On the other hand, human memory is not completely reliable: PINS and passwords consist of long strings of letters and numbers that need to be memorized and can be used by anyone. It has been recently estimated that at least 40 % of all help desk calls are password or PIN-related. Losses attributed to fraud, identity theft, and cyber vandalism due to password reliance run into the billions.

Biometric methods of identification are currently being used to replace the less secure ID/Password method of user authentication. Biometrics focus on the physical uniqueness of individuals. Once identified, significant physical features can be exactly measured, numbered, and counted. The statistical use of variations in these elements of living organisms is known as biometrics. Biometrics are particularly useful for Identity Management, in which people are recognized by biometric-based security systems according to their own unique corporal or behavioral characteristics include fingerprints, voice, face, retina, iris, handwriting, and hand geometry. Using biometric identifiers for Identity Management reduces or removes reliance on tokens. While passwords have in fact nothing to do with a person's identity and have proven to be mildly easy to decode, with biometric security the access-enabler is the person, not something he/she knows or possess. After years of research and development, biometric security systems are now in the forefront of modern security. Although public acceptance has lagged behind expectations for certain biometric applications, many concerns have been dispelled through persistent engagement and education.

Most biometric systems can be fine-tuned to work in high security or low security environments. Increasing security sometimes makes systems reject registered users, resulting in an increased False Rejection Rate (FRR). In these cases, user training may be needed. If security is set too low, though, the False Acceptance Rate (FAR) may increase. Popular biometric systems in use include iris recognition, voice recognition, and fingerprint recognition systems. Iris recognition is extremely accurate but expensive to implement and scanning the human eye is sensitive that find A typical sys-

tem is much less expensive but often exhibits unacceptably high FRR stemming from illness, hoarseness, or other throat problems. Fingerprint recognition is generally considered the most practical choice for its reliability, non-intrusive interfaces, and cost-effectiveness. However, regarding ergonomic factors, signature recognition, also known as Dynamic Signature Verification (DSV), is the least controversial of all the biometric technologies because of its natural occurrence in everyday transactions. Individuals are less likely to object to their signature being confirmed as compared to other possible biometric technologies. Besides, DSV is by far the least expensive of current biometrics on the market today. Currently, over 100 patents have been issued regarding signature verification. DSV systems are already in use in places like Chase Manhattan Bank, Internal Revenue Service (IRS), Employment Services in England, some pharmaceutical companies and visitors to Pentonville Prison in England. It is expected that DSV will become more of an everyday occurrence in society because of high public acceptance and its efficiency. DSV also presents a major advantage: even people not familiar with technologies is used to signatures for authentication and validation.

The main drawback of biometrics is that, in order to minimize the risk of loss, raw biometric data for authentication should neither be stored nor shared. Once biometric data is compiled into a database or accessible over a network, biometric information is simply data and it can be stolen. Any design based on biometrics must include the possibility that there is a loss of control over the authenticating data. Biometric systems require measures of loss recovery. The authenticating entity can control the template, and the encryption method of the biometric but never the raw authenticating data. This problem could be partially solved by separating the authentication technology from verification processes. Basically, when the user's signature is available, all parameters required for authentication are checked. Then, once his/her identity is confirmed, a feature extraction method is used to extract from the signature a stable set of characteristics that can be used as a digital PIN. This PIN does not need to be transmitted: it can be extracted by any government entity having acess to the signature and the adequate technology. It is important to note that, in this case, the PIN does not need to be memorized, is not chosen by the user and can not be forgotten because it is extracted from the signature in a straight way. Besides, since identity is already verified when the PIN is produced, forgery is not obvious. Finally, no raw biometric data is exchanged. Next section presents a rough algorithm to extract a PIN from a signature to support this proposal. It is important to keep in mind that it is not a final design but simply meant to prove the feasibility of using signatures in authentication for *e*Government applications. In order to grant the uniqueness of a given feature vector, not only global shape should be taken into account but also temporal features. Nevertheless, the proposed design would be enough for authentication in a non-global, bounded environment.

# 4 Verification and Digital Identity: a Signature Coding Method

DSV systems analyze two different areas of signatures: signature specific features (static) and signing specific features (dynamic) like speed, pen pressure, directions or stroke length. Some systems like UNIPEN [4] rely mostly on pen-tip velocity, but such systems are not suited for children or handwriting with tremor because they are sensitive to speed and regularity. Consequently, most systems (e.g., [9] [16]) combine both static and dynamic systems. The main drawback of static features is that the number of features to analyse is usually very large, ranging from a few dozens to hundreds. There are techniques to determine which of the features available carry more information [6]. However, even after chosing the most suitable features, it is not obvious to differentiate between the consistent parts and the behavioral parts of the signature that may change with each signing. Verification typically relies on statistically gathering enough information to grant that identification is correct despite existing feature differences. However, in order to also extract a digital ID from a signature, it is necessary to select a set of features which remain constant despite signature changes. It can be observed that strokes, angles and symmetries may change mildly from one signature to another even when they are taken from a person at consecutive time instants (Fig. 1). However, a human can easily recognize signatures belonging to the same person because they globally present the same shape. Shape has been reported to be of key importance in planar object recognition applications [13], which are typically resistant to mild local shape variations and capture condition changes. Hence, if global shape could be represented by a feature, it could be a consistent part of the signature. It is important to note that authentication must not rely uniquely on shape because, in absence of dynamic features, forgery could be easy. We propose to use both static and dynamic features in signature for authentication, like in [9] or [16], and, once the person is identified, a feature representing the global shape of the signature as a digital ID. Next subsections present a methodology to extract such a feature which has already been succesfully applied to planar object recognition [13].

## 4.1 Preprocessing

In order to process the shape of a signature, some preprocessing is required. First, a dilation stage is used (Fig. 2.b) to remove small discontinuities and partially soften noise. The goal of this process is to obtain a single closed shape. Then, a region growing process is performed. The seed is set at the boundaries of the image to grant that the region that grows is the background. After the background is removed, whatever remains is the global shape of the signature (Fig. 2.c).

## 4.2 Shape Representation

Curvature is a measure of how much the contour of a shape bends at each point. Many techniques rely on curvature to represent 2D shapes because curvature is

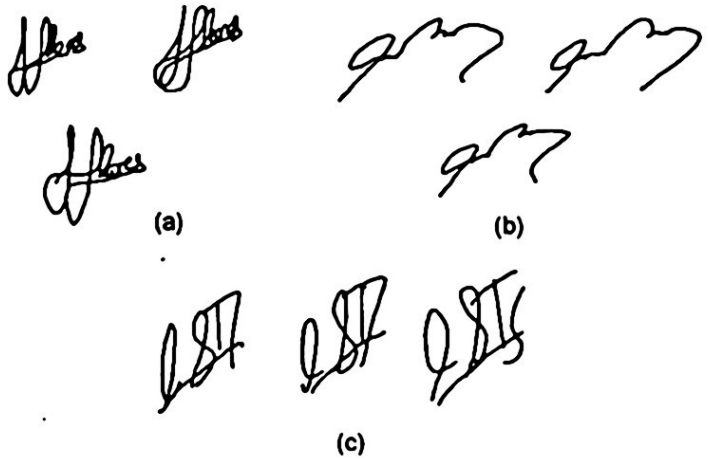


**Fig. 1.** Different signatures from: a) person 1; b) person 2; c) person 3.


**Fig. 2.** Preprocessing: a) original signature; b) dilated signature; c) region growing

usually: i) meaningful; ii) resistant to geometric transformations; iii) robust to occlusions; and iv) computationally feasible to calculate. The authors proposed a method to calculate curvature in [13] that is also very resistant against noise and adapted to the natural scale of the curve. The proposed method consists of the following steps:

- Contour encoding by means of an incremental chain code. The incremental chain code associated to a given pixel $n$ is a vector $(\Delta x(n), \Delta y(n))$ which presents the difference in $x$ and $y$ between points $n$ and $n+1$ of the contour. Further steps will represent the function by means of a code adapted to the natural scale of the curve
- For every point $n$, calculation of the maximum contour length $k(n)$ free of discontinuities around $n$. The value of $k$ for a given pixel $n$ $(k(n))$ is calculated by comparing the Euclidean distance from pixel $n - k(n)$ to pixel $n + k(n)$ of the contour $(d(n - k(n), n + k(n)))$ to the real length of contour between both pixels $(l_{max}(k(n)))$. Both distances tend to be equal in absence of corners, even for noisy contours. Otherwise, $d(n-k(n), n+k(n))$ is significantly shorter than $l_{max}(k(n))$. Thus, $k(n)$ is the largest value that satisfies:

$$d(n - k(n), n + k(n)) \geq l_{max}(k(n)) - U_k \tag{1}$$

being $U_k$ a constant value that depends on the noise level tolerated by the detector.

- Calculation of the incremental adaptive chain code $(\Delta x(n)_k, \Delta y(n)_k)$, associated to $n$. This new vector shows the variation in $x$ and $y$ between contour pixels $n - k(n)$ and $n + k(n)$ and it is equal to:

$$\Delta x(n)_k = \sum_{j=n-k(n)}^{n+k(n)} \Delta x(j) \qquad (2)$$

$$\Delta y(n)_k = \sum_{j=n-k(n)}^{n+k(n)} \Delta y(j)$$

- Calculation of the slope of the curve at every point $n$. We consider that the slope at point $n$ can be approximated by the angle between the segment $\overline{(n - k(n), n + k(n))}$ and the vertical axis. This angle is equal to:

$$Ang(n) = \arctan\left(\frac{\Delta x(n)_k}{\Delta y(n)_k}\right) \qquad (3)$$

- Calculation of the curvature at every point $n$. The curvature at every point $n$ can be defined as the slope variation respect to $n$, $d(Ang(n))/dn$ This value can be approximated by the incremental $\Delta(Ang(n))/\Delta n$, or locally by $Ang(n + 1) - Ang(n)$.

Fig. 3 presents a signature and its curvature function (CF). A high point in the CF means that the curve bends a lot at such a point. Hence, corners in the signature are peaks in the function, whereas flat segments correspond to lengths of constant curvature.

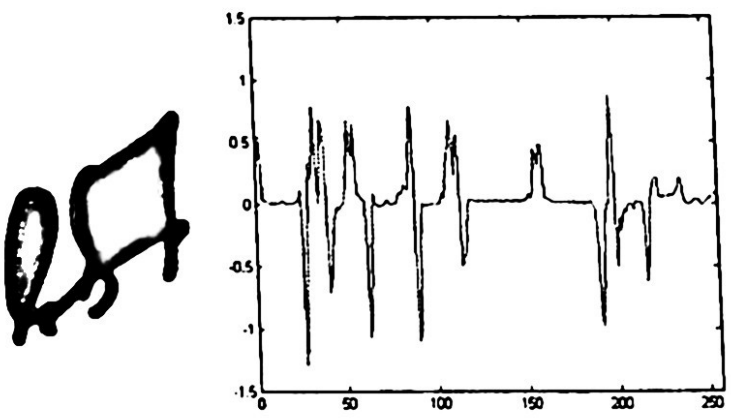


**Fig. 3.** A signature and its curvature function

### 4.3 PIN Extraction

CFs are not valid to work as PINs because: i) they may present shiftings; ii) their length depend on the signature scale; iii) they may be affected by distortions and local changes. Thus, further processing is required to achieve a stable shape feature. The authors proposed in [13] a process to reduce a curvature function to a 10 elements vector which is resistant against noise, transformations and mild distortions. First, curvatures are represented in the Fourier domain to avoid shiftings. Because of the low pass nature of the CFs, Fast Fourier Transforms of CFs (||CFFFT||s) conform a subspace of this space and its intrinsic dimension $P$ is lower than $N$, being $N$ the number of points of a ||CFFFT||. Using Principal Components Analysis (PCA), the best approximation of a ||CFFFT|| when projected onto a $P$-dimensional subspace is achieved by the $P$ Principal Components associated to the $P$ higher eigenvalues of their autocorrelation matrix. The orthogonal basis conformed by these $P$ components, $\left\{\vec{\phi_k}\right\}_{k=1}^{P}$, is used to obtain the feature vectors for new planar shape. Given a new shape, its associated feature vector $\vec{Y}$ is obtained by projecting its ||CFFFT|| onto the proposed orthogonal basis. $\vec{Y}$ presents only $P$ components and it is as resistant to noise and transformations as the corresponding ||CFFFT||.

$$\vec{Y} = \sum_{i=0}^{N-1} y_i \vec{\delta_i}, \tag{4}$$

In this specific case we have statistically evaluated that 10 Principal Components are enough to explain most of the variation in a signature ||CFFFT||. Fig. 4 presents different signatures from the same person and their feature vectors. It can be noted that, despite the obvious differences in strokes and proportions in the original signatures, all vectors are very similar. Thus, either any of them is used as a prototype or, after gathering some signatures, the prototype is calculated as the average of them all. This prototype becomes the digital PIN associated to the signature. Whenever a person is authenticated, both by dynamic features and vector matching, he/she receives the prototype of his/her signature as digital PIN. It can be observed that a 10 elements digital PIN is harder to hack than the usual four digit PINs currently available. It is also interesting to note that there is no need to store prototypes locally as long as a digital picture of a signature and a copy of the vector extraction algorithm is locally available. In this case, people could be authenticated by dynamic features, as proposed in [4], and vectors would be locally generated each time and matched only in reception.

### 4.4 Examples

In order to be useful as digital IDs, not only should vectors extracted from signatures of the same person be similar but also different from vectors of other persons. This subsection presents a simple test to show that a signature can be

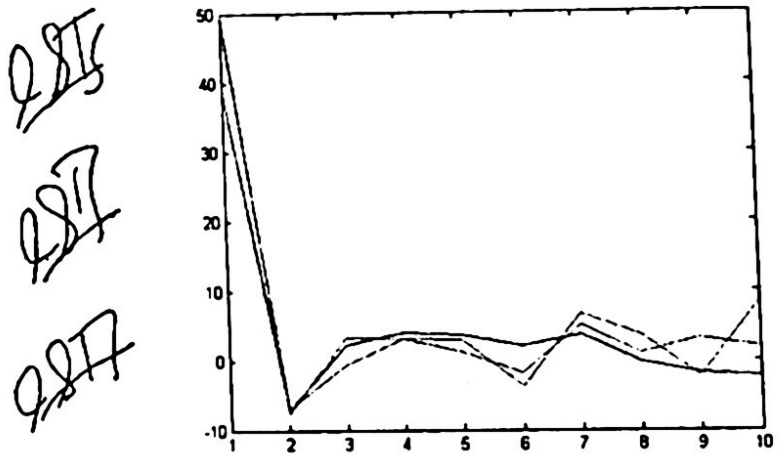


**Fig. 4.** Three signatures from the same person and their feature vectors.

identified using the proposed global shape feature. It is important to note that even signatures corresponding to the same person may change from time to time. Hence, the feature vectors of such signatures may also present small variations. This basically means that a signature is not recognized when a perfect match is found, but rather when the distance between the input feature vector and the signature prototype is lower than a threshold. Thus, in order to be reliable, a signature feature vector must be not only similar to its prototype but also different enough from other prototypes.

Fig. 5 presents a test with nine signatures from three different persons. Identification is correct if a signature is more similar to its prototype than to any of the other ones. It can be observed that even though signatures corresponding to the same person are globally similar, they present some differences. Fig. 5 presents the Tanimoto distances of every signature in Fig. 1 to the prototypes of the signatures of persons 1, 2 and 3 in the same figure. The dot line represents the distances to the prototype of person 1, the dash line represents the distance to the prototype of person 2 and the continuous line represents the distance to the prototype of person 3. It can be easily appreciated that all signatures from person 3 (left side of the plot) are significantly closer to prototype 3 than to the rest of the prototypes. The same occurs with signatures from persons 1 (middle of the plot) and 2 (right side of the plot). It is important to note that even though all signatures from the same person are similar, they are not equal at all: no constraints were put on persons when signatures were captured. Nevertheless, the distance between the shape vector and the prototype of each of the three persons is clearly lower when the signature is his/hers. Thus, these prototypes could be used as digital IDs as proposed.

## 5 Conclusions

In this paper, given the key importance of security on *e*Government, we have analysed different technological factors that might have a negative impact on the

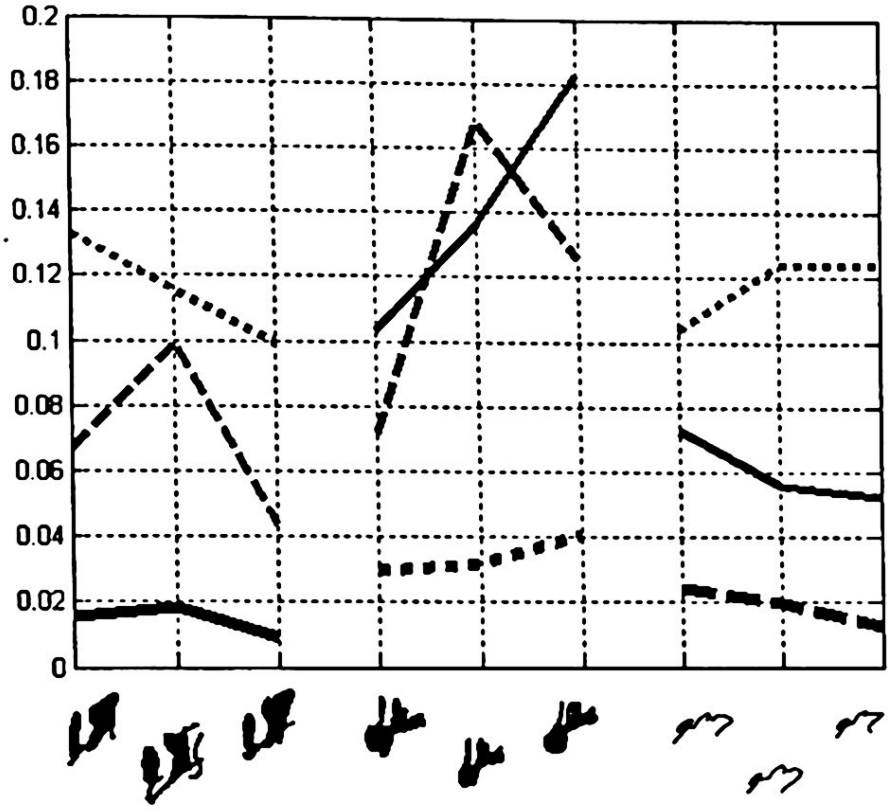


**Fig. 5.** Distance among each of the signatures in Fig. 1 and the prototypes per persons 1 (....), 2 (- - -) and 3 (—).

development of *e*Government initiatives. Among these factors, several studies have reported that the most important one seems to be education. Specifically, technological education seems to be required to accept IST in day to day life. Reports point out that in the EU the gap between those who may be dissadvantaged to use IST and those who are not seems to be increasing. Thus, an important effort is required to reduce that gap. Specifically, ergonomics can be applied to reduce this gap by bringing IST closer to people who may have no technological skills. Keeping all this discussion in mind, different security technologies available nowadays have been evaluated. We have focused on signature verification, which is expected to be easily accepted by users because of its natural occurrence in everyday transactions. Then, we have discussed the pros and the cons of current signature verification systems and we have proposed a technical solution to extract an stable digital ID from signatures after authentication. Finally, we have discussed the advantages of doing so. To prove the validity of the proposal, we have also outlined and tested a simple and fast algorithm to extract such an ID from the global shape of signatures. IDs in this work present 10 digits and, hence, are more difficult to hack.

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# Legal Engineering: A Knowledge Engineering Approach To Improving Legal Quality

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**Abstract.** Knowledge engineers have been working in the legal domain since the rise of their discipline in the mid-eighties of the last century. More and more knowledge engineering is not just seen as a way of capturing and distributing (legal) knowledge by means of the knowledge-based systems created, but as an analytical approach that helps to improve legal quality. Improving legal access of course remains equally important. This insight has lead to the application of knowledge engineering methods at a much earlier stage in the development of normative systems (including legal systems), preferably when the (new) norms are created or adapted (legislation drafting). A good example of this approach is the POWER-approach developed in the Netherlands by the Dutch Tax and Customs Administration (DTCA in Dutch: Belastingdienst) and some partners (see e.g. Van Engers et al., 1999, 2000, 2001, 2003). This POWER-approach offers both a method and supporting tools that support a systematic translation of (new) legislation into the administrations' processes. This paper describes how this systematic approach that has its origins in knowledge engineering can help to improve legal quality. The POWER-method not only helps to improve the quality of (new) legislation. It also supports codification of the legal knowledge into procedures, computer programs and other designs. One of the advantages thereof is the reduction of the time-to-market of the implementation of legislation and its increased transparency (which will lead to reduced maintenance costs. In this chapter we will focus on legal quality improvement and explain some knowledge representation techniques that we use to enable this. In contrast to other knowledge modelling approaches the POWER-approach is focused on modelling legal sources rather than expert knowledge. Expert knowledge however is needed to find the correct interpretations but also for efficiency reasons. Starting with representing the (legal) experts' knowledge (using scenarios) helps to find the adequate scope (the legal sources to be analysed). Confronting the expert with differences between the model build out of the experts' knowledge and the knowledge that can be distilled out of the other knowledge sources (specifically the law) causes the legal experts to see things in a different light and has often led to changes in the law.

J. Padget, R. Neira, J. Díaz de León (Eds.). e-Government and e-Democracy: Progress and Challenges

## 1 Introduction

Getting the right knowledge at the right place at the right time has always been a great challenge for governments since this inflicts the ability to effectuate the legislative power to regulate and control. The Dutch Tax and Customs Administration (DTCA) has developed a method and supporting tools supporting the whole chain of processes from legislation drafting to executing the law by government employees and citizens (see e.g. Van Engers et al., 1999, 2000, 2001, 2003). These method and tools resulted from the POWER research program (Program for an Ontology-based Working Environment for Rules and regulations), a research program that was partly sponsored (the E-POWER project) by the European Commission through the IST 5th framework program.

The motive behind running the POWER program is that drafting and implementing new legislation is a rather time, energy and money consuming process consisting of many inter-connected processes. These processes are very vulnerable to errors. Not only because of the intrinsic complexity of the law, but also because mostly a large number of people is involved in these processes as wells as of the complexity of these processes themselves. Varying interests have to be aligned and communication difficulties due to differences in technical jargon have to be overcome in both drafting and implementing changes to legislation. The same holds when completely new legislation has to be implemented.

The knowledge and experience needed to create new laws or adapt existing ones, specify, design and implement procedures and systems in legislative domains is very scarce. A (piece of) law should reflect the intentions of the political responsible minister and should also meet some quality criteria such as clarity and consistency from the perspective of the law-enforcement organization. This is the responsibility for the legislation drafters that are responsible for drafting the new law.

The people responsible for implementing the law (i.e. the administration) have to adapt the procedures, processes and information systems to the new law. Also risk diagnosis, assessment procedures and audit measurements have to be designed and implemented as well. Needless to say that next to this, political and social-environmental requirements have to be taken into account. One of these requirements is the need for diminishing the administrative costs for the citizens.

Between drafting new legislation and enforcement thereof a chain of processes has to be managed and aligned. Preventing errors as early as possible in this chain can save a lot of time and money. Not only at the design stage but even more during the law-enforcement stage. Unintended use or even worse abuse is often due to anomalies in the law. Also, the position of the government is much stronger when involved in a dispute if the law is very clear with respect to the object of disagreement.

Many legislation drafting departments at the different ministries already have their own quality insurance techniques. Furthermore in many cases the ministry of Justice has a special role because they are usually responsible for the overall legal quality of a country. Despite all the effort that's been spend on improving legal quality using traditional measurements, such as co-reading (peer reviewing etc.) many anomalies

can still be found in recently drafted legislation. The situation is even worse in situations when existing legislation is adapted.

Quality insurance measurements also exist for the other processes in the chain mentioned. Most attempts to achieve quality improvements however focus at just one of the processes involved. In the approach developed in the POWER-research program we consider each of these processes as equally important. We furthermore stress the importance of managing the chain rather then the distinctive processes themselves.

Improving legal quality is just one of the three main goals of the POWER research program. The other two goals are reduction of total cost of ownership (TTO) of the (knowledge-based) systems intended for the support of civil servants or of citizens and secondly, reduction of time to market (TTM) i.e. the speed with which these (knowledge-based) systems can be created.

The POWER-approach supports the finding of anomalies in legal sources. Central in the approach is the central role for formal (and semi formal) knowledge representations. In the POWER-approach different knowledge representation formats are used. This paper describes how these knowledge representations are used and how they contribute to improving legal quality.

The knowledge representation formats discussed in this paper are procedural description called 'scenarios' (which are more or less comparable to UML action diagrams) and POWER-conceptual models (expressed in UML/OCL). Although scenarios (see section 3) lack the benefits of a strict formal model expressed in UML/ OCL (van Engers et al., 2001 [3] and [4]) they are useful to provide both analysts and experts with a good insight in the legal domain represented, especially when the legislation involved is to be used in a categorization or assessment task. Scenarios also proved to be an excellent means of communication with experts and representatives of disciplines involved in the implementation of legislation (see Van Engers et al. 2002 [7]).

This chapter that is based on previous work (see Van Engers and Boekenoogen 2003) we present some results form a project that was aimed a improving the quality of legislation and the investigation of consequence of implementing a new law. We illustrate the results with scenario's and parts of POWER-conceptual models.

## 2 Verification and Validation

The quality of the law enforcement depends on the quality of the legislation itself and on the quality of the knowledge-based systems that are actually used in the client handling processes as well. Many approaches have been described that aim at improving the quality of legislation (see e.g. Voermans 2000) or improving the quality of knowledge bases used in knowledge-based systems (see e.g. Preece 1994 and Vanthienen 1997).

Legal sources (including law texts) suffer from different quality problem, some of them are fundamental ones. First of all the legal sources are expressions in 'natural' language ('natural' is between quotes because many citizens might consider a piece of law beyond the language they are familiar with). Natural language often is ambiguous and this feature can not always be avoided even when it is used to specify a normative system (e.g. a specific law). Besides this feature of the natural language that is used to carry the desired behaviour of the normative system described by the legislator other sources of vagueness exist. Legal sources often contain so-called open evaluative terms. These terms are intentionally used to achieve a certain amount of sustainability (i.e. making the regulation robust to a certain level of change in the world that is subject to the regulation). Another reason for vagueness is due to the fact that legislation often results from a political debate and is as such a compromise of different interests.

Two techniques, verification and validation (V&V), can be used to test the quality of the knowledge representations. Validation deals with testing the knowledge representation against the legislation drafters' intentions. Verification deals with the consistency of the formal representation, while validation deals with the intentional aspects of the representation (does the model represent what it should). Spreeuwenberg et al. (Spreeuwenberg 2001) show how automated supported verification processes can be applied on formal legal models. VALENS for example is a verification tool that operates on a rule-based system (which is a specific representation form of a formal model). VALENS can be used by a developer after or during construction of a rule-base or can be integrated in a tool that allows users to write their own business rules. The output of the tool is a document in which all invalid rules (combinations) detected are reported. Each fault is classified and explained.

The problem with verification procedures like the one supported by VALENS is that these procedures can only be applied after most of the hard work has already been done, i.e. constructing a rule-base. Since this process of formalizing the legislation into a formal representation generating a rule-base out of it (van Engers et al., 2001 [5]) and applying a verification process to it, usually takes some time even when it is supported by tools such as the Power-workbench, a less subtle and profound approach is needed to satisfy the practical needs of legislation drafters and policy makers need feedback .Especially if in the drafting process, where these drafters deal with the politicians and other influential stakeholders feedback is needed in a much earlier stage. Furthermore it is not always necessary to design a (rule-based) system at all. Therefore a less labour and time intensive method derived from the original Power-method that helps to find anomalies has been developed. That method is called the Power-light method. The fact that no formal model actually results from that Power-light approach is a small price to pay, given the demands mentioned earlier.

In this chapter we will show how the POWER-approach can be used to detect anomalies in legislation. The Power-light method works quite similar, except for the fact that formalization only takes place in the modellers' mind. During the modelling process using the POWER-method, more defects are found than would have been found when applying automated verification (e.g. with VALENS). Automated verification, combined with conceptual modelling, is still very valuable because it might detect defects that have not been noticed during the modelling of the legislation. Automated verification has also proved its value when applied to a knowledge-base that has received maintenance (Gerrits et al., 2000). In the same way, it could be applied to changed conceptual models due to changes in the legislation.

In the project we describe in this chapter we didn't apply VALENS, nevertheless as an illustration, we will indicate which of the examples of errors found are errors that could have been found with VALENS if we would had applied it to the corresponding rule-based implementation.

## 3 Scenarios

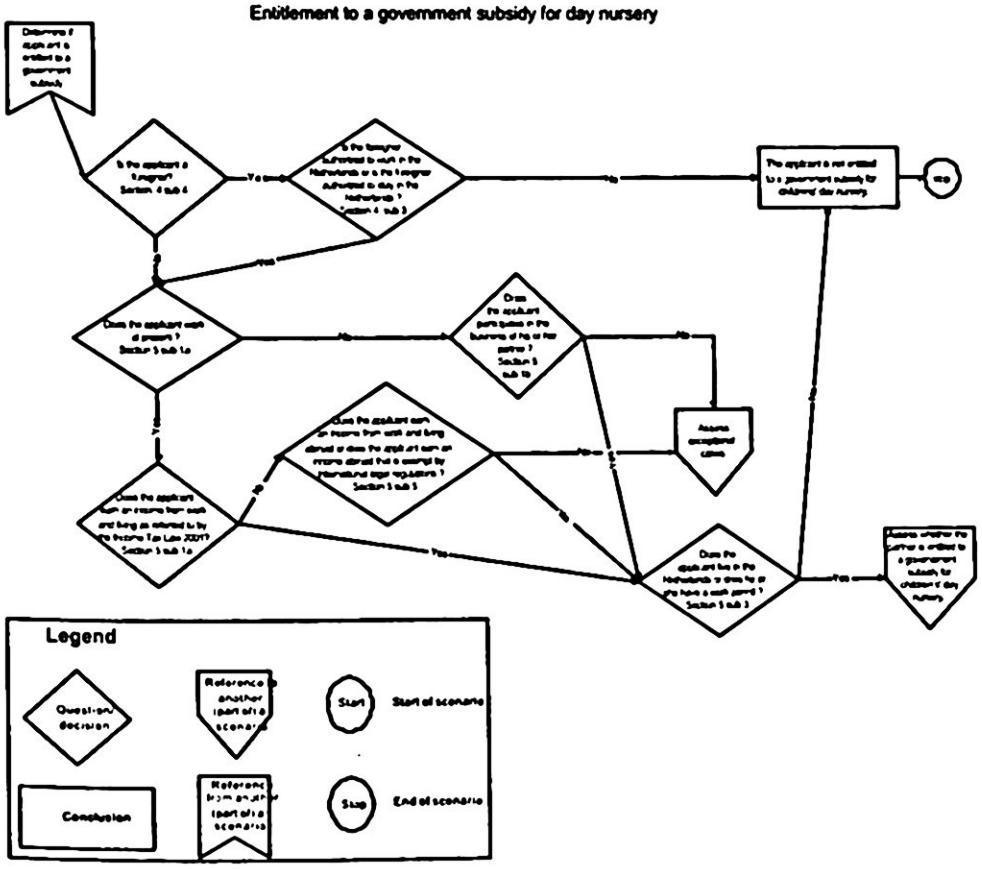


**Figure 1** Example of a (part of) a scenario called "determine entitlement to a government subsidy for day nursery"

Before making a formal representation of a certain domain it proved to be helpful to first understand a bit about the legal domain. This is best obtained by looking at how

some (prototypical) cases are solved that correspond to a certain target group. The reasoning strategies of legal experts used for the solution of these (hypothetical or real) cases can be represented in a kind of procedural representation like a decision tree which can be expressed in e.g. UML action diagrams. Within the POWER research program we use a special form of such action diagrams which we call 'scenarios' because they represent the possible scenarios of solving cases (see also Van Engers et al. 2002 [7]).

We experienced in the projects ran at the DTCA that developing such scenarios at the start of the knowledge modelling process helped both knowledge analysts and legal experts, especially in case of modelling new or complex legislation.

The process of creating a scenario goes starts by asking the experts to explain how he or she applies the legislation (within the domain of interest) to a certain prototypical case. This reasoning strategy is then mapped onto a decision tree. The decision tree is subsequently elaborated until all cases within the range of interest can be "handled" by the decision tree. The join of all scenarios corresponding to solving a case using the legal source(s) forms the final scenario: a map of the legal domain expressed in the form of a kind of decision tree.

The nodes of the map correspond to questions or decisions that follow from applying the legislation: a node typically contains a reference to a part of the legal source it is based on. A decision needs to be taken by a (certain) yes or no. Traversing the scenario a result or conclusion is reached. Figure 1. presents an example of a part of a scenario that was made of a bill concerning subsidies for children's day nursery.

These scenarios have showed to be a rather effective representation if we want to communicate between knowledge modellers and legal experts (see Van Engers et al 2002 [7]). Not only the scenarios create a quick and global overview of the legal domain at hand, but also they serve different purposes.

One of the things law enforcement agencies face when designing an implementation strategy is their risk assessment process. The diamonds in the scenarios represent a question or decision that has to be made when making a legal inference. The legal experts and the risk management analysts use these diamonds in the scenario diagrams to ask themselves what kind of data elements will be needed when taking such decisions and what alternatives exist for acquiring these data elements. Although many details still are lacking, one can for instance already use this information to start thinking about what data elements will have to be on the documents that need to be designed. One can also use it to check if the law to be implemented will or will not increase or diminish the administrative burden of the citizens involved. The questions or decisions in scenarios are kept as global as possible because we aim at providing just a quick overview of how a certain legal domain functions. If everyone involved in the modelling process shares a global understanding of the domain, we might for example ask whether a certain section applies instead of posing several separate questions, each spelling out the exact conditions of the specific section. As with calculations, we leave the details to POWER UML models of legal sources (van Engers et al., 2001).

POWER scenarios provide a pure functional idea of how legal experts use legislation to solve certain cases: it does not provide a "system view" on how a decision support system would function. This is the distinction between a POWER scenario and a UML scenario, which is a story about how a system will be used. A UML scenario describes a prototypical sequence of interactions in a business-collaboration or the system context (D'Souza et al., 1999). The main difference between POWER scenarios and UML scenarios is that UML scenarios are used to define the boundary of a system, whereas POWER scenarios can be considered as a (global) specification of the knowledge intensive process (which could be supported by a system). However different, UML scenarios and POWER scenarios match when it comes to the goal of capturing the task flow. UML scenarios are used to capture the ideal task flow as perceived by end users. POWER scenarios provide us with the means for discovering the implicit tasks and task flow within legal domains. Legislation typically is declarative in nature. Tasks and task flow are revealed when asking the expert to apply the legislation to solve cases.

In POWER scenarios, tasks are represented by grouping questions concerning one issue on one diagram (or more if necessary) and naming the diagram accordingly to the issue at hand. Note that such a diagram not necessarily contains an end point of the reasoning path: the decision tree may be connected to another issue ("task"). In the next sections scenarios refer to POWER scenarios, not UML scenarios (unless explicitly stated otherwise).

The idea of using these scenarios as the basis for knowledge-based systems design may be tempting, but essential to the POWER approach is that we base our knowledge models on the legal sources rather than on the experts' interpretation of these sources. As we found out the experts' interpretations may be incomplete or even conflict with these knowledge sources (i.e. the law!). Furthermore a serious handicap of procedural representations is their limitations they put on the implementation. The order of the different reasoning steps represented in the scenarios may very well be not the most efficient one. Also when designing an user dialogue for a knowledge-based system one may want to choose a different order for posing questions then you would derive form such scenarios.

## 4 The Power Conceptual model

Although the way conceptual models are represented was already published in previous publications (e.g. Van Engers et al 2001 [5]) for readers yet unfamiliar with this approach in this section a short introduction is given. The POWER-conceptual model is represented in a notation called Unified Modelling Language (UML see D'Souza and Wills 1999). This notation has become the standard notation for representing models in the domain of information technology, but there are many ways to use the notation. The usage defined in the POWER-method, starts by dividing the model in UML packages. The structure of packages within the translated conceptual model is identical to the hierarchy in the legislation (i.e. chapters, sections, articles, members etc.), which allows tracing all conceptual models, and products that

will derive from them, to the original legislation. The structure of packages within the integrated conceptual model represents the definition of concepts found in the legislation, and the relationships between these definitions.

Within each UML package, the important concepts found in the legislation are modelled as types and attributes. As opposed to the more often used classification of concepts in classes, the use of types allows introducing redundant concepts, and is independent of the way the data will be structured in later applications. Examples of concepts that demonstrate potential redundancy are e.g. "Natural Person" and "Tax Payer". Attributes can be simple properties of existing concepts, such as the age of a natural person, or can be relationships between concepts, such as the children of a natural person. The references found in the legislation are modelled as an extension to the UML, which we called "Package Reference". A package reference is modelled as a classifier, which represents some not-yet-identified other packages. Finally, the norms within the legislation are modelled in a formal language, named Object Constraint Language (OCL), which is a part of the UML. The Object Constraint Language can for instance determine under which conditions a "Natural Person" becomes a "Tax Payer". This is written down in an invariant about "Natural Person", which is a statement in the OCL that uses all the concepts modelled about "Natural Person". One can use OCL in a similar way as one would use a reified first order predicate calculus to express a legal norm.

The translation from legal text into a POWER-conceptual model (expressed in UML/OCL) is a two-phase process: translate and integrate.

### 4.1 Translate

After deciding on the (restricted) scope of legislation (using the scenarios as described before) that piece of legal text is analysed. First we analyse the hierarchical structure of legislation and within each chapter, article, section, the text is analysed for references. This view of legislation contains sufficient detail for detecting structural defects that can be reported as attention points.

Then, concept extraction (supported by a natural language parser) is used to identify the concepts used in each chapter, article and section that are consequently put into a conceptual model.

Finally the norms within each block are written down as (OCL-) constraints (expressions over the concepts). The result of this step is a conceptual model that represents the unique interpretation of a single article of legislation, which does not depend on any other articles.

### 4.2 Integrate

Still within the scope of legislation, we can combine the articles that use identical concepts to create an integrated conceptual model. During this process, synonyms (different words, same meaning) are discovered to be identical concepts and

homonyms (same word, different meanings) are distinguished as separate concepts. The structure of exceptions and extensions to the general rule is unraveled for each concept. At this point, a conceptual model is produced that represents the unique interpretation, but also the reasoning, involving specific interdependent concepts. This integrated conceptual model can be used to reason on a specific scope of cases, although some reasoning knowledge for rare cases may still be missing and may have to be added in future iterations or put out of scope for the project.

The (integrated) conceptual models produced this way (the POWER-model) contain the legal knowledge. When this knowledge is combined with the process and task knowledge, we have a specification for a supporting knowledge-based component.

# 5 Legal Quality control of the Basic Facility Nursery's Act

## 5.1 Context and assignment

The Ministry for Social Affairs and Employment has written a bill regarding the Basic Facility Nursery's Act[1]. At the time of writing this article, the bill had to be passed by the Dutch Lower Chamber. The intended date of commencement is on the first of January 2004. The Basic Facility Nursery's Act (BFNA) aims at guaranteeing the quality and accessibility of day nursery and at creating possibilities for parents to combine jobs and child care. The Ministry of Finance is involved because the Dutch Tax Administration is assigned to be the executive organization. Implementation of the BFNA by the Dutch Tax Administration seems logical because of its acquaintance with similar business processes, however there is one difference: as a tax administration it executes fiscal processes, not subsidiary processes like the Basic Facility Nursery's Act. This new dimension places even greater demands on aspects such as validating legal quality and risk assessment.

In the middle of 2002, the POWER-team received the assignment of making a conceptual model of the Basic Facility Nursery's Act. The main reason for making a conceptual model of the Basic Facility Day Nursery's Act was to perform a quality check of the new legislation so possible defects could be repaired before the law would come into operation. Secondly, it enabled the Dutch Tax Administration to obtain a good insight into the content of the bill and consequences for the processes at the DTCA that were designed for implementation of the bill.

[1] Wet Basisvoorziening Kinderopvang.

### 5.2 The procedure

First, the POWER knowledge analysts developed scenarios of the relevant part[2] of the BFNA. These scenarios were created in cooperation with and validated by the only BNFA expert available at that time at the DTCA. Because of the scarce expertise and the totally new kind of legislation, the scenarios were immediately used by the different disciplines involved in the implementation design of the BNFA at the DTCA: particularly process and organizational design and compliance and risk assessment. The scenarios were also handed over to the Ministry of Social Affairs and Employment.

Next, the conceptual model of the relevant part of the BFNA was developed. The POWER-team had already developed some tools that support the modelling process: a structure parser for detecting the structure of a piec of law (e.g. the chapters, sections, articles, members, sentences etc.) and a natural language processing based parser for automated concept extraction (see e.g. Van Gog and Van Engers 2001) used for the translation of the legislation into a formal model in UML. These UML-models are then exported to a case tool (e.g. Rational Rose or MEGA). In this project MEGA was used. The conceptual modelling took place in two phases (see Van Engers et al. 2001 [5]): first translation of the legislation into partial models closely corresponding to the legislation text. Next, the integration and re-factoring of the partial conceptual models into complete and coherent conceptual models of the main concepts defined in the legislation.

Possible defects were found during the analysis of the legislation. They were reported to the experts at the DTCA and the experts at the Ministry of Finance. If possible defects indeed seemed defects, the experts passed the findings to the legislation drafters of the Ministry of Social Affairs and Employment. In the next paragraph, we will present some examples of the defects that were found while making a conceptual model of this piece of law.

As a result of completing the conceptual model of the BNFA, we derived a data model from the conceptual model. This data model, indicating the data necessary for applying knowledge-based components based on the conceptual model (however incomplete at that time due to a missing Order of Council for the BNFA), proved very important for the DTCA in being able to estimate whether they could implement the BNFA, particularly with respect to back-office information systems and requirements for form design.

### 5.3 Examples of detected defects

The sections of the bill of the Basic Facility Nursery's Act[3] used in the examples are all unofficial translations from Dutch.

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[2] The part of the BFNA that regarded the task of the Dutch Tax Administration.

[3] Version as presented to the Dutch Lower Chamber.

**Defect: no reference found & concept confusion**

Figure 2 shows the partial conceptual model of subsection 2 of section 22. The first step in the integration process is resolving all package references. Package reference "section 5 sub 2" that refers to the person is easily solved as can be seen in the legal text below: the person is underlined in the text. Package reference "Section 5 subsection 1" proved impossible to solve: first it is an ambiguous reference as it can be read as a reference to "nursery" or to "costs of nursery". However, section 5 sub 1 does not contain the concept of "nursery" at all, nor of "costs" (of nursery).

Basic Facility Nursery's Act

Section 22

2. If a parent is a person as referred to in section 5, second subsection, only the costs of nursery as referred to in the first and second subsection of that section are rated among costs that are associated with nursery as defined in that subsection.

Section 5

1. A parent is entitled to a government subsidy for a contribution year, if the parent in that year:

   a) works at present from which an income from work and living as referred to in the Income Tax Law 2001 is earned,

   b) [],

2. Also entitled to a government subsidy is a parent, insofar this is not a person as referred to in the first subsection, who:

   a) is handicapped or is a chronically sick patient, of which has been laid down by order, as referred to in section 20, that this is a necessary condition for nursery , or

   b) has a child with respect to whom, by order as referred to in section 21, has been laid down that nursery in the interest of a good and healthy development of that child is necessary.

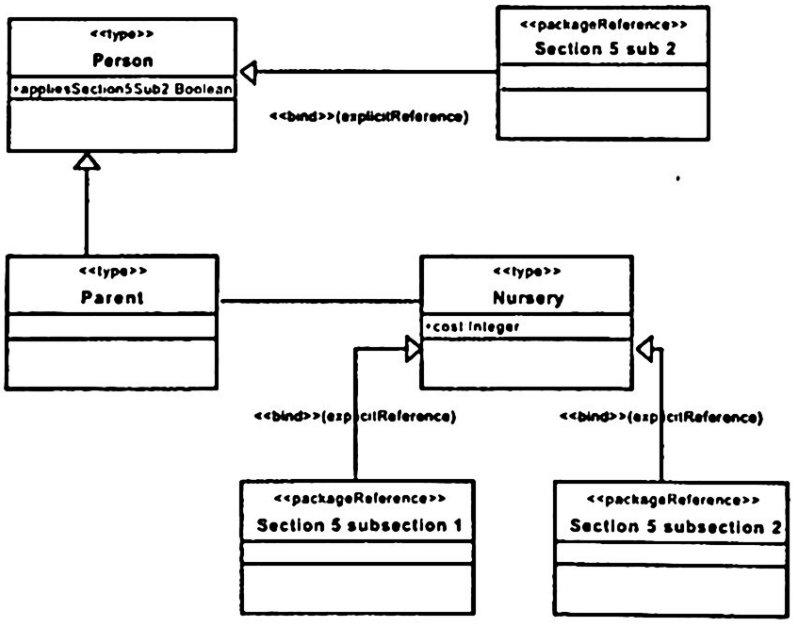


**Figure 2.** Partial conceptual model of section 22 subsection2.

The last package reference "Section 5 subsection 2", is the same ambiguous reference ("nursery"/"costs of nursery") as described before, but now it refers to subsection 2. In subsection 2 the concept of "nursery" is indeed mentioned but the concept is certainly not defined there, as the legal text suggests: "costs that are associated with nursery as defined in that subsection [section 2]". On a more close reading of the text of section 22 sub 2 it almost seems circular. These findings were reported to the experts. They agreed with the findings and wrote the following amendment:

Section 22 *(amendment, concept version)*

2. If a parent is a person as referred to in section 5, second subsection, only the costs of nursery which are connected with the circumstances defined in section 5, second subsection are rated among costs that are associated with nursery as defined in the first subsection.

**Ambiguous reference & missing concept**

Basic Facility Nursery's Act

Section 2

3. Anyhow there is report of having a joint household, as referred to in section 1.2, first subsection, beneath part b, 1°, of the *Income Tax Law 2001*, if the parent and a third person reside in the same house and

a) they have been married to one another or earlier for the enforcement of *this law* have been equated with it, [...].

Income Tax Law 2001

Section 1.2

5 For the enforcement of this law and the regulations that rest with it will for the determination of relationship the classification as partner be equated

In subsection 3 of section 2, a reference is made to *this law* for the concept of "being equated with having been married to one another". At first sight we modelled it as a package reference to the Basic Facility Nursery's Act. Then, when we tried to resolve the package reference, we could not find the concept of "being equated with being married to one another" at all in the BFNA. On closer reading, the reference to *this* law could also be interpreted as a reference to the *Income Tax Law 2001*. If we used this interpretation, the package reference could indeed be solved, because the Income Tax Law 2001 does contain a definition of the concept of "the equation with marriage" in section 1.2 subsection 5:

The equation with marriage from the Income Tax Law did not seem to correspond to what one would expect from the reference in the BFNA, so we asked the experts to what law the reference *this law* referred and what equation with marriage the legislator alluded to. The answer finally came that the reference could not be to the Income Tax Law, as the fiscal motives for equating a fiscal partner with marriage did not have any meaning in the context of the BFNA. The reference is indeed to the BFNA itself. The experts confirmed that the concept of the equation was empty or at least not sufficiently specified. This defect is a fine example of a treacherous reference which possible defects can only be found when the partial conceptual models are integrated and an attempt is made to resolve the reference. Because the POWER-method of modelling legislation works in such a structured way, these defects are always filtered out.

**Gap in the law**

The classification of the partner of a parent who has children that go to a nursery and who is entitled to the subsidy for nursery, is an important concept defined in he BFNA. This is because the subsidy is income-related and it is related to the collective income of both parent and partner. When people are married, they are automatically partner for the BFNA, but if they are not, there are a number of regulations specified for classifying a housemate as a partner. We will not go through all of the regulations for partner, but there is one aspect that is equal for all of them: the regulation only applies if both parent (applicant) and its housemate (potential partner) are older than 18 years. This age limit comes from the definition of the classification as partner in the *Income Tax Law 2001*. As can be seen in the legal text of section 1, part b, the BNFA refers to the Income Tax Law for the concept of making the choice for classification as partner.

Basic Facility Nursery's Act

Section 1

In this law and the regulations that rest with it is meant by partner:

a) []

b) the one who is not the partner of the parent for the enforcement of the *Income Tax Law 2001*, but *pursuant to article 1.2 of that law* together with the parent may make the choice for classification as partner.

Section 3

A minor is competent to execute the legal transactions that are necessary to receive a subsidy pursuant to this law. [...].

We will illustrate the definition of classification as partner form the Income Tax Law 2001 with the following OCL constraint from the conceptual model of article 1.2 of the Income Tax Law 2001:

| Constraint name | Income Tax Law 2001:: article 1.2 1b |
|---|---|
| Context | Person |
| Constraint text: | |
| self <> Parent AND<br>NOT(Parent.isMarried) AND Parent.isAdult AND<br>NOT(self.isMarried) AND self.isAdult AND<br>sharesAHouseholdForMoreThanSixMonthsContinuouslyWith (Parent, ContributionYear)<br>AND<br>isRegisteredAtTheSameAdressDuringThePeriodOfTheJointHouseholdWith(Parent, ContributionYear)<br>==> self: Partner | |

**Figure 3.** Example of an OCL constraint from the conceptual model of article 1.2 of the Income Tax Law 2001

From the constraint it is clear that both parent and person that may classify as a partner must be adult, that is, having attained the age of 18 years. The BNFA, however, has a special regulation (see section 3) that enables minors (e.g., teen-mothers) to apply for the subsidy for nursery. The combination of section 3 and the rules for classification as a partner reveal that for a teenager that has become a parent, the partner cannot be classified for the enforcement of the BFNA, even though they are living together. The result is that the income of the partner (not in the legal sense but in real life) is not taken account of, as it would be if the parent had been adult.

We submitted this issue to the experts, who told that the legislators had recognized this deficit and had thought that this situation would be so very rare that an amendment for this type of exception was not necessary.

**Non applicable regulation**

Basic Facility Nursery's Act

Section 5

1. A parent is entitled to a government subsidy for a contribution year, if the parent in that year:

   e) has not yet attained the age of 18 years, receives education and [...],

4 A parent with a partner is only entitled to a claim, if the partner is also a person as referred to in the first or second subsection. [...]

In section 5 subsection 1, combined with section 5 sub 4, we have a piece of legislation that for logical reasons can never apply: subsection 4 states that a parent (applicant for the subsidy) and its partner must both be persons that have right to a subsidy. The idea behind this is that the subsidy is only granted to families where both parents work or are returning to work; also special target groups can make a claim to the subsidy. Now, part *e* of subsection 1 [section 5] defines a target group with the property: "has not yet attained the age of 18 years". We just saw that this can never apply to a unmarried person who is a partner in the sense of the BFNA: he or she must have attained the age of 18 year, as this requirement is part of the definition of Partner.

This conclusion will not have far reaching consequences for the enforcement of the BFNA, but it is again an illustration of something that can be easily overlooked because of the complicated definition of the concept of Partner (it is largely imported from another (type of) law) and the recursive use of the definition of persons who make a claim to the subsidy.

The error found is one that can be found by a automated verification tool like VALENS. The proof-by-processing algorithm (see Gerrits and Spreeuwenberg, 1999) would detect that there are no situations in which the rule that corresponds to section 5, subsection1, part *e* can ever apply to a person to which a partner rule applies. Also the example of the "gap in the law", which we discussed before, is a defect that can be detected by a verification tool.

## 6 Conclusions

The POWER-method has shown to be a very useful approach for modelling normative systems. These systems are described in laws and other regulations including regulations that are used outside the government e.g. insurance policies. The POWER-method is not only suited for designing (and even generating) knowledge-based systems. One of its benefits lies in its possibilities to detect anomalies in legislation in an early stage of design (preferably even before the law becomes effective). With the processes created around the formal models that are the result of applying the POWER-method in which different legal experts are involved, a feedback loop is implemented that has proven its power to improve the legal quality significantly. This makes the Power-method a powerful tool for both legislation drafters, law-enforcement organizations and other organizations that are responsible for the design and/or execution of large bodies of regulations.

This paper shows some examples of errors found in real-life projects. In the study, both the original Basic Facility Nursery's Act and a part of the Order in Council that belongs to that act were analysed. The exact results can not be published yet because the Dutch House of Parliament is still discussing the Order at present. Ten deficits were found and immediately reported to the legislators (analysis and report within one day). The method was also applied to the two following concept versions of the Order in Council, and will be done for the versions to come. The project is a perfect illustration of how knowledge analysts, experts and legislation drafters can interact

with the aim of realizing a sound and enforceable piece of legislation. The representations used in the POWER-method have shown to be also very useful when designing law-enforcement strategies, design (E-)forms etc. By providing insights in the data-elements needed to enforce the law one can think about alternative process designs for the law-enforcement organization (in this case the DTCA). Furthermore, estimates can be made, based upon this information about the administrative costs that would result from effectuation of the law. Also, the inventory of data-elements needed for the law enforcement can be used to advise the legislation drafters if implementation problems are to be expected or not.

In a future project it would be interesting to see which errors would be detected by a automated verification tool in relation to the errors found during the modelling process. We know that during the "manual" modelling process we find many more errors than by applying a verification tool alone. This is logical because the analyst also finds the semantic errors and errors resulting for example from incorrect references within legislation. However it would be interesting to see if there is a category of errors that escape the attention of the analyst (and experts) but that can be found by a verification tool.

Many things still can be improved, like the natural language parsing components in the POWER-supporting tools (we are e.g. working on parsing deontic expressions in the law into OCL), but with the POWER-method the designers of new legislation and the designers of the administrations' processes and systems already have a very 'powerful' instrument at their disposal. In the near future we hope to further improve the POWER-method and its' supporting tools (the POWER-workbench). We thank the European Commission for taking the IST 5th framework program initiative.

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This book contains a selection of the papers presented at the EU-LAT Workshop on e-Government and e-Democracy, held in Santiago de Chile on May 2004. The EULAT project (IST-2001-32792) has been funded by the European Commission to hold a series of three workshops located in Latin America. The objective of the workshops is to showcase European and Latin American research in the areas of (a) e-Health (b) e-Government and e-Democracy (c) e-Environment, and create a forum in which to bring together research groups, companies and SMEs from the European Union and Latin America to encourage collaboration on proposals to the Framework 6 funding program.

The best sixteen papers of the workshop are presented in the book, organized in three topics: *e-Government*, *e-Participation & e-Democracy*, and *Legal & Identity Issues*.

We are very glad to show the ongoing work on e-Government and e-Democracy and to serve as the stepping stone for new ways of cooperation.

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