Lecture Notes in Computer Science 7452

Commenced Publication in 1973
Founding and Former Series Editors:
Gerhard Goos, Juris Hartmanis, and Jan van Leeuwen

Andrea Kő Christine Leitner
Herbert Leitold Alexander Prosser (Eds.)

Advancing Democracy, Government and Governance

Joint International Conference on Electronic Government and the Information Systems Perspective, and Electronic Democracy, EGOVIS/EDEM 2012 Vienna, Austria, September 3-6, 2012, Proceedings

Springer

Volume Editors

Andrea Kő
Corvinus University of Budapest
Fővám tér 13-15, 1093 Budapest, Hungary
E-mail: ko@informatika.uni-corvinus.hu

Christine Leitner
Danube University Krems, Center for European Public Administration
Dr.-Karl-Dorrek-Strasse 30, 3500 Krems, Austria
E-mail: christine.leitner@donau-uni.ac.at

Herbert Leitold
A-SIT, Secure Information Technology Center - Austria
Inffeldgasse 16a, 8010 Graz, Austria
E-mail: herbert.leitold@a-sit.at

Alexander Prosser
University of Economics and Business
Augasse 2-6, 1090 Vienna, Austria
E-mail: prosser@wu.ac.at

ISSN 0302-9743 e-ISSN 1611-3349
ISBN 978-3-642-32700-1 e-ISBN 978-3-642-32701-8
DOI 10.1007/978-3-642-32701-8
Springer Heidelberg Dordrecht London New York

Library of Congress Control Number: 2012944200

CR Subject Classification (1998): K.5.2, H.4, H.5, J.1, K.4.2, K.4, C.2

LNCS Sublibrary: SL 3 – Information Systems and Application, incl. Internet/Web and HCI

Typesetting: Camera-ready by author, data conversion by Scientific Publishing Services, Chennai, India

Printed on acid-free paper

Springer is part of Springer Science+Business Media (www.springer.com)

Preface

EGOVIS and EDEM 2012 built on the experiences of its predecessors, the Electronic Government Conferences organized by DEXA, but this was the first time that the two scientific conferences joined forces in the area of eGovernment and eDemocracy.

The international conference cycle EGOVIS focuses on aspects of information systems in e-government, while the EDEM conference series focuses on electronic citizen participation ("eParticipation"). The two domains are interrelated, and the aim of the conference is to provide a cross-cutting forum where experts from both domains are able to discuss and exchange innovative ideas. Information systems are a core enabler for electronic government/governance in all its dimensions: eAdministration, eParticipation, and eVoting. Successful electronic democracy implementation has technical, legal, organizational, and social aspects. The conference has hence reflected this multidisciplinary approach. EGOVIS and EDEM 2012 brought together experts from academia, public administrations, and industry to discuss eGovernment and eDemocracy from different perspectives and disciplines, i.e., technology, policy and/or governance, and public administration.

The Program Committee accepted 27 papers from recent research fields such as open data, cloud applications, interoperability and eGovernment architectures, Web 2.0 and Web 3.0 solutions, and public dialogues. Beyond theoretical contributions, papers cover eGovernment and eDemocracy experiences from all over the world; cases are presented from Europe, Asia, America and Middle-East.

The proceedings volume reflects the session structure of the conference and groups the contributions into thematic clusters.

The Chairs of the Program Committee wish to thank all the reviewers for their valuable work; the reviews raised several research questions that were discussed in the conference. We would like to thank Gabriela Wagner for the administrative support and stimulating us in proper scheduling.

We wish pleasant and beneficial learning experiences for the readers, and we hope that the discussion will continue after the conference between the researchers and contribute to building a global community in the field of eGovernment and eDemocracy.

September 2012

Andrea Kő
Christine Leitner
Herbert Leitold
Alexander Prosser

Organization

Conference Program Chairs

Andrea Kő	Corvinus University Budapest, Hungary
Christine Leitner	CEPA, Danube University Krems, Austria
Herbert Leitold	A-SIT Secure Information Technology Center, Graz, Austria
Alexander Prosser	University of Economics and Business Administration, Vienna, Austria

Honorary Chairs

Wichian Chutimaskul	King Mongkut's University of Technology, Thailand
Andras Gabor	Corvinus University Budapest, Hungary
Fernando Galindo	University of Zaragoza, Spain
Roland Traunmüller	University of Linz, Austria

Program Committee

Georg Aichholzer	Austrian Academy of Sciences, Austria
Jan Aidemark	Växjö University, Sweden
Luis Álvarez Sabucedo	Universidade de Vigo, Spain
Kim Normann Andersen	Copenhagen Business School, Denmark
Majed Ayyad	NextLevel Technology Systems
Carlo Batini	University of Milano-Bicocca, Italy
Victor Bekkers	Erasmus University Rotterdam, The Netherlands
Trevor Bench-Capon	Liverpool University, UK
Jaro Berce	University of Ljubljana, Slovenia
Thomas Buchsbaum	Austrian Foreign Ministry, Austria
Alejandra Cechich	Universidad Nacional del Comahue, Argentina
Wojciech Cellary	Poznan University of Economics, Poland
Yannis Charalabidis	University of the Aegean, Greece
Eleni Christodoulou	University of Cyprus, Cyprus
Wichian Chutimaskul	King Mongkut's University of Technology, Thailand
Flavio Corradini	University of Camerino, Italy
Peter Cruickshank	Edinburgh Napier University, UK
Vytautas Cyras	Vilnius University, Lithuania
Annelie Ekelin	Blekinge Institute of Technology, Sweden

Bengt Feil	TuTech Innovation GmbH
Fernand Feltz	Centre de Recherche Public - Gabriel Lippmann, Luxembourg
Joan Francesc Fondevila Gascón	Universitat Abat Oliba CEU (UAO), Spain
Enrico Francesconi	Italian National Research Council, Italy
Iván Futó	National Tax and Customs Administration, Hungary
Fernando Galindo	University of Zaragoza, Spain
Johann Gamper	Free University of Bozen, Italy
Matjaz Gams	Jozef Stefan Institute, Slovenia
Francisco Javier García Marco	University of Zaragoza, Spain
Julia Glidden	21consultancy.com
Stefanos Gritzalis	University of the Aegean, Greece
Åke Grönlund	Örebro University, Sweden
Henning Sten Hansen	Aalborg University, Denmark
Helle Zinner Henriksen	Copenhagen Business School, Denmark
Chuck Hirt	Central and Eastern European Citizens' Network
Patrik Hitzelberger	Centre de Recherche Public - Gabriel Lippmann, Luxembourg
Zahir Irani	Brunel University, UK
M. Sirajul Islam	Örebro University, Swedish Business School (Informatics), Sweden
Hannakaisa Isomäki	University of Jyväskylä, Finland
Dan Jellinek	Headstar.com
Christos Kalloniatis	University of the Aegean, Greece
Nikos Karacapilidis	University of Patras, Greece
Dimitris Karagiannis	University of Vienna, Austria
Vagelio Kavakli	University of the Aegean, Greece
Michel Klein	HEC Paris, France
Bozidar Klicek	University of Varazdin, Croatia
Takashi Koga	Kyoto University Library, Japan
Ah Lian Kor	Leeds Metropolitan University, UK
Jaroslav Kral	Charles University of Prague, Czech Republic
Irene Krebs	Brandenburg University of Technology in Cottbus, Germany
Hun-yeong Kwon	Kwangwoon University, Korea
Rudolf Legat	Umweltbundesamt, Austria
Fabio Luiz Leite Júnior	State University of Paraíba, Brazil
Philip Leith	Queen's University Belfast, Ireland
Ralf Lindner	ISI Fraunhofer, Germany
Rolf Lührs	TuTech Innovation GmbH
Marian Mach	Technical University of Kosice, Slovakia
Ann Macintosh	University of Leeds, UK

Ylle Madise	Riigikontroll
Ursula Maier-Rabler	Universität Salzburg, Austria
Peter Mambrey	University of Duisburg-Essen, Germany
Antonio Maña	University of Malaga, Spain
Rony Medaglia	Copenhagen Business School, Denmark
Jeremy Millard	Danish Institute of Technology, Denmark
Francesco Molinari	Italy
Pedro Rafael Muro-Medrano	University of Zaragoza, Spain
Robert Müller-Török	University of Applied Sciences Ludwigsburg, Germany
Sinisa Neskovic	University of Belgrade, Serbia
David Newman	Oxford University, UK
Mara Nikolaidou	Harokopio University of Athens, Greece
Javier Nogueras	University of Zaragoza, Spain
Graham Orange	Leeds Metropolitan University, UK
Monica Palmirani	University of Bologna, Italy
Aljosa Pasic	Atos Research
Flooh Perlot	Institut für Strategieanalysen, Austria
Günther Pernul	University of Regensburg, Germany
Matt Poelmans	Burgerlink.nl
Andrea Polini	University of Camerino, Italy
Reinhard Posch	Technical University Graz, Austria
Gerald Quirchmayr	University of Vienna, Austria / University of South Australia, Australia
Péter Racskó	Corvinus University of Budapest, Hungary
Peter Regner	FAW, Austria
Peter Reichstädter	Federal Chancellery of Austria
Aires J. Rover	Federal University of Santa Catarina, Brazil
Christian Rupp	Federal Chancellery of Austria
Erich Schweighofer	University of Vienna, Austria
Colin Smith	Napier University, UK
Tom Steinberg	mysociety.org
Michaela Strasser	University of Salzburg, Austria
Ella Taylor-Smith	Edinburgh Napier University, UK
Daniela Tiscornia	ITTIG Institute for Theory and Techniques for Legal Information, Italy
A Min Tjoa	Vienna University of Technology, Austria
Roland Traunmüller	University Linz
Tom M. van Engers	University of Amsterdam, The Netherlands
Daniel van Lerberghe	European Center for Political Technologies
Costas Vassilakis	University of the Peloponnese, Greece
Daniel Ventre	CNRS French National Center of Scientific Research, France
Mark Vermeulen	DNA, The Netherlands
Jorge Viera da Silva	Mobility Ticketing & Applications

Gianluigi Viscusi	University of Milano-Bicocca, Italy
Doug Vogel	City University Hong Kong, Hong Kong
Melanie Volkamer	Technical University Darmstadt, Germany
Roland Wagner	University Linz, Austria
Silke Weiss	Austrian Federal Ministry of Finance
Andy Williamson	London School of Economics and Political Science, UK
Christopher C. Wills	Caris Research Ltd.
Frank Wilson	Interaction Design
Robert Woitsch	BOC Asset Management, Austria
Chien-Chih Yu	National ChengChi University, Taiwan

Table of Contents

eGovernment: Process Management

eParticipation

Social Networks

Open Data

Knowledge Management in Government: New Perspectives

Roland Traunmüller

Johannes Kepler Universität Linz
Altenbergerstrasse 69
4040 Linz, Austria
traunm@iwv.jku.at

Abstract. Knowledge Management in Government is high on the agenda and new developments give strong impulses. The contribution portrays chances and challenges in conjunction with these trends and discusses the following subjects: Knowledge Transfer, Best Practice Case Collections, Open Government Data, Social Media, Mobile Government, and Semantic Technologies.

Keywords: E-Government, Digital Government, Knowledge Management, Knowledge Transfer, Best Practice Collections, Open Government Data, Social Media, Mobile Government, Semantic Technologies.

1 Knowledge Society and Government

With the emergence of the Knowledge Society, establishing an integrative approach to Public Governance is essential. Building a modern administration with novel patterns of co-operation is tantamount to changing the distribution of knowledge. Redistribution of knowledge must be designed and orchestrated carefully, and so directing and managing knowledge becomes a major responsibility for officials. Thus Knowledge Management in Government has become a hot topic. Prospects are remarkable seeing it from the point of demand; nearly all administrative tasks are informational in nature, decision making is an official's daily work, and for any agency its particular domain knowledge is an asset of key importance.

Then, enhancement of participation deserves to be named next. Entering into the Knowledge Society exerts via participation significant implications. Government is supposed to support the formation of a democratic culture. So e-Participation develops and implements new forms of participation in decision and policy making processes for citizens. The communication will involve citizens, public authorities, elected representatives etc. In that way planning processes in the political system get more input. One might say that knowledge and expertise of citizens waits for being"tapped". In such a way decisions become better and more sustainable. In that way Knowledge Management in Government is of high importance and new developments driving the advancement of the field attract high interest.

A. Kő et al. (Eds.): EGOVIS/EDEM 2012, LNCS 7452, pp. 1–9, 2012.

2 Knowledge Management in Government

Knowledge Management in Government may improve quite many administrative actions. It has a broad scope from building administrative repositories, sustaining decisions, assisting planning processes and improving citizen participation to enhancement of processes. Also the scope of knowledge types involved is broad so touching knowledge on different subject matters: on people and society, on documents and relationships, on procedures and structures, about experiences and on lessons learnt. Often also knowledge about knowledge is gathered, so in results of assessments, evaluating experiences and retrieval procedures is involved.

A quite distinctive point is that Knowledge Management in Government has to cope with the fan of particularities occurring in the Public Sector. Thus in the subsequent sections we consider four sets of essential distinctions; (a) characteristic features discriminating Government from other fields; (b) the high diversity of Government; (c) legal and administrative knowledge types; (d) characteristic features due to the particular form of administrative processes.

A first set of differences is founded in Government as a quite particular field. Remarkable are the differences appearing when you compare Government and Commerce. One point is the complex goal structure of the public realm. Then public tasks are set in political processes and described by law. Consequently, legal norms have become a standard vehicle of communication between Government and executive agencies. Quite often norms establish only a framework that leaves leeway for interpretation and situation-bound decisions. As a further consequence, consensus building and negotiation come in especially as agencies work via a complex tissue of cooperating acting entities. All this means a collaborative working mode as a strict demand and collaborative platforms supporting collaboration as necessary.

3 Characteristics Making Government a Particular Realm

There are further discriminating differences between Government and Commerce that are rooted in custom. So there exists an administrative culture as well as historically grown structures which both may impede change. Some inertial forces of the structures are reinforced by bureaucratic attitudes of staff. So, no wonder, administrative work appears to the citizen as complex and rather strange. In addition, responsibility seems to be diluted, which is a consequence of a multitude of actions in complex networks.

A further set of differences concerns the high diversity in Government. There are the three principal realms - Legislation, Public Administration and Justice – which have quite different features. Then there are the different levels to be considered such as the state, the regions and communal entities as the cities and the villages. To this diversity adds a high specification of materials to be dealt with. Diverse subject matters range from quite different topics as Health, Defense and Social Welfare to Human Resources.

A third set of differences concerns the features and elements of the field of knowledge that is relevant for Government. Sophistication is high as there is a rich cosmos of varied knowledge types. As basic classes there are repositories on

registers, management information and legal norms; then there is a lot of service knowledge that has to be made explicit. That includes knowledge about the policy field to be influenced, about the own means and modalities of action, about the stakeholders, about the internals of the administrative system etc. On one hand the required kind of knowledge may be very specific (the legal regulations), on the other hand the knowledge involved may be very broad as in the case of common world knowledge (so for planning). Summing up, a real bounty of different knowledge types and repositories is involved.

A fourth set of differences comes in by the distinctiveness of administrative and legal processes. In such decisions different knowledge types (legal, factual and general world knowledge types) have to be combined and this has to be done in several decision steps. This all has to be performed in quite particular and well defined processes directed by law and administrative custom. Differences are high. So in some administrative processes the structure may go very deep (as in a complicated individual tax case) in other processes knowledge goes in the broad and is assembled in complex interaction procedures involving several agencies and external stake holders (so for handling building permits).

In this contribution the field of Knowledge Management in Government can only be treated in a somehow cursory way; so for details and special aspects reference is given to our earlier publications [3-6, 9, 11-13].

4 New Directions

In recent years several developments have emerged that influence and enhance managing of knowledge. This contribution discusses a set of such trends that show particular relevance to Knowledge Management:

a) Promoting exchange of experience via platforms.
b) Promoting exchange of experience by collecting model cases.
c) Extending the realm of Public Knowledge by Open Government Data.
d) Capturing the wealth of collaborative service knowledge with Social Media.
e) Mobile Business applications intensifying service interactions.
f) Adding meaning to the bounty of existing repositories in using Semantic Technologies.

In the following sections these trends are treated in a rather concise form; so for more details on these trends and citations reference is given to our earlier publications [1, 2, 7, 8, and 10].

5 Promoting Exchange of Experience via Platforms

Many administrators want to draw on the experience of others on a whole or in a particular field of applications. So virtual communities emerge and the way they meet is on platforms and portals which offer a fan of ways for communication. Such communication helps the diverse stakeholders discover what they know and share it. It is the diversity of virtual communities which contributes to learning, detections and

making contacts to an enormous extent. Communication is the core activity and makes platforms and portals vivid. Concerning the methods and tools offered the choice is broad. Some tools are easy-usable and low-cost such as discussion fora and mailing lists. Other more advanced solutions comprise meeting support and brainstorming software. There are quite sophisticated tools that may need experts for handling. Examples are simulation, spatial technology for visualization, argumentation systems. To give an example of an excellent and wide-known portal we cite the Portal e-Practice for E-Government which shows the capabilities offered by such a platform. There are many ways of Knowledge Transfer and so platforms and portals are complemented by other means: conferences, learning journeys; involvement of facilitators and mentors and organizing twinning projects.

Knowledge Transfer is by no means easy as it targets the whole organization. On one hand transfer is much more than a mere exchange of knowledge between individuals – on the other hand transfer relays on engaging individuals; no institution learns others than via its members. High interest has to focus on the stakeholders. Especial internal stakeholders are strongly influenced by the changes involved and so need special care and attention. To imagine the complexity of the situation - one has to be aware that all these diverse actors are embedded in different circumstances and will have diverging views and diverse attitudes towards the transfer process. Hence addressing the specific needs of user groups is central in any application design. Particular their demands have to be gathered carefully and applications have to be developed in strong relation with the specific target groups.

An intrinsic impediment is that Knowledge Transfer is typically asymmetric. This means a transfer of knowledge between organizations and partners of unequal competence. Such an asymmetric situation is caused by the fact of different maturity in e-Transformations. Some institutions are in an adult stage; others are in a less advanced stage (as a whole or in a particular field of application). Generally the asymmetric form of knowledge transfer attracts great attention – only to recall the number of events that have such words as empowerment and knowledge transfer in their announcements.

6 Promoting Exchange of Experience by Collecting Model Cases

There is no use re-inventing the wheel – so the establishment of model cases is an important contribution. A case project has to provide a valuable and sufficiently detailed list of advice which can be given to others. The case project should show that the underlying principles can be examined and adapted by others or used as inspiration and as guiding principles. The collections of model cases are mostly established in competitions. Such a procedure needs a lot of effort but achieves visibility and recognition (e.g. as it was in the case of the e-Europe Awards which were organized by EIPA with the support of the Information Society Technologies Programme of the European Commission). In concrete the EIPA competitions had to handle several hundred cases. As a consequence the competition needed a lot of resources: many remote evaluators; two consensus meetings which reunited a core jury quasi in conclave for some days; and at the end a great Conference exhibiting fifty cases and organizing the declaration of the winners.

Evaluation for selecting model cases is a tricky business and several features have to be clearly identified such as: quality, impact, benefits, performance, relevance and transferability. Especially the evaluation of relevance and transferability of a case study needs attention. First, the case has to provide a valuable and sufficiently detailed list of advice which can be given to others in e-Government. The case should show that the underlying principles can be examined and adapted by others (or at least used as inspiration and as a guiding principle). Basically, the criterion transferability of practice has to include both: what can be learned (supply side) and who can learn (demand side). Most discussion is grounded on qualitative arguments. Having in addition quantifiable items is of special interest. As example for quantification one could regard for the category of impact diverse parameters. For external impact such factors as up-take, user feedback, satisfaction are measurable, while for internal impact the elements resources, throughput and claims statistics count. Turning to the factor benefits realization on could consider parameters such as cost savings or gaining more time for clients.

Choosing a model case suitable for the own project will starts as following:

- Have the targeted situation in mind.
- Define the main goal of a new project.
- Define further goals of this project.
- Define the initial situation for the new project.
- Regard the actual situation on ground.
- Comparing with different best practice cases.
- Searching after suitable best practice model cases

It sounds easy but often certain phases need special attention and a lot of work. To show an example, there may be several projects that may suit in principal and the selection needs burdensome analyzing and comparison.

There are intrinsic problems which occur in any form of Knowledge Transfer. Bad experiences are hidden and don't get reported. For this question there exists a cultural bias. In some cultures, it is acceptable to learn from failure. In others failures are to be ignored or denied, and are certainly not to be discussed for the purposes of learning, because it would be signaled a kind of weakness. In addition, some difficulties may occur with glossy descriptions. They may fool you, as quite often the decisive factors, which make a certain application a success, are not communicated along with the official documentations.

Finally, a fundamental admonition has to be stated. There is no such thing as a mere transposing and duplicating. Designing individual systems cannot be substituted by copying successful projects and feasibility of transferring has to be considered for each individual case. All in all, design has to take sincerely the characteristics of the circumstances.

7 Extending the Realm of Public Knowledge

Open Government roots back in history to the proclamation of the Freedom of Press. First it was proclaimed in the American (1776) and French (1789) Revolution. In the last decades the FOIA (Information Act) 1966 in the USA was a big step. Now a number of institutions provide open data creating an e-Government demand pull. Open Government

Data means opening the wealth of data for the Public. The general goal is broad: improving transparency; making Public Value from Government data; promoting commercial use in joint ventures and heighten the quality of life by having useful applications.

Public value is linked to individual and societal interests. There is an intrinsic value in Government per se as well as in openness and transparency. A broad consensus exists that more openness will promote good governance. Several marks of good governance are influenced: participation, consensus reaching, accountability and responsiveness.

The fan of Open Government Data is broad; it comprises geographical data, micro-census, regulations, traffic data etc. So many business related projects flourish with an opening of the Government Data. Many successful applications have been created in cooperation of private enterprises with agencies. Now, developers, designers, statisticians, librarians, officials and citizens write applications in using public available data. One example is using geographical information provided by Public Administration. This has created several apps that have proven as useful and well accepted services.

There is a close connection between citizen participation and Open Government Data. Influence may go in both directions as to show on the example of city planning in Cologne. The city gives planning data and receives suggestions for priorities, as in the concrete case on budget decisions for recreational facilities.

8 Capturing Collaborative Service Knowledge

One innovation that profoundly changes the way Government runs its business is Social Media which put the user in a central role. Social media provide a way to improve Public Governance, as well for the part of administration and the part of citizens. As help for Government in the general administrative part feedback for agencies is given. As a further point goal there is an improvement of collaboration among and within agencies.

An essential point is that Social Media allow collecting also such pieces of knowledge which are implicit. Implicit knowledge means that part of knowledge which is present only in the heads and which becomes visible in the behavior of persons as well as in their social practices. Especially, in the collaboration among and within agencies a lot of implicit knowledge is involved. In storing these interactions and analyzing them knowledge turns to become explicit. In that way agencies become explicitly aware of their internal tacit knowledge.

There are further methods that deal with collecting knowledge namely crowd sourcing. The term was first coined in US technology magazine “Wired” back in 2006. The collaborative energy of people creates a far more powerful knowledge engine than ever before. Innovative ideas can come from anyone. There are millions of creative people and always there are a lot of experts around.

A quite important field of applying Social Media is e-Democracy and e-Participation. Government is supposed to support the formation of a democratic culture. Social Media provide new forms of participation of citizens in decision and policy making processes. Social Media create virtual communities and supported them with various tools such as group's news, special forums and chat rooms. Examples for applications have become plentiful: citizen participation, city planning, petitions, campaigning, monitoring and law enforcement.

9 Intensifying Service Interactions

Using mobile devices makes the access to the Internet quasi ubiquitous. Both innovations, Social Media and Mobile Business, reinforce each other in co-evolution. Evidently, mobile devices, smartphones and tablets, have become the user's common device. This is a fact that has severe consequences. First, seen from the part of the users, change of patterns of access and communication will occur. Largely, the level and the intensity of participation in with an increased usage of mobile devices communication will increase. Second, regarded from the part of commercial enterprises and governmental agencies, this trend will press for considerable changes. So, a customary and widespread usage of mobile devices urges Commerce and Government to adapt technical communication and business procedures. Both, communication and procedures have to fit into the technical frame set by a mobile world. A comment has to be stated. Such notions as Mobile Business do not imply that we are going to make everything "on the move" – it is more coping with the fact that the common devices at hand are "the mobile ones."

All in all, one can state that Mobile Business brings a lot of benefits. First to list is staying in contact with one's tasks aided by instant access to computing and internet. Top on the list is also speeding up the decision process. This includes offering a more responsive service to customers. This all will increase profits and decrease costs. Further advantages are data capturing at the point of origin which heightens accuracy and may pay in reducing risky and costly errors. A prime request is ease of use - as uptake of applications depends high on usability. In human-computer interaction usability concerns the elegance and clarity with which the interaction with a computer program is designed.

10 Adding Meaning to Stored Data

Knowledge dissemination is a key task. It can be made by push and pull strategies – but is always sensitive to a thorough description of metadata. Further, the power of the stored data depends on the level of formalization. Low degree formalization may only be useful for retrieval, and does not suffice for automatic procedures. Examples are simple structures such as paragraphs, footnotes, and links. Advanced degree of formalization is used for data exchange. High degrees allow automatic knowledge engineering and reasoning. This becomes possible with rules in expert systems and software agents.

Metadata and formalized storing give way towards many successful applications. In the following some examples are given:

1) **Electronic Data Exchange:** This capability is the unconditional precondition for Tele-cooperation in general and Online One Stop Government in particular. In EDI legal and administrative semantics of data need to be represented carefully, to allow global use of locally created and stored data. Otherwise the correctness of a remote usage of those data cannot be granted. In praxis most modeling is done in a description on XML basis and using RDF for structures. Note: This is a pragmatic solution and is sufficient for several tasks. Yet more demanding applications may need a higher precision and call for the usage of semantic ontologies.

2) **Intelligent Modules for Citizen Advice:** A further field of using Semantic Technologies is the improvement of Help-systems providing advice for life events and business situations. There are several particular functions that can be made more intelligent and user-friendly. The list is long comprising citizen information at various stages, choice of the access channel, aid for filling in forms, ways for matching of the citizen's demand with the administrative structure etc. We turn to two examples: (a) There is the task of an automatically routing of the citizen demand (either to relevant knowledge repositories or to the agency with competencies in the legal sense). (b) Improving comprehension of the citizen advice system is quite urgent. In the core this means bridging the gap between user language and the legal-administrative jargon of Public Administration.
3) **Repositories for Planning Knowledge:** For policy formulation the realm for information search and investigation is rather unlimited; collecting all relevant information might include exhaustive seeking for information sources. Collecting expertise and preparing information for decisions is a tough part: gathering as well internal and external information, furthermore both factual information as well as deontic information. Especially the latter one is crucial and manifold so including norms, prior decisions, binding expectations etc.
4) **Repositories for Process Knowledge:** Another example is collecting administrative process knowledge. Such repositories gather experience from different cases and their usage may be helpful for staff novices at work.

Creating metadata in a global dimension leads to the most important endeavour in semantics: The Semantic Web. It directs toward achieving collective intelligence on the internet and a world-wide sharing of unstructured information and informal knowledge. The Semantic Web is accomplished via architectures of layering and standardisation. In such a sophisticated schema quite heterogeneous resources can be described, joined up and used simultaneously.

Technically regarded, the Semantic Web can be seen as gigantic Layer Cake. The basic layers comprise: (a) Identifying Entities (Resources) as a ground for everything using HTTP, URI, and IRI. (b) Data Interchange with XML as extended Mark-up Language and RDF as graph structured data format; (c) Advanced layers with OWL as Web Ontology Language covering heterogeneous resources with different ontologies, further RDFS is a schema allowing comprehensive models for a domain of interest and RIF that enables the triggering using rules. On these basis layers higher layers allow aggregating of different systems and contain a well utilizable user interface.

Note and Acknowledgement. This contribution is intended to offer a general and cursory survey. Several subthemes were published in a more comprehensive way in earlier publications. Therefore for citations we refer to those publications. The list of publications at the end is also intended for giving acknowledgement to the co-authors.

References

1. Gieber, H., Orthofer, G., Traunmüller, R.: Best Practice in E-Government: Some Reflections on Usage. In: Wimmer, M.A., Traunmüller, R., Orthofer, G. (eds.) Knowledge Transfer Across Europe: 4th Eastern European elGov Days and 5th elGov Days. Reihe books@ocg.at #203. Österreichische Computergesellschaft Wien, pp. S.61–S.68, (3-85403-203-X) (2006)
2. Gieber, H., Leitner, C., Orthofer, G., Traunmüller, R.: Taking Best Practice Forward. In: Chen, H., et al. (eds.) Digital Government: E-government Research, Case Studies, and Implementation, Springer-Verlag New York Inc. (2007) ISBN 978-0387716107
3. Lenk, K., Traunmüller, R.: Innovative Information Systems in Public Administration. In: Bots, Lenk, Traunmüller (eds.) Innovative Public Services and Policy Support, Proceedings of the IFIP WG 8.3/8.5 Joint Working Conference, Delft, January 25-26. Technische Bestuurskunde Delft (1996)
4. Lenk, K., Traunmüller, R (Hrsg.): Öffentliche Verwaltung und Informationstechnik: Perspektiven einer radikalen Neugestaltung der öffentichen Verwaltung mit Informationstechnik. Schriftenreihe Verwaltungsinformatik Bd. 20, im R. v. Decker´s Verlag, Heidelberg (1999)
5. Lenk, K., Traunmüller, R., Wimmer, M.: The Significance of Law and Knowledge for Electronic Government. In: Grönlund, A. (ed.) Electronic Government - Design, Applications and Management. Ideas Group Publishing (2002)
6. Traunmüller, R.: Rechtsinformatik auf dem Weg ins nächste Jahrzehnt. In: Lenk, K., Reinermann, H., Traunmüller, R. (Hrg.) Informatik in Recht und Verwaltung: Entwicklung, Stand und Perspektiven. Ehrenband für Herbert Fiedler, R. v. Decker's Verlag, Heidelberg (1997)
7. Traunmüller, R.: Web 2.0 Creates a New Government. In: Andersen, K.N., Francesconi, E., Grönlund, Å., van Engers, T.M. (eds.) EGOVIS 2010. LNCS, vol. 6267, pp. 77–83. Springer, Heidelberg (2010)
8. Traunmüller, R.: Mobile Government (Invited Paper). In: Andersen, K.N., Francesconi, E., Grönlund, Å., van Engers, T.M. (eds.) EGOVIS 2011. LNCS, vol. 6866, pp. 277–283. Springer, Heidelberg (2011)
9. Traunmüller, R., Wimmer, M.: KM for Public Administration: Focusing on KMS Feature Requirements. In: Karagiannis, D., Reimer, U. (eds.) PAKM 2002. LNCS (LNAI), vol. 2569, pp. 314–325. Springer, Heidelberg (2002)
10. Traunmüller, R., Orthofer, G., Gieber, H.: Public Governance Urges for Better e-Government Solutions: Best Practice Will Indicate the Way. In: Traunmüller (ed.) Knowledge Transfer for eGovernment. Seeking Better eGovernment Solustions. Schriftenreihe Informatik, vol. 20, Trauner Druck, Linz (2006) ISBN 3-85499-177-0
11. Traunmüller, R., Wimmer, M.: Knowledge Management and Electronic Governance. In: Janowski, T., Pardo, T.A. (eds.) Proceedings of the 1st International Conference on Theory and Practice of Electronic Governance, ICEGOV 2007, Macao, China, December 10-13 (2007)
12. Traunmüller, R., Wimmer, M.: E-Gov 2.0: Improving Participation. In: E-Gov 2.0: Pave the way for E-Participation. E-Democracy Workshop, Madrid, Eurospace, Roma, October 5 (2009)
13. Traunmüller, R., Wimmer, M.: Wissen als Potential der öffentlichen Verwaltungen. In: Geist, A., Brunschwig, C., Lachmayer, F., Schefbeck, G. (eds.) Structuring Legal Semantics. Editions Weblaw, Bern (2011)

ePartication – Did We Deliver What We Promised?

Alexander Prosser

Department of Information Processing and Process Management,
University of Economics and Business Administration,
Vienna, Augasse 2-6, A-1090 Vienna
prosser@wu.ac.at

Abstract. This contribution attempts to critically compare the vision of online citizen participation to the developments that can be observed in the field thus far. The analysis then focuses on areas of improvement to help develop this area further. The main focus is on the evolution in the European Union, however, general conclusions may be drawn beyond that.

Keywords: eParticipation, eVoting, citizen participation.

1 The Promise

eParticipation in the context of this paper will be seen as the use of ICT to expand and deepen political participation by enabling citizens to connect with one another and with their elected representatives [1]. In extension to this definition, this paper will also consider citizen participation in large-scale administrative decision-making as part of eParticipation [2-3]. Also, this paper will not follow Macintosh [4] to divide eDemocracy into citizen participation and eVoting, whereby the latter "should be viewed as a technological problem", as a decision-making step (which may well be concluded by some type of voting) could be considered as an integral part of online citizen participation.[1] This also applies to agenda-setting tools, such as citizens' initiatives and petitions in online mode. Finally, "e" of course also includes all forms of mobile devices and apps.

What have been the promises made by eParticipation (or that have been projected into it)? The objectives listed by Macintosh in [4] could be summarized as (i) to reach a wider audience, (ii) to cater for the diverse technical and communicative skills of citizens, (iii) to enable a deeper deliberation and (iv) to enable more informed discussions by providing pertinent information. Council of Europe Recommendation 2009(1) on eDemocracy in Recital 6 derives some goals, particularly to "enhance[.] the effectiveness of democracy, democratic institutions and democratic processes", to "provide[.] opportunities for meaningful and effective public deliberation and participation in all stages of the democratic process, responsive to people's needs and priorities" and – probably as the ultimate goal of citizen engagement – to "maintain[.] and enhance[.] citizens' trust in democracy, democratic institutions and democratic processes".

[1] Following the holistic view of Trechsel in [31], p. 22: "[...] part of a wider e-democracy agenda through which voters are not only given the possibility to cast their vote, but may gather supplementary information about issues and parties, deliberate online, [...]".

A. Kő et al. (Eds.): EGOVIS/EDEM 2012, LNCS 7452, pp. 10–18, 2012.

In the field of eVoting, Buchstein [5] derives quite similar aims (pp.44ff) as (i) higher voter turnout, (ii) strengthening direct democracy and (iii) additional election options to enable more differentiated decisions. He also indicated cost reductions ("cheap democracy") and efficiency gains among the advantages. Due to the decreased cost per election/referendum, Buchstein hypothesises an increase in the number of such popular decisions, which would lead to a more direct form of democracy (which he implicitly considers an improvement).

Condensing the issues would hence lead to the following aims:

A.1 Facilitate *access* to information, deliberation and decision-making;
A.2 Increase the level of participation and *turnout*;
A.3 Increase the *quality* of participation, particularly deliberative processes;
A.4 Create a *sustainable* system, not just a one-off pilot;

Whereby the overall aim would be to enhance the *legitimacy* of democratic institutions and processes.

The following Sections attempt to investigate applications of online citizen participation and evaluate, whether these aims have been achieved. They will of course not be exhaustive enumerations o projects and pilots, yet the author believes them to be a representative sample of what has been achieved thus far; an assumption, which is of course falsifiable.

2 Evidence from eVoting

The promises of ubiquitous access and increased citizen engagement has arguably been highest in the field of eVoting, particularly in view of the, at times sharply, reduced voter turnout. This mainly applies to Internet voting, as voting machines in the polling station still require voters to attend the polling stations. Here a selection of eVoting pilots or pilot programmes across the EU:

The UK performed a number of Internet-, TV-, phone- and kiosk-based remote voting pilots in local elections between 2000 and 2007.[2] Particularly in 2007, massive irregularities occurred (cf. [10-11]). The main issue seems to have been a far-reaching loss of control by the election officials (eg, vendor staff manually editing electronic ballots so that the "import process [into the counting application, red.] could continue" ([11], para 6.2.12). Consequently, the U.K. Electoral Commission recommended discontinuing any further eVoting pilot schemes [12], in particular until "sufficiently secure and transparent e-voting solutions that have been tested and approved can be selected by local authorities" (p. 4).

[2] For an overview and a link collection see the page of the Austrian Computer Society `http://www.ocg.at/ak/edemocracy/wiki2/en/doku.php?id=projects:great_britain:e-government_and_e-voting_in_great_britain`

Germany used eVoting in polling stations for the Bundestag elections 2005 in several Federal States. The usage was contested in the Constitutional Court [7] and in its ruling [8], the Court cancelled the usage of voting terminals, mainly on transparency grounds.[3]

Finland conducted an eVoting pilot in a number of constituencies in local elections in 2008, where more than 200 votes seem to have "disappeared" [9]. The eVoting part of the election in all constituencies concerned was declared null and void by the Supreme Administrative Court and had to be repeated on paper [13]. There is no information available to the author in regards to increased/decreased voter turnout. For a relation with "Operation Bravo" in the U.S. and various other eVoting pilots, see [38], pp. 51-53.

Switzerland tested eVoting for referenda in several Cantons in what was from the beginning declared as pilot projects [14]. Three system designs were tested and the tests were limited in scale, so that a possible issue in eVoting could not stop the entire referendum. [15] The empirical evidence as to a possible increase in voter turnout is ambiguous.[4] The pilot phase has now concluded and is subject to a review process after some security issues have become apparent [25-26].

Austria fielded its first binding use of eVoting in 2009 in the election for the legal student representatives. Accompanied by reports on technical [27] and usability issues [28], only 1% of the electorate used eVoting [29, p. 99]. In December 2011, the Austrian Constitutional Court cancelled the eVoting section of election due to unconstitutional practices (for a closer discussion of the ruling, see [20]).

Voter turnout, as one of the main themes in introducing eVoting does not seem to have been increased. Sources [6], [29], would indicate that other factors are a lot more decisive than the electronic voting channel as such. Franklin [30] points out that the introduction of postal voting has generally not boosted voter turnout (which interestingly correlates with some of the findings of [31] for eVoting in Switzerland), whereas Norris [32] finds a "positive and highly significant impact" of requirement-free postal voting and turnout in the U.K. Gibson [33], on the other hand, in the same study volume derives mixed results mainly relating increased/decreased voter participation to design principles of the system.

The only country in Europe with a success story in eVoting is arguably Estonia [21], [34-35] with 140,000 voters casting their vote electronically in the general elections in 2011 [36, p.8]. The report also concluded that the "OSCE/ODIHR EAM in general found widespread trust in the conduct of the Internet voting by the NEC" (ibid.).

Summarizing, the pilots quoted, except for the Estonian case, have shown no or only limited sustainability[5] and, again with the exception of the Estonian case, did not scale to the national level. As far as utility is concerned, the achievement of A.1 (access) depends on the system design and the media used, above all the identification

[3] "Election procedures, were the voter cannot reliably ascertain that his vote was counted and included in the election result correctly, do not fulfill the constitutional requirements" (§112 of [8], my translation).

[4] See the Canton-wise analysis in [14], pp. 5498-5504 and [31], Table 1 and Figure 1 for Geneva, where even a negative correlation can be derived from the data.

[5] With the annotation that the Swiss pilots have never been intended to be anything but pilots (cf. [37], p. 52).

media. A.2 clearly cannot be maintained; there seems to be, at best, mixed evidence as to whether eVoting increases turnout or whether other factors (decisive political decisions, "hot" topics in referenda, curiosity in first-time eVoting usage that afterwards drops) are a lot more decisive in this regard.

3 Evidence from Participatory Budgeting as Example for Deliberative Systems

Participatory budgeting can be seen as a way to engage citizens in a palpable decision making issue, that is on the spending of a part of the budget, typically of a municipality. Participatory budgeting pilots have been conducted in many European countries, they have particularly gained a certain popularity in Germany[6]. Reviewing the information given on the projects in this list, the common denominator appears to be (i) a low participation rate (1 – 2% of the population at best), (ii) a higher participation in the paper mode (for detailed figures see [41], p. 35) and, where available, (iii) figure show a massive under-representation of less educated groups (for example, [42], p. 24) and (iv) a random selection of citizens allowed to participate, which means that the largest part of the population was *ab initio* excluded from the participation.

Puerto Allegre in Brazil has been quoted as a successful example for participatory budgeting increasing the spending on education and utilities and generally improving the quality particularly of disadvantaged, marginalised areas of the city. [40] However, it has to be noted that the main channel of this endeavour is *not* "e", but conventional "neighborhood assembles" and "thematic assemblies" (p. 2). The concept is apparently gaining support in several other Brazilian municipalities. Such a conventional – or at least multi-channel approach as chosen in [39] – may counter concerns that (mainly online) citizen participation may create a digital elite and may only "feign participation to legitimise one's own interests" ([41] my translation) due to (i) low participation rates and (ii) a digital divide between less and highly educated groups within the population.

A study on EU-funded pilot projects in deliberative participation conducted in [43] shows similar results for a more general type of projects: The typical project attracted 200 users per pilot and reached an audience of 2100 people, typically in 2-3 pilots in EU countries.

4 Evidence from Agenda-Setting Systems

Online petition systems have become a popular feature for parliamentary web sites.[7] The main issue of such systems appears to be the lack of a reliable identification of

[6] `http://www.buergerhaushalt.org/status/` which lists 70 municipalities or municipal districts as introducing participatory budgeting and 21 as doing it for the third time or more often.

[7] See as examples `https://epetitionen.bundestag.de/` (Germany), `http://epetitions.scottish.parliament.uk/list_petitions.asp` (Scotland) or `http://www.parlament.gv.at/` (Austria).

the supporters. The German system requests registration on the platform in order to support a petition, this registration is however possible under a bogus name and a non-existing email address. The Austrian system requires indication of an email address to send a confirmation email with a validation link which has to be followed for the support declaration to be counted, however, the email address can also be a free-mail address just created by the user.[8] A standard CAPTCHA mechanism at least protects both sides from automated spam. The Scottish page could not be tested as there seems to currently be no open petition. These "identification" mechanisms of course raise concerns about the long-term credibility of the system.

The usage figures yield a mixed picture. In the German system, there are currently (June 17, 2012) four petitions above or close to 1000 support declarations, two dealing with the ratification process of the European Stability Mechanism (7,800 and 1,000 declarations, resp.), aspects of financial aid for the handicapped (1,500) and noise protection along railroads (1,000). The bulk of the petitions seems to gather around one hundred declarations or less. There is no information as to what happens with the petition. Four online petitions in the Austrian system attracted between one and two thousand declarations, most remaining ones hold around 100 and less.

Arguably the (potentially) biggest online citizen participation project in Europe is the new European Citizens' Initiative ECI,[9] which can also be signed online. The Regulation by the Commission [16] puts the entire burden of collecting support declarations on paper or online on the organisers ("citizen committee") of the ECI, who do not only have to provide the substantial financial means for the collection, but also bear the full – and potentially crippling – civil, administrative and criminal liability of the collection in all Member States of the Union [19]. Since [16] calls for natural persons to be organisers, this personal liability cannot be limited. The assistance provided by the Commission mainly consists of a software package due in January 2012 that however was not available due to severe technical difficulties in June 2012[10] (for an earlier analysis of the ECI software see [23]).

Another main issue that may affect the long-term success of the ECI is the mode of collection. As the entire collection process was "privatised" and no generally available means of reliable EU-wide citizen identification exists, the declarations are "signed" by simply adding name/address and – in some Member States – a passport/ID or citizen number (for the different data requirements for a support declaration see Annex III in [16]). These declarations are then verified ex post by the Home Office of the respective Member State, which depending on the data required by each Country will in many cases only be a plausibility check, not a real verification of identity [24]. This credibility issue is further aggravated by the possibility to use Random Sampling for the verification of declarations (Recital 18 in [16], for a comment see [24], p. 129f).

---

[8] Both: Personal experiment of the author.

[9] For legal and procedural details, see [16-17] and all contributions in [18].

[10] This lead to the unfortunate situation that initiatives cannot collect declarations online, see
`http://www.euractiv.com/pa/ecis-get-signatures-due-problems-news-513315,`
`http://www.citizens-initiative.eu/?p=1169#more-1169`
`http://www.more-onion.com/blog/our-eci-signature-setup-has-been-approved`
for which the Commission has apologised and accepted full responsibility [22].

The ECI, introduced by Article 11(4) of the Treaty of Lisbon, promised a concept of EU-wide citizen participation and a powerful tool of agenda setting. Given the importance of the electronic collection in an EU-wide collection process, it also held the promise of a boost for eParticipation in general. The concrete implementation, in particular Regulation [16] and the factual implementation of the tools provided by the Commission have raised concerns about (i) the credibility of the legal instrument as such, (ii) its applicability due to severe liabilities borne by the organisers and (iii) and the support given to organisers by the Commission. In terms of the aims outset in Section 1, there are concerns whether the ECI will be able to enhance level and quality of participation. It has to be borne in mind that the ECI due to its *potential* size is arguably the current flagship eParticipation project in the entire EU – its success or failure as a participation tool will hence have far-reaching consequences on the field as a whole.

5 Some Lessons Learnt

The above experience could be merged into some organisational and technical recommendations:

(i) Identify high-demand areas for implementation, where citizens experience a high value added in the (online) participation.

Arguably the most successful eParticipation platform in Austria has been unibrennt.at. This platform was created in the student protests 2009 and is still online (hence, sustainable[11]). It has over 28,000 Facebook fans and 130,000+ tweets. It served as a coordination device in the student protests and also facilitated access to relevant information including various broadcasts and life streams. It hence met a real demand – and government-driven (and –financed) eParticipation initiative should have a similar aim.

(ii) Provide software and platforms that meet standards for commercial software as being used in mature eGovernment solutions already.

Again, unibrennt.at can serve as best practice example: The platform is rather slim, mainly consisting of embedded services, such as Twitter, ustream or Facebook, which can be regarded as proven commercial software that is also upgraded regularly and adapted to the technical evolution in ICT including security patches.

(iii) Provide for reliable user/citizen authentication.

The credibility of any government-driven platform depends on the correctness of results, whether in voting, agenda setting or deliberation projects. Correct user authentication may be seen as a necessary, but not sufficient pre-requisite for online participation success. This is also a (probably the) main value-added of government-driven eParticipation initiatives that private platforms operating on Facebook/Twitter accounts or nicknames cannot easily achieve.

[11] It is currently (June 2012) being (re)used heavily in protests against the partial re-introduction of student fees in Austria.

(iv) Provide for multi-channel and social inclusiveness.

It is highly problematic to make the "e" channel the only participation channel, as it creates a new digital divide and limits the range and scope of the interaction with the citizen. In some cases, see the Puerto Allegre case cited above, "e" may even be a supplementary, not the main channel.

Faced with the mixed results in the areas discussed one has to answer the question in the heading with a clear "no". However, if we get a clear und unemotional view on what determines the success of a project, we may finally be able to deliver.

References

[1] Fuchs, C., Bernhaupt, R., Hartwig, C., Kramer, M., Maier-Rabler, U.: Broadening eParticipation: rethinking ICTs and participation in Association of Internet Researchers Association Conference 7.0, Brisbane (2006)

[2] Prosser, A., Müller-Török, R.: Technische Möglichkeiten einer Neuregelung der Großverfahren nach AVG. In: Matzka, M. (ed.) E-Partizipation im Verwaltungsverfahren, Facultas, Wien, pp. 47–124 (2011)

[3] Prosser, A.: eParticipation in Administrative Procedures. In: Proceedings of the Eastern European eIGov Days 2011, Ljubljana (2011)

[4] Macintosh, A.: Characterizing E-Participation in Policy-Making. In: Proceedings of the 37th Hawaii International Conference on System Sciences, HICSS (2004)

[5] Buchstein, H.: Online Democracy, Is it Viable? Is it Desirable? Internet Voting and Normative Democratic Theory. In: Kersting, N., Baldersheim, H. (eds.) Electronic Voting and Democracy – A Comparative Analysis, pp. 39–60. Palgrave, Macmillan, Houndmills (2004)

[6] Editorial: E-voters 'not boosting turnout'. BBC World News (July 5, 2007), http://news.bbc.co.uk/2/hi/uk_news/politics/6268734.stm

[7] Prosser, A.: The Ruling of the Federal Constitutional Court on eVoting and its technical consequences for Internet voting. In: Conference on Electronic Democracy, EDEM 2009, pp. 17–26 (2009)

[8] Bundesverfassungsgericht Urteil BVerfG 2 BvC 3/07 and BvC 4/07, Karlsruhe (March 3, 2009)

[9] Karhumäki, J., Meskanen, T.: Audit report on pilot electronic voting in municipal elections, University of Turku (2008)

[10] Open Rights Group: May 2007 Election Report - Findings of the Open Rights Group Election Observation Mission in Scotland and England, London, pp. 19–24 (2007)

[11] Actica Consulting: Technical Evaluation of Rushmoor Borough Council e-voting Pilot 2007, London (2007), particularly Sections 6.2 and 6.3

[12] The Electoral Commission: Key Issues and Conclusions. Electoral Pilot Schemes, London (May 2007)

[13] Editors: E-Votin-Wahlgang in Finnland ungültig, futurezone ORF 2009 (July 5, 2009), http://futurezone.orf.at/stories/1602230

[14] Bundeskanzlei, S.: Bericht über die Pilotprojekte zum Vote électronique, Drucksache 06.056 (May 31, 2006)

[15] Braun, N.: Schweizer E-Voting Pilotprojekte: Evaluation, Situationsanalyse und weiteres Vorgehen. In: Schweighofer, E., Liebwald, D., Drachsler, M., Geist, A. (eds.) e-Staat und e-Wirtschaft aus Rechtlicher Sicht, Boorberg, pp. 142–150 (2006)

[16] Regulation (EU) No 211/2011 of the European Parliament and of the Council of 16 February 2011 on the citizens' initiative, http://ec.europa.eu/citizens-initiative/public/welcome
[17] Obwexer, W., Villotti, J.: Die Europäische Bürgerinitiative. Grundlagen, Bedingungen und Verfahren in Journal für Rechtspolitik (3), 108–121 (2010)
[18] Pichler, J.W., Kaufmann, B. (eds.): The next big thing – Making Europe ready for the Citizens' Initiative. Schriften zur Rechtspolitik 32. NWV Verlag, Vienna (2011)
[19] Müller-Török, R., Stein, R.: Die Rechtsakte zur Europäischen Bürgerinitiative – offene Fragen und Risiken für Organisatoren. In: Schweighofer, E., Kummer, F., Hötzendorfer, W. (eds.) Transformation Juristischer Sprachen – Tragungsband der IRIS 2012, pp. 237–244. OCG Verlag, Wien (2012)
[20] Balthasar, A., Prosser, A.: E-Voting in der "Selbstverwaltung" – Anmerkun-gen zum Beschluss des VfGH vom 30. Juni 2011, B 1149, und zum Erkenntnis des VfGH vom 13. Dezember 2011, V 85–96. Journal für Rechtspolitik 20(1), 47–85 (2012)
[21] Drechsler, W., Madise, Ü.: Electronic Voting in Estonia. In: Kersting, N., Baldersheim, H. (eds.) Electronic Voting and Democracy – A Comparative Analysis, Palgrave, Macmillan, Houndmills, pp. 97–108 (2004)
[22] Häfner, G.: ECI - problems with online collection tool - concession of the Commission, http://www.democracy-international.org/eci-software.html
[23] Cagdas, Ö., Starskaya, M.: Analysis of the Online Collection Software provided by the European Commission for the European Citizens' Initiative. Department for Information Processing and Process Management, University of Economics and Business, Vienna (2012)
[24] Balthasar, A., Prosser, A.: Die Europäische Bürgerinitiative – Gefährdung der Glaubwürdigkeit eines direktdemokratischen Instruments? Journal für Rechtspolitik (3), 122–132 (2010)
[25] Office for Democratic Institutions and Human Rights Swiss Confederation Federal Assembly Elections. OSCE/ODIHR Election Assessment Mission Report (October 22, 2011)
[26] Brühwiler, P.: E-Voting in der Kritik Übungsabbruch nach Abstimmungspanne? Blick (March 15, 2012)
[27] http://derstandard.at/1234507356955/Sicherheitsluecken-und-Interessenkonflikt-E-Voting-Nicht-geeignet-fuer-geheime-Wahlen
[28] Editor: Weitere Fehler im e-Voting System gefunden, http://papierwahl.at/2009/05/18/weitere-fehler-im-e-voting-system-gefunden/
[29] Bundesministerium für Wissenschaft und Forschung: E-Voting bei den Hochschülerinnen- und Hochschülerschaftswahlen 2009 – Evaluierungsbericht, Wien (2010)
[30] Franklin, M.: Voter Turnout and the Dynamics of Electoral Competition in Established Democracies since 1945. Cambridge University Press (2004)
[31] Trechsel, A.: E-voting and electoral participation, http://eui.academia.edu/AlexanderHTrechsel/Papers/615901/E-voting_and_electoral_participation
[32] Norris, P.: e-Voting as the magic ballot for European Parliamentary elections? Evaluating e-voting in the light of the experiments in the UK local elections. In: Trechsel, A., Mendez, F. (eds.) The European Union and E-Voting – Addressing the European Parliament's Internet Voting Challenge, pp. 60–90. Routledge, London (2005)

[33] Gibson, R.: Internet voting and the European Parliament elections - Problems and prospects. In: The European Union and E-Voting – Addressing the European Parliament's Internet Voting Challenge, pp. 29–59. Routledge, London (2005)
[34] Estonian National Electoral Committee: E-Voting System General Overview, Tallinn (2010)
[35] Maaten, E.: Towards Remote E-Voting: Estonian case. In: Prosser, A., Krimmer, R. (eds.) Electronic Voting in Europe - Technology, Law, Politics and Society. Lecture Notes in Informatics, pp. 83–100. Gesellschaft für Informatik, Bonn (2004)
[36] OSCE Office for Democratic Institutions and Human Rights: Estonia Parliamentary Elections; OSCE/ODIHR Election Assessment Mission Report (March 6, 2011)
[37] Braun, N.: E-Voting: Switzerland's Projects and their Legal Framework. In: Prosser, A., Krimmer, R. (eds.) Electronic Voting in Europe - Technology, Law, Politics and Society. Lecture Notes in Informatics, pp. 43–52. Gesellschaft für Informatik, Bonn (2004)
[38] Awad, M., Leiss, E.: Internet voting in the USA: analysis and commentary. Transforming Government: People, Process and Policy 5(1), 45–55 (2011)
[39] [39] Bücker, H., Röber, M., Klages, H., Knipp, R., Märker, O., Roeder, S.: Abschlussbericht des Bezirksamtes Lichtenberg von Berlin Projekt B 8 der Neuordnungsagenda Berlin, Partizipative Haushaltsplanaufstellung, -beschluss und -kontrolle im Bezirk (Bürgerhaushalt) (2006)
[40] World Bank: Participatory Budgeting in Brazil, http://siteresources.worldbank.org/INTEMPOWERMENT/Resources/14657_Partic-Budg-Brazil-web.pdf
[41] Schmelzer, T.: Bürgerbeteiligung im Internet Wirkungslose Wunderwaffe, http://www.sueddeutsche.de/politik/buergerbeteiligung-im-internet-wirkungslose-wunderwaffe-1.1358838
[42] Taubert, N., Krohn, W., Knobloch, T.: Evaluierung des Kölner Bürgerhaushaltes, Bielefeld (2010)
[43] Koussouris, S., Charalabidis, Y., Askounis, D.: A review of the European Union eParticipation action pilot projects. Transforming Government: People, Process and Policy 5(1), 9–19 (2011)

Factors Affecting the Development of e-Government in Saudi Arabia

Emmanuel Nyakwende and Ali Al Mazari

ALFAISAL University, PSCJ Campus, Jeddah, Saudi Arabia
{Emmanuel,Almazari}@pscj.edu.sa

Abstract. The purpose of this paper is to explore the factors influencing the implementation of e-Government in Saudi Arabia. Those factors can be viewed in the context of internal and external trends, political and economic climates, technological factors, and customer needs. Internal trends have to do with how government employees add value to the services they provide to the public. The handling of personal data, digital divide between those with access to IT facilities and those without, the need to respond to customer needs, and government policies are factors which create political climate. The increases in disposable income, rise in service culture and business mergers have a bearing on e-Government. Internet penetration worldwide and households, proliferation of smart phones and availability of broadband communication networks are among the technological factors facilitating e-Government. Governments have to appreciate customer requirements to address them adequately using ICT.

Keywords: e-Government, Technology Acceptance Models, Change management, IT readiness.

1 Introduction

E-government is the application of the Internet and networking technologies to digitally enable relationships of government with citizens, businesses, and other arms of government. The factors influencing e-Government can be viewed in the context of internal and external trends, political and economic climates, technological factors, and customer needs. Internal trends have to do with how government employees add value to the services they provide to the public. The handling of personal data, the digital divide between those with access to IT facilities and those without, the need to respond to customer needs, and government policies are some of the factors which create the political climate. The increases in disposable income, the rise in service culture and business mergers have a bearing on e-Government. Internet penetration worldwide is growing at a fast rate. Households with PCs are also growing fast. The proliferation of smart phones and availability of broadband communication networks are among the technological factors which facilitate e-Government. Governments have to appreciate customer needs and requirements in order to address them adequately using ICT. However, according to Gartner reporting in 2007 [4], it has

A. Kő et al. (Eds.): EGOVIS/EDEM 2012, LNCS 7452, pp. 19–28, 2012.

been shown that providing a government services portal does not automatically translate to demand for its use because citizens have a different relationship with their government compared to their bank and retailers. They consider interactions with government services as mere compliance with rules and regulations and not value adding.

The Kingdom of Saudi Arabia invested extensively in technology infrastructure to support e-government. Mechanisms are in place to guide e-development through the Yasser project (www.Yesser.gov.sa). The Balanced Score Card has been adopted to measure and evaluate e-government development progress. There is a proliferation of smart phones and an expansion of broadband communication networks. Internet penetration is growing at a fast rate and disposable income of the general public is growing. Households with PCs are also growing fast. According to [4], the five year National Communications and Information Technology Plan developed in 2005 for the Kingdom of Saudi Arabia had the following vision.

"By the end of 2010, everyone in the Kingdom will be able to enjoy – from anywhere and at any time – world-class government services offered in a seamless, user-friendly and secure way by utilizing a variety of electronic means."

The purpose of this paper is to explore some of the reasons why this vision might not be realized by the end of 2010. This is a theoretical research paper which considers holistically the factors that affect the development of e-government in Saudi Arabia and suggests a framework that could be useful in guiding e-development.

2 e-Government Models

The major models of e-government are Government to Citizen (G2C), Government to Business (G2B), Government to Employee (G2E) and Government to Government (G2G). G2C uses single web sites to reduce time to access government services. It is convenient and is available anytime and anywhere. G2B aims to reduce burdens on doing business with the government. It facilitates access to online tender applications, renewal of licenses and permits, economics and business statistics, e–procurement to increase transparency and to clear goods from customers, completion of export forms and compliance with regulations. G2E aims at enabling the online interactions between the governmental departments and the employees. Such model provides the employees with facilities to access their records, abilities to exchange their knowledge and learning, and facilities to obtain software and electronic materials. G2G allows different government departments to work together seamless through communication networks. This results in increased employee productivity, cost effectiveness and efficient processes.

3 e-Government Development Stages

The framework in Fig.1 was developed by [6] to depict the stages which an e-Government project goes through in its lifecycle. They propose that all government agencies should strive to reach the highest level (Horizontal Integration) because the systems are integrated across different functions, which results in efficient service rendition.

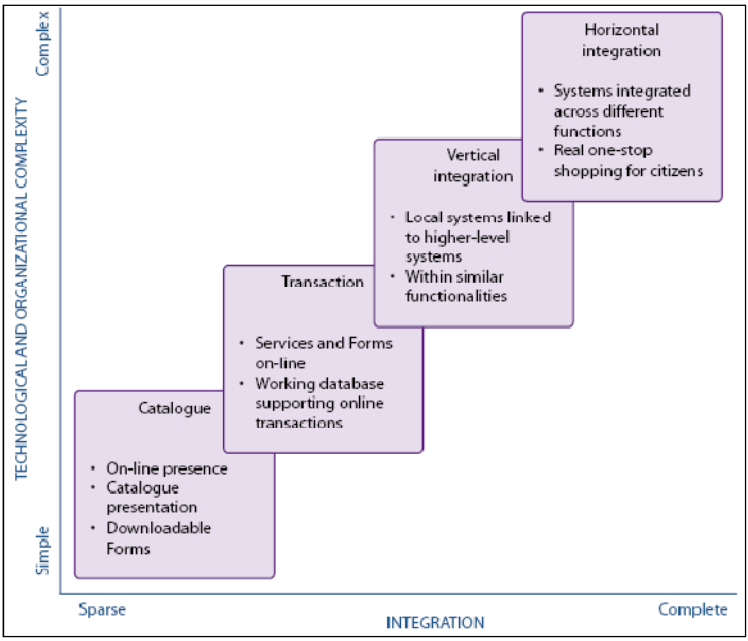

Fig. 1. E-government Development Stages (Adopted from [7])

According to [7], the following are the components of good e-Governance:

- Stakeholder Analysis
  - All parties that have been identified as beneficiaries should be consulted throughout the entire development process. There should be buy-in from all stakeholders in order for the project to be successful.
- Organizational Structure
  - Governmental red tape should be completely eliminated so that the development process is not hindered in any way.

- Project Management
  - One of the success factors of the e-government projects is the availability of adequate project management skills and adequate project managers [9].
- Process Streamlining
  - Processes need to be re-engineered so that e-Government developments are streamlined to meet the expectations of the stakeholders.
- Technological Feasibility
  - The technology to be used needs to be up-to-date and easily understood by all stakeholders.

4 ICT Indicators in the Kingdom of Saudi Arabia

According to Fig.2, the total number of mobile subscriptions in the Kingdom of Saudi Arabia resulted in 161.8% penetration in 2009. Pre-paid subscriptions account for 85% of the market.

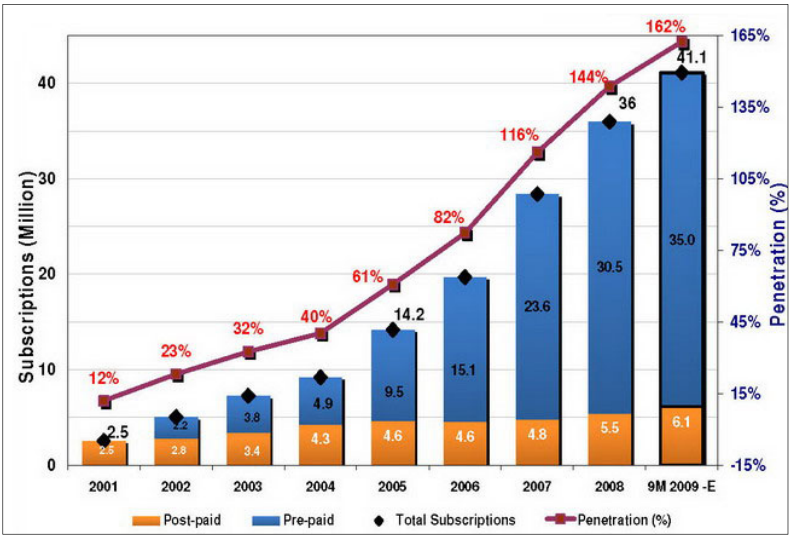

Fig. 2. Mobile Telecommunications Market (www.cdsi.gov.sa) [5]

Fig.3 shows that there were more than 4 million fixed telephone lines in Saudi in the Third Quarter of 2009, and 74% of these were residential lines. The graph also shows a household teledensity of around 69% and a population teledensity of around 16.3%.

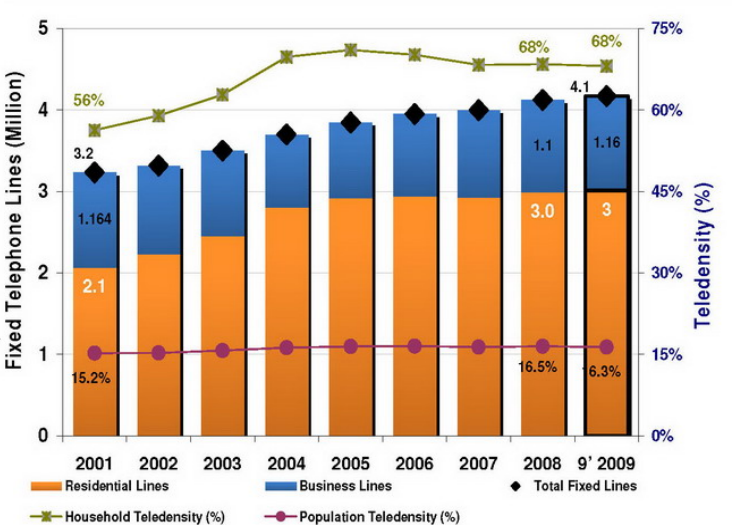

Fig. 3. Fixed Telephony Market (www.cdsi.gov.sa) [5]

Fig.4 shows a significant growth in broadband teledensity for both the population and households. During 2009 fixed and mobile wireless broadband represented over 62.5% of all broadband connections.

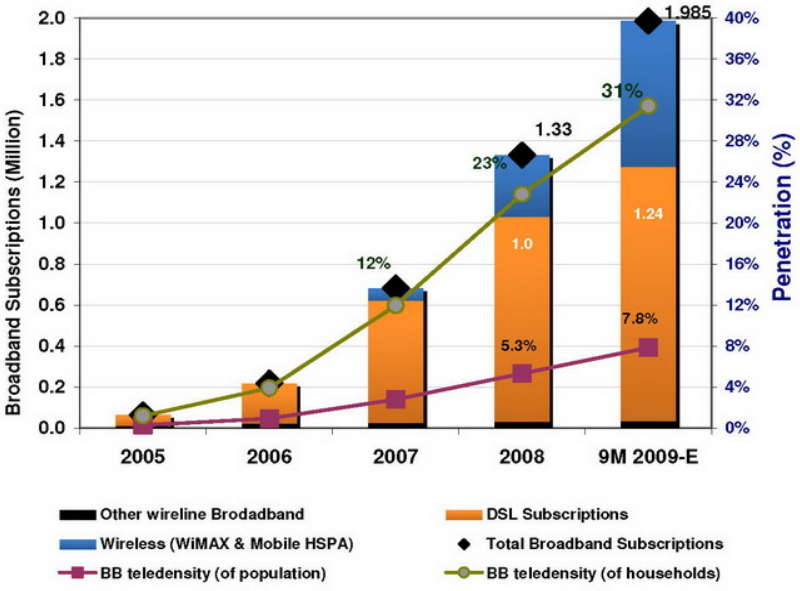

Fig. 4. Broadband Services Market (www.cdsi.gov.sa) [5]

Fig.5 shows that Internet penetration increased to 38.5% of the population by the end of September 2009.

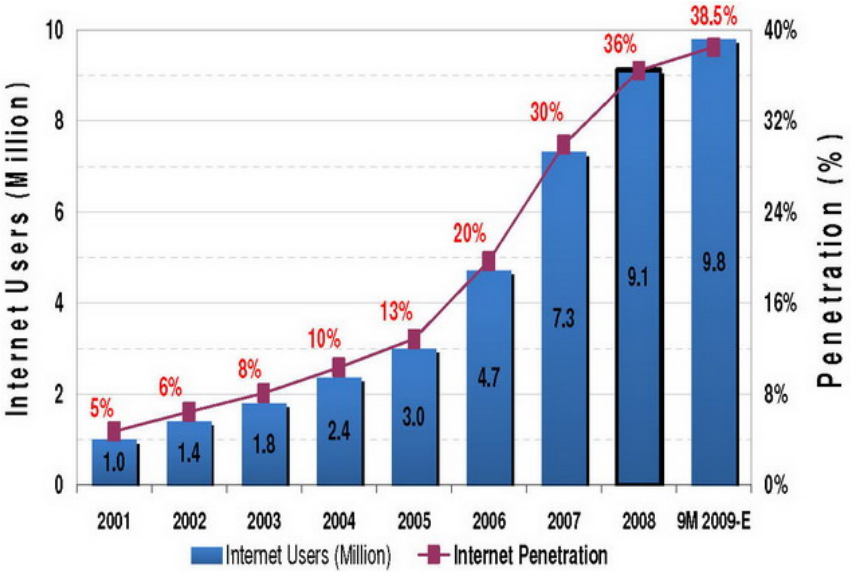

Fig. 5. Internet Services Market (www.cdsi.gov.sa) [5]

According to the Cost of Living Index (inflation) over the period 2002-2008 data published by the Central Department of Statistics & Information (www.cdsi.gov.sa) [5], the cost of telecom services in Saudi Arabia reduced by 23.5%. These facts together with the indicators illustrated in Fig. 1 to Fig. 4 augur well for e-development.

5 Measuring e-Government Progress

In order to assess and compare the progress of e-Government strategies across countries, it is necessary to consider the following elements [4]:

- **The Availability and Actual Use of ICTs**
  E-Government development in a country depends on the availability of the necessary technology infrastructure support (hardware, software, networks, ISPs, mobile platforms such as smart phones, iphones, blackberries, etc). The general public should readily access e-government services; there should be designated information centers, for example. Both government employees and the general public should be willing to use the available technology to access government services.
- **The Regulatory and Political Framework**
  Proactive support by government leadership significantly enhances e-government development. However, the different laws and regulations

regarding privacy and security can inhibit e-development. Restriction on the dissemination of Internet-based information access can render data integration and business intelligence very difficult.

- **The Actual Needs of Citizens**
  E-government development should not be one size fits all. Citizens in different countries want and need different services. Citizens' views should influence development priorities for e-government.
- **The Overall Efficiency of Established Processes**
  E-Government should not only transform inefficient processes but also retain well established processes that meet citizens' expectations and government efficiency goals. Some processes therefore need to be redesigned or reengineered while others need only be automated.

6 e-Government Metrics

Gartner in 2007 reported the following metrics for e-government development [4]:

- Usage of government websites and Stakeholder satisfaction and value, measured by surveys before and after electronic delivery commences.
- Web channel usage relative to other channels (e.g., walk-in, phone or mail)
- Continuous availability of e-services 24x7 and Process improvement
- Improvement in service delivery due to decreased costs or time it takes to deliver services compared with traditional channels
- Multi-department collaboration and Standardization of systems in different departments
- Promotion of e-Government concepts and benefits on Web sites, in the press and in public places.

7 Technology Acceptance Models

According to [2], the new technologies such as personal computers are complex and an element of uncertainty exists in the minds of decision makers with respect to the successful adoption of them, and therefore, people form attitudes and intentions toward trying to learn how to use the new technology prior to initiating efforts directed at using. As a basis for investigating the acceptance and use of IT, different models have been used over the years. The most widely used models include Innovation Diffusion Theory (IDT) [10], the Theory of Reasoned Action (TRA) [1] and the Technology Acceptance Model (TAM) [3]. The TAM model has been developed by [8] in 2001 as in Fig.6. According to this model, the external variables of individual characteristics, organizational characteristics, task-related characteristics, and characteristics of IT resources affect both perceived ease of use and perceived usefulness. Perceived usefulness and perceived ease of use both reinforce the attitude towards use. The reinforced attitude results in the actual system use.

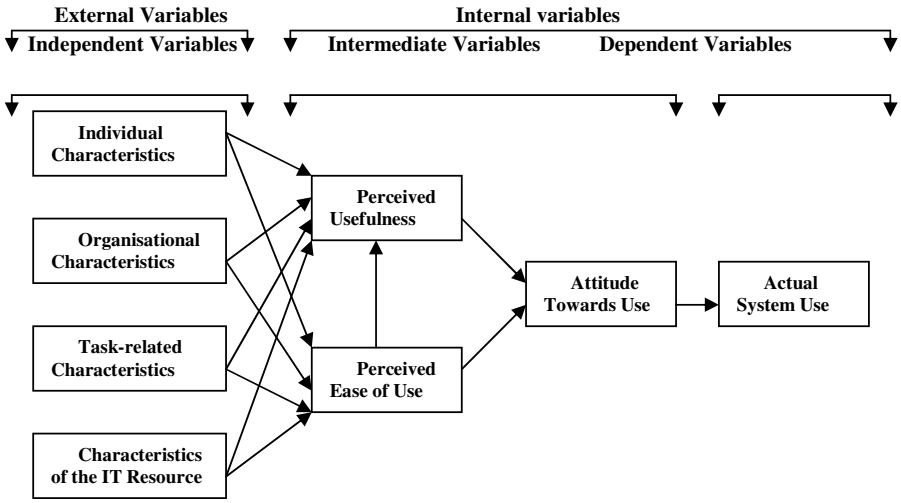

Fig. 6. Technology Acceptance Model, adopted from [8]

8 Framework for e-Government Development

Fig.7 shows the proposed framework for e-government development. The starting point is to have full government support coupled with meaningful citizen participation. Since government is the major supplier of citizen-centric services, its involvement will ensure that the project is adequately supported to meet the needs of citizens. Strategies, policies and plans should be in place to ensure successful development.

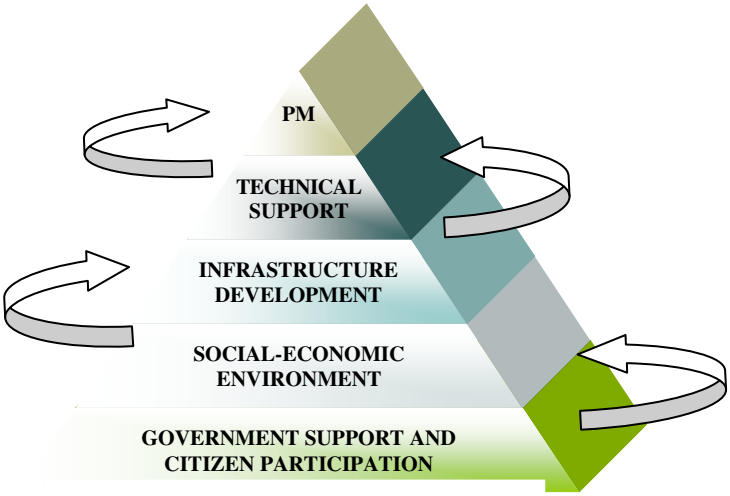

Fig. 7. Framework for e-government development

On the other hand, concerted citizen involvement throughout the development of the project guarantees the crucial buy-in which would affect behavioural intention to use the e-government services created.

Government support and citizen participation create the appropriate platform for a conducive, socio-economic environment for infrastructure development. ICT skills levels for both the general public and government employees should be improved in order for the stakeholders to make full use of e-government services.

Infrastructure in the form of broadband wireless networks, information centres, Internet hosts, mobile phone technologies, and fixed telephone lines significantly affect the potential for Internet use in a particular country. Inefficient, heavily manual processes need to be redesigned.

Technical support refers to the extent to which e-Government projects have the necessary technical expertise to ensure that the project is a success. Besides development of technologies related to e-Government projects, emphasis should also be put on the maintenance and upkeep of those technologies.

Coupled with technical support is sound project management. In all ICT projects, good project management practises are very difficult to employ, but with stringent policies and guidelines, project management can be very effective. The availability of skilled project managers, project management tools, techniques and processes enable proper monitoring and controlling of the projects.

9 Conclusion

The growing changes in technology affect the way people live and interact with their governments. Citizens expect their governments to use the available technologies to make services accessible more conveniently and quickly. There is also now demand for more efficiency and transparency. ICT has revolutionized the way governments offer their services to their citizens. Public services are accessible via the Internet in most countries worldwide. Since the Internet is available 24x7x365, one can access the services quickly and efficiently "anywhere anytime". E-governance renders services using technology as an enabler with the goal of aligning services to citizens' needs and wants. It aims to optimize efficiency and productivity of administration and to provide a prompt and quality administrative service for citizens. Although the Kingdom of Saudi Arabia invested a lot in technological infrastructure for e-government development the vision of having every citizen seamlessly accessing e-government by end of 2010 is unlikely to be realized. Literature has shown that successful e-government development requires more than just technology. Stakeholder involvement is of paramount importance. A technology savvy citizenry needs to have access to e-services and should participate fully throughout the development process. Mechanisms should be in place to influence people's behavioral intentions to use technology. Proper assessment of legacy systems should determine processes to be automated and reengineered. Sound project management practices are a prerequisite for successful implementation.

References

1. Ajzen, I., Fishbein, M.: Understanding attitude and predicting social behavior. Prentice-Hall, Englewood Cliffs (1980)
2. Davis, F.D., Bagozzi, R.P., Warshaw, P.R.: Extrinsic and intrinsic motivation to use computers in the workplace. Journal of applied Social Psychology 22, 1111–1132 (1992)
3. Davis, F.D.: User acceptance of information technology: system characteristics, user perceptions and behavioural impacts. International Journal of Man-Machine Studies 38, 475–487 (1993)
4. Gartner report (2007), http://www.Yesser.gov.sa (accessed February 12, 2010)
5. ICT Indicators in the Kingdom of Saudi Arabia (2010), http://www.cdsi.gov.sa (accessed February 17, 2010)
6. Layne, K., Lee, J.: Developing fully functional E-Government: A four stage model. Government Information Quarterly 18, 122–136 (2001)
7. Mahapatra, R., Perumal, S.: E-Governance in India: A Strategic Framework. International Journal for Infornomics (2006)
8. Pijpers, A.G.M., Bemelmans, M.A., Heemstra, F.J., Van Montfort, V.A.G.M.: Senior executives' use of information technology. Doctorial dissertation, Eindhoven University of Technology (2001), http://www.guuspijpers.com (accessed February 22, 2010)
9. Reffat, R.: Developing a Successful e-Government. In: Proceedings of the Symposium on e-Government: Opportunities and Challenges, Muscat Municipality, Oman, pp. IV1–IV13 (2003)
10. Rogers, E.M.: Diffusion of Innovation, 4th edn. The Free Press, New York (1995)

Websites

www.saudi.gov.sa
www.Yesser.gov.sa
www.cdsi.gov.sa
www.citc.gov.sa

The Framework for Monitoring the Development Process and Inspection of Government Information System and Technology: A Case Study in Thailand

Wichian Chutimaskul and Suree Funilkul

Requirement Engineering Laboratory, School of Information Technology
King Mongkut's University of Technology Thonburi
126 Prachauthit Rd, Bangmod, Thungkru, Bangkok 10140, Thailand
{wichian,suree}@sit.kmutt.ac.th

Abstract. This research addresses the problems, causes, and solutions of the government information system and technology (IST) development, and the framework for measuring the development process and inspection of government IST. The best practice of IST development is discussed in order to maximize cost and return value from investment and to meet each government agency's purpose and benefits. Such a framework has been developed based on COBIT 4.1, ISO/IEC 9126, SERVQUAL and PMBOK, which contains 5+1 main components. They are stakeholder, corporation plan and management, development methodology, information technology, business environment, and the quality of information system and technology. Each component must be measured, monitored, and evaluated to support sustainable government IST development. The quality of IST is therefore important, and is divided into three categories: information quality, software quality, and service quality. Furthermore, this work develops the prototype for implementing this framework by dividing it into three phases: 1) pre-development for competency checking, 2) mid-development for IST process management and project management, and 3) post-development for the acceptance of government IST to assure its quality.

Keywords: Framework, System Quality, Monitoring, Inspection, Development Process, System Development, Information System and Technology.

1 Introduction

Information System and Technology (IST) is an important tool to help organization and management. Some issues are to increase the performance of their processes and competitiveness with other agencies [1,2,3]. At present, governments realize the importance of IST for improving internal management and public services [4]. IST is used as a tool to collect, analyze, distribute, manage and store data, and for decision support [5]. The Thailand government has allocated a continuously increasing budget for IST development since 2003 [6]. The aim is to comply with the government policy called e-Thailand which incorporates e-Government, e-Industry, e-Commerce, e-Education, and e-Society [7].

A. Kő et al. (Eds.): EGOVIS/EDEM 2012, LNCS 7452, pp. 29–43, 2012.

Considering the status of the government IST from 2003 to the present, it was found that the number of projects funded and completed was at 4.82%, discontinued or cancelled 5.10%, and in development 90.08% (or 5,866 projects). The reasons for failed IST projects were ineffective project management, delay, over budget, and users' satisfaction. The causes of this problem are related to the stakeholders, planning and organization management, methodology for IST development, information technology, and the environment. This research therefore aimed to develop a conceptual framework for monitoring the developmental process and inspection of government IST to prevent such problems and to suggest the best practices for the IST development process.

2 Theory, Standard, and Related Work

This section provides a definition for monitoring and inspection of IST, and the process and tools for monitoring the development process and inspection. The information system quality which is composed of information quality, system or software quality, and service quality, are also addressed.

2.1 The Definition of Monitoring and Inspection Information System and Technology

The meaning of monitoring information system and technology defined by Weber [8] and the IT Governance Institute [9] is the method of warning of IST development in the case it does not comply to a schedule. This can be done by monitoring project management and the IST process management in order to gather evidence or proof to ensure that the use of information technology will support the organizational objectives and utilize resources to maximize the benefit for the organization. Moreover, monitoring IST helps achieve the balance between risk in information technology and the investment in information systems.

2.2 The Process of Monitoring the Development Process and Inspection

The process of monitoring is adapted from the Audit Risk and Information Technology Office [10] and the Bank of Thailand [11], and is divided into five steps. They are the preparation of the monitoring plan, pre-monitoring preparation, monitoring, monitoring analysis and summary, and issuing the monitoring reports.

The process of the inspection is to use the acceptance form by checking the Terms of Reference (TOR). The process of inspection is different from the testing and evaluation in that it is used for finding the defects early in the system development. Monitoring the development process and inspection tool concerns two aspects: hardware aspect and software/information system aspect.

For the hardware perspective, monitoring the development process and inspection of hardware conduct is done by monitoring the acceptance of the scope of work identified in TOR as well as the inspection of a personal computer specification. This inspection process in Thailand can be carried out under NECTEC standard [12]. For the software/information system perspective, monitoring the development process and inspection of software/information systems is considered by relevant completed documents.

2.3 The Quality of Information System

The process of inspection system needs to check the quality of information systems because it affects the system usage. This will affect user satisfaction with the system and will impact on individuals and organizations [13]. Iivari [14] and DeLone and McLean [15] found that perceived quality of the system and information has an effect on users' satisfaction. The users' satisfaction can be used to predict the individual and organization impact. The proposed conceptual framework for inspecting information system quality is divided into three dimensions information quality, system/software quality, and service quality [5,16].

2.3.1 Information Quality

Information Quality is determined by evaluating the output from the system. Bailey and Pearson [17] conducted empirical research on factors affecting the satisfaction of the users and found that the accuracy, timeliness, reliability, completeness, relevance, precision, and currency are critical factors to the users. Doll and Torkzadeh [18] developed an instrument to evaluate users' satisfaction including accuracy, timeliness, format, and content. This tool was tested later to confirm its validity by Gelderman [19], Chin and Lee [20] and McHaney, et al [21]. Moreover, Pipino, Lee, and Wang [22] proposed the assessment of information quality on the following elements: accessibility, appropriate amount of data, accuracy, believability, completeness, conciseness, consistent, ease of manipulation, interpretability, objectivity, relevancy, reputation, security, timeliness, ease of understanding, and value added. Furthermore, Iivari [14] suggests the quality of information containing the elements of accuracy, format, completeness, precision, consistency, and currency. Finally, Wangpipatwong and Chutimaskul [5], addressed information quality and define its components as accuracy, timeliness, completeness, precision, and relevance. Considering the information quality proposed by COBIT 4.1, it can be grouped according to the quality of information as follows.

- **Efficiency.** The information is accurate, received on time, readable and concise, and format and content meet users' requirements.
- **Effectiveness.** The information is in the form of value-added information that can be utilized.
- **Confidentiality.** The information is kept secure regarding its confidentiality.
- **Integrity.** The information is complete, accurate, consistent, relevant and meets the purpose of the information usage.
- **Availability.** The information must be updated and can be accessed whenever required.
- **Compliance.** The information must be compliant with related regulations.
- **Reliability.** The stable and on-time delivered information.

The components of information quality defined by COBIT 4.1are similar to those of many researchers. Moreover, COBIT 4.1has introduced a compliance aspect. Therefore, this paper defines the components of information quality based on COBIT 4.1.

2.3.2 System/Software Quality

The quality of the system/software are significantly dependent on the users' satisfaction [13,14,23], the adoption of the system [24] and the system use [13,25]. If the users are satisfied with the system, they are willing to use it [26]. Bailey and Pearson [17] provide empirical research on the components of system quality and include integration, flexibility, convenience, and response time. Dewitz [27] identified the following quality components including flexibility, reliability, ease of use, efficiency, and functionality. Moreover, Iivari [14] studied the system quality and identified the following factors: recoverability, integration, flexibility, convenience, language, and response time. Furthermore, Wangpipatwong and Chutimaskul [5] proposed the components of system quality as reliability, usability, efficiency, and functionality. According to ISO/IEC 9126 [28], the system quality is composed of the modified six components as shown below.

- **Functionality.** The system must work correctly according to the users' needs. It can also integrate and interface to other systems.
- **Reliability.** The system must be able to manage any possible error. It must prevent loss of data.
- **Usability.** It is easy to use, understand, and learn.
- **Efficiency.** Efficiency means minimal resources or time are used for it to work effectively.
- **Maintenance.** Maintenance is to analyze the causes of damage and to support the change.
- **Flexibility.** Flexibility is the ability to change the software or system so that it can be used with other systems.

For the inspection of information system and technology, the dimension of software/systems quality is based on ISO/IEC 9126 and is employed for this work.

2.3.3 Service Quality

Service quality is the quality of service users receive from the system. Service quality is related to the users' satisfaction with the system [25, 29]. Parasuraman, et al. [30] developed SERVQUAL to measure customer satisfaction of service quality and was latter used by Brady, et al., [31] and Kuo, et al., [32]. Some features that are used for measuring users' satisfaction are given below.

- **Tangible.** It means to provide tools or equipment for service including the person who gives the service.
- **Reliability.** This is an ability to provide services as promised by providing accurate services.
- **Empathy.** Empathy can be viewed as an understanding of users of such services.
- **Responsiveness.** This means the willingness and readiness to provide the services to customers.
- **Assurance.** An assurance means humility and courtesy of service and trust in the services.

In addition, the life cycle of the Information Technology Infrastructure Library (ITIL) can be divided into five main issues. They are service strategy, service design, service transition, service operation, and continual service improvement [33]. Nevertheless, the aim of ITIL is to achieve the service-oriented process for IT service management, and IT service delivery and support for the inspection system. In regard to citizens' satisfaction, this work employs SERVQUAL [30] for measuring this aspect.

3 Research Methodology

The research methodology of this study comprises a collection of standards and related research work required to develop the framework of monitoring the development process and inspection of government information systems and technology (IST). In addition, this work has introduced some factors for monitoring the development process and inspection of government IST, which have been verified by user survey. A stratified sampling was used for our data collection from government agencies. Each selected agency completed around 15 questionnaires to avoid data bias. The data was processed on SPSS 15.0 for Windows. The result was analyzed using descriptive statistics, which are presented in the form of frequency, percentage, mean, and standard deviation. The results of the analysis shown in section 5 are divided into three periods. These three periods are classified by the percentage of evolving in development process and inspection of government IST.

4 Framework for Monitoring the Development Process and Inspection of Government IST

From the study of theory and related research on necessary factors to monitor the development process and to inspect the government IST, a conceptual framework has been developed by modifying those from Esteves and Joseph [34], Whitten, et al. [35], Chongsuphajaisiddhi [36], Ndou [37], and Bakry [38]. The Quality of IST is adopted from COBIT 4.1, ISO/IEC 9126, and SERVQUAL for information quality, system/software quality, and service quality respectively. Our framework is comprised of 5+1 components. They are stakeholder, corporation plan and management, development methodology, information technology, and business environment. These five components are for supporting the quality of IST. The framework for monitoring the development process and inspection of government IST is shown in Figure 1. This framework can be applied for any government organization to serve for monitoring the development process and inspection of government IST. All components from this framework should be considered as the guideline by government organization to achieve the quality of service to citizens through the government IST.

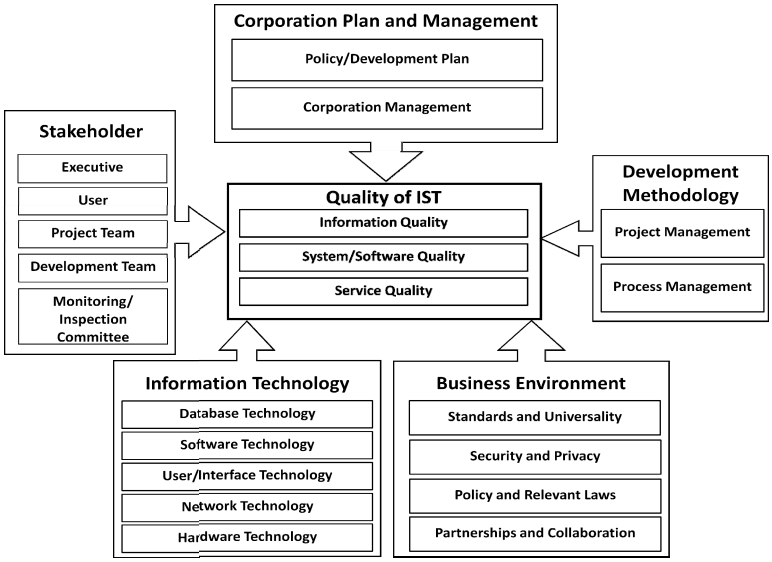

Fig. 1. Framework for Monitoring the Development Process and Inspection of Government Information System and Technology

4.1 Stakeholder

Stakeholders who are involved in the development of information systems are the executive, users, project team, development team, and the monitoring/inspection committee. These stakeholders must participate closely in the process of developing information systems and technology. The participation is one of the key issues for driving e-Government [12], especially during monitoring and evaluation of the system development process.

4.2 Corporation Plan and Management

The corporation plan and management contains two major parts: policy development plan and corporation management. The government agencies need to be fully aware of the corporation plan and management to increase the efficiency of public services and internal organizational management [1,3,9,33,36,37,39,40,41]. In order to get an approval budget from the government, the development of IST must not only comply with the policy or national development plan but also be consistent with the various strategies from local government strategy to central government strategy [42]. Moreover, the assessment of the IST development proposal must be consistent with the information technology development strategy [41,43]. This will lead to the efficiency and effectiveness of corporate management [43]. In addition, allowing the government to work with clear and adequate performance must be considered. The requirement specifications defined by citizens/users are important to manage IST resources efficiently [44].

4.3 Development Methodology

The development methodology is divided into two parts: project management and process management [35,36]. Consider project management, its standard is based on Project Management Body of Knowledge (PMBOK) which is employed for managing e-Government projects to balance various factors, such as quality, budget, scope of work, and schedule [45]. PMBOK concentrates on 9 aspects. They are 1) project integration management for ensuring a smooth project management, 2) project scope management for analyzing the project scope, 3) project time management for managing the project completion and workable schedule, 4) project cost management for calculating reliable project cost, 5) project quality management for designing concise and precise requirement specifications, 6) project human resource management, 7) project communication management, 8) project risk management and 9) project procurement management. Concerning process management, COBIT 4.1 is applied for this work. The domains of COBIT can be divided into 4 main categories [46]. They are 1) plan and organize (PO) for showing the relationship between the strategy and organizational objectives, and addressing information technology and communication among employees, 2) acquire and implement (AI) for focusing on the strategies, the need for a development or procurement, and change management, 3) delivery and support (DS) for focusing on delivering information technology services and supporting the system operation, security, services availability, and training and seminars, 4) monitor and evaluate (ME) for monitoring and evaluating the system to ensure its quality and compliance with related regulations.

4.4 Information Technology

Information technologies, such as database technology, software technology, user interface technology, and network technology are used as tools to support government IST development and deployment [35]. The careful use of information technologies must be considered regarding costs and returns and meeting organization needs. In addition information technologists need to do a feasibility study, e.g. the impact of information technologies on the development and deployment of government IST. When government IST is implemented, users also need to improve their skills through training courses or attending seminars on government IST usage.

4.5 The Business Environment

The business environment includes the standards and universality, security and privacy, policy and relevant laws, and partnerships and collaboration. Details are shown below.

- **Standards and Universality.** The development of information technology systems needs to take into account international standards so that all nationalities can communicate with the public sector by providing multi-languages system, e.g. English, Chinese, or Germany.
- **Security and Privacy.** Information technology systems must be stable, private, and secure to protect against viruses, hackers, privacy violations, and unauthorized access.

- **Policy and Relevant Laws.** Government policy and related laws should be developed in order to support the development of information systems and technology. The system development for public use will be efficient if it has a clear development policy. Its regulation should be compliant with e-Government strategy [12]. Penalties against system or information misuse should be defined [47].
- **Partnership and Cooperation.** The system must be compatible with existing or other related systems for better management and services, and investment utilization.

4.6 The Quality of Information Technology System

The quality of the information technology system is divided into three dimensions: information quality, system/software quality, and service quality. These three dimensions of quality are based on the seven aspects of COBIT 4.1, ISO/IEC 9126, and SERVQUAL, respectively. The characteristics of the quality of information technology system are shown in Figure 2.

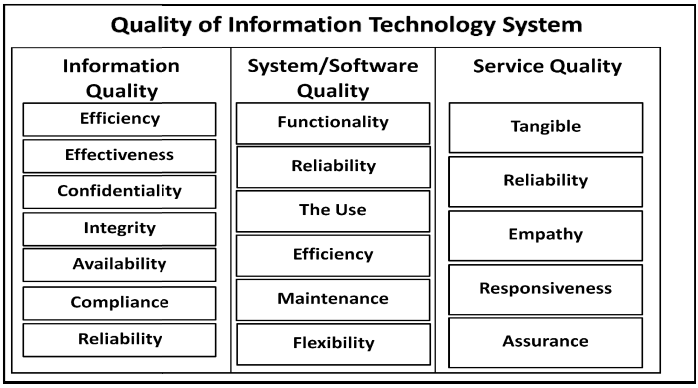

Fig. 2. The Quality of Information Technology System

5 Guidelines for Monitoring and Inspection System

This section provides the guidelines of monitoring and inspection of government IST. The survey results of this work are also presented.

5.1 The Evaluation Criteria for Monitoring and Inspection

The evaluation criteria for monitoring and inspection are described below. The equation for calculating the monitoring and inspection from each participant is shown in equation 1 and 2. The equation for calculating the monitoring and inspection of each project is shown in equation 3 and 4.

$$Y = \sum_{i=1}^{n} w_i x_i \tag{1}$$

When Y is the total score from the monitoring and inspection
w_i is the weighted value of checking each item ranged from 1 to 50 points (total score is not exceeding 100 points for each set)
x_i is the score received from each monitoring and inspection
n is the number of sub-item of all monitoring and inspection

To determine the value of Y, the calculation of value Z in percentage is achieved by having the total score from the monitoring and inspection (Y) divided by the score from monitoring and inspection of all received items (A) which answered "Yes", and multiplied by 100 as shown in equation 2.

$$Z = \left[\frac{Y}{A}\right] \times 100 \tag{2}$$

When Z is the percentage of the monitoring and inspection of each person
Y is the total score from the monitoring and inspection
A is the total score from monitoring and inspection of all received items

$$\bar{Y} = \frac{\sum_{i=1}^{n} Y_i}{n} \tag{3}$$

When $\bar{Y}$ is the average score obtained by the monitoring and inspection
Y_i is the total score from the monitoring and inspection of each person
n is the number of monitoring and inspection persons

To determine the value of $\bar{Y}$, the calculated value of B in percentage is achieved by bringing the average score obtained by the monitoring and inspection divided by the total score from monitoring and inspection of all received items which answered "Yes", and multiplied by 100 as shown in equation 4.

$$B = \left[\frac{\bar{Y}}{A}\right] \times 100 \tag{4}$$

When B is the percentage of the monitoring and inspection of each project

$\overline{Y}$ is the average score obtained by the monitoring and inspection

A is the total score from monitoring and inspection of all received items

The results of the analysis are divided into three periods [42]. If the result of the first period of the monitoring and inspection is less than or equal to 60%, it will be shown in red. If the result of the second period of the monitoring and inspection is between 60% and 85%, it will be shown in yellow. If the result of the third period of the monitoring and inspection is greater than or equal to 85%, it will be shown in green. Each of the evaluation criteria of the monitoring and inspection is different as shown in Table 1.

Table 1. Evaluation Criteria of the Monitoring and Inspection

Period of Monitoring/ Inspection	Evaluation Criteria
Pre-development	• Period 1. Less than or equal to 60% means that a project is not viable. A new project should be considered. • Period 2. Between 60 % and 85 % means that it is acceptable. However, same issues must be improved. • Period 3. Greater than or equal to 85% means a project is worthy of development.
Mid-development (project and process management)	• Period 1. Less than or equal to 60% means that a project should be improved in almost all parts of the project management and process management. • Period 2. Between 60 % and 85 % means that a project has acceptable project management and process management, and is reasonably good. However, both processes should be improved. • Period 3. Greater than or equal to 85% means a project has very good project management and process management.
Post-development	• Period 1. Less than or equal to 60% means that almost all elements in the project should be improved. • Period 2. Between 60 % and 85 % means that a system is reasonably good. However, both processes should be improved. • Period 3. Greater than or equal to 85% means that the developed system can be achieved.

5.2 The Surveyed Result for the Monitoring and Inspection

This section shows the survey results are include the general information of the respondents and their opinions. The checklist for the monitoring is divided into three categories: pre-development, mid-development, and post-development.

5.2.1 General Information of the Respondents

The respondents are 15 males (44.1%) and 19 females (55.9%). Mostly the age is between 31-35 years (11 persons). A bachelor's degree or equivalent has been completed by 32.4% (18 persons). 52.9% of respondents are members of the audit committees. The monitoring and inspection of project which is less than or equal to 5 million baht is 55.8%. The respondent has work more than 15 years is 33.3%. 29.4% have information technology experience for 1-5 years. Finally, 23.5% use computer or information technology every day.

5.2.2 The Detail of Monitoring Result

1. Before starting the development process, it is important to focus on six components according to the survey. First, the goals, objectives and corporate strategy should be clearly defined and measurable. Second, it should clearly define each stakeholders' responsibility, the project implementation plan, and project sponsorship. Third, the budget must be carefully allocated to the project. Fourth, the development team should have sufficient knowledge and capabilities in information technology for system development. Moreover, the development team should thoroughly understand the process development in order to achieve the objectives of the system or project. Fifth, the software should be set up in development process within cost and time. The specifications of hardware and software compatibility should also be clarified. Finally, concerning the environment aspect, the database administrator should give the instructions for users to secure their systems.

2. During the project development, the respondents should focus on (1) clarified project planning and the scope, (2) the allocation of the system resources both hardware and (system and application) software, (3) responsible and effective team work, (4) tracking and monitoring the system development progress, and (5) the evaluation of the system development in comparison to its goals and objectives.

3. During the process management, most respondents focused on four aspects. First, the requirement analysis should be clearly collected to assure that the system meets users' needs. Second, the system design should be professionally done and consist of database design, process design, and interface design. The user interface design must be usable. Third, the test plan should be declared for supporting the system quality, and finally, the system installation and delivery must be carefully identified.

According to the survey, in the development phase, all components in the proposed framework including stakeholder, corporation plan and management, development methodology, information technology, business environment, and quality of IST, should be considered during the development phase.

5.2.3 The Inspection Detail

For the inspection process, the analyzed data for data collection shows that most respondents give importance to the following four areas. They are (1) hardware must have a standard and must be tested to guarantee that it meets the requirements,

(2) confidential and qualified data, such as integrity, completeness, accuracy, and reliability that users' need, (3) completed, accurate and reliable software functions, and (4) ease of operation and reliable system in order to meet the users' requirements.

According to the survey, in the inspection phase, the components in the proposed framework including information technology and the three aspects of quality of IST, should be considered.

6 Conclusion

The problems, causes and solutions of the government information system and technology (IST) development have been addressed. The framework for monitoring the development process and inspection of government IST has also been discussed. Such a framework is developed based on COBIT 4.1, ISO/IEC 9126, SERVQUAL and PMBOK, which contains 5+1 components. They are stakeholder, corporation plan and management, development methodology, information technology, business environment, and the quality of information system and technology. Each component must be measured, monitored, and evaluated to support the sustainable government IST development. In addition, the quality of IST can be categorized into three aspects: information quality, system or software quality, and service quality. This research has developed the prototype for implementing this framework by dividing it into three phases: 1) pre-development for competency checking, 2) mid-development for IST process management and project management, and 3) post-development for the acceptance of government IST to assure its quality. Further work should address the expansion and employment of this framework for other government IST projects. Since this work supports general users, some requirements and information technology for those with disabilities and the elderly should also be considered.

References

1. Gallegos, F.: IT Governance: IT Audit Role. Information Systems Control Journal 4 (2003), http://www.isaca.org/Template.cfm?Section=IT_Audit_Basics&Template=/ContentManagement/ContentDisplay.cfm&ContentID=15938 (March 18, 2008)
2. Schware, R., Deane, A.: Developing e-Government Program: The Strategic Importance of 'I' before 'E'. The Journal of Policy, Regulation and Strategy for Telecommunications 5(4), 10–19 (2003)
3. Kadam, A.: IT Governance Global Status Report 2008. In: CISAC-2008 –Conference of Information Security Audit and Control, India, February 18 (2008), http://www.isaca.org/Template.cfm?Section=Home&Template=/ContentManagement/ContentDisplay.cfm&ContentID=39744 (March 18, 2008)
4. National Electronics and Computer Technology Center (NECTEC). E-Government Project (2008), http://wiki.nectec.or.th/gitiwiki/pub/Pub/ThailandEGovernmentResources/EGovProjectSummary_Edit9.doc (March 18, 2008)

5. Wangpipatwong, S., Chutimaskul, W.: E-government Web Quality Assessment a Citizen-Centric Approach. In: Proceedings of the 9th IASTED International Conference on Internet, Multimedia Systems and Applications, Honolulu, Hawaii, USA, August 15-17, pp. 65–68 (2005)
6. Ministry of Information and Communication Technology. Information Systems to Support the ICT Sector, the Budget Agency (2008), http://202.47.227.36/ICTPDS/Module/ReportProject/report05.aspx (April 30, 2008)
7. Office of National Information Technology Council. Information Technology within the Framework of B.E. (IT 2010), pp. 2544–2553. National Electronics and Computer Technology Center, Bangkok (2002)
8. Weber, R.: Information Systems Control and Audit. Prentice-Hall, Upper Saddle River (1999)
9. IT Governance Institute, COBIT 4.1 (2007), http://www.itgi.org (November 7, 2007)
10. Office of Audit Services. The Audit Process, 2nd edn., p. 7 (2005)
11. Bank of Thailand, Audit Risk and Information Technology. Introduction: Risk Management Manual, Risk Management Manual for Financial Agency, I-4–I-6 (2003)
12. Electronic Research and Development Division, National Electronics and Computer Technology Center, Guide to the Personal Computer Manual, Bangkok (October 2001)
13. DeLone, W.H., McLean, E.R.: Information Systems Success: The quest for the Dependent Variable. Information Systems Research 3(1), 60–95 (1992)
14. Iivari, J.: An Empirical Test of the DeLone-McLean Model of Information System Success. The Database for Advances in Information Systems 36(2), 8–27 (2005)
15. DeLone, W.H., McLean, E.R.: The DeLone and McLean Model of Information Systems Success: A Ten-Year Update. Journal of Management Information Systems 19(4), 9–30 (2003)
16. Chang, C.-J.J., King, R.W.: Measuring the Performance of Information Systems: A Functional Scorecard. Journal of Management Information Systems 22(1), 85–115 (2005)
17. Bailey, J.E., Pearson, S.W.: Development of a Tool for Measuring and Analyzing Computer User Satisfaction. Management Science 29(5), 530–545 (1983)
18. Doll, W.J., Torkzadeh, G.: The Measurement of End-User Computing Satisfaction. MIS Quarterly 12(2), 259–274 (1988)
19. Gelderman, M.: Translation and Validation of the Doll and Torkzadeh End User Computing Satisfaction Instrument. In: Proceedings of the 31st Hawaii International Conference on System Sciences, Hawaii, USA, January 6-9, pp. 537–546 (1998)
20. Chin, W.W., Lee, M.K.O.: A Proposed Model and Measurement Instrument for the Formation of IS Satisfaction: The Case of End-User Computing Satisfaction. In: Proceedings of the 21st International Conference on Information Systems, Brisbane, Australia, December 10-13, pp. 553–563 (2000)
21. McHaney, R., Hightower, R., Pearson, J.: A Validation of the End-User Computing Satisfaction Instrument in Taiwan. Information and Management 39(6), 503–511 (2002)
22. Pipino, L.L., Lee, Y.W., Wang, R.Y.: Data Quality Assessment. Communications of the ACM 45(4), 211–218 (2002)
23. Seddon, P.B., Kiew, M.Y.: A Partial Test and Development of the DeLone and McLean's Model of IS Success. In: Proceedings of the International Conference on Information Systems (ICIS 1994), Vancouver, Canada, December 14-17, pp. 99–110 (1994)
24. Bevan, N.: Quality in use: Meeting User Needs for Quality. Journal of System and Software 49(1), 89–96 (1999)

25. DeLone, W.H., McLean, E.R.: Information systems success Revisited. In: Proceedings of the 35th Hawaii International Conference on System Science, Hawaii, USA, January 7-10, vol. 3(1), pp. 2966–2976 (2002)
26. Baroudi, J.J., Olson, M.H., Ives, B.: An Empirical Study of the Impact of User Involvement on System Usage and Information Satisfaction. Communications of the ACM 29(3), 232–238 (1986)
27. Dewitz, S.D.: Analysis and Design and the Transition to Object. McGraw-Hill, New York (1996)
28. ISO, ISO/IEC 9126: Software Engineering - Product Quality; Parts 1-4, International Organization for Standardization (ISO)/International Electrotechnical Commission (IEC), Geneva, Switzerland (2001-2004)
29. Cronin Jr., J.J., Taylor, S.A.: Measuring Service Quality: A Reexamination and Extension. Journal of Marketing 56(3), 55–68 (1992)
30. Parasuraman, A., Zeithaml, V.A., Berry, L.L.: SERVQUAL: A Multiple-Item Scale for Measuring Consumer Perceptions of Service Quality. Journal of Retailing 64(1), 12–40 (1988)
31. Brady, M.K., Cronin, J.J., Brand, R.R.: Performance - Only Measurement of Service Quality: A Replication and Extension. Journal of Business Research 55(1), 17–31 (2002)
32. Kuo, T., Lu, I.-Y., Huan, C.-H., Wu, G.-C.: Measuring Users' Perceived Portal Service Quality: An Empirical Study. Total Quality Management 16(3), 309–320 (2005)
33. Cartlidge, A., et al.: An Introductory Overview of ITIL® V3. A High-Level Overview of the IT Infrastructure Library (2007), http://www.best-managementpractice.com/gempdf/itSMF_An_Introductory_OverviewofITILV3.pdf (November 20, 2007)
34. Esteves, Joseph: A Comprehensive Framework for the Assessment of eGovernment Projects, ScienceDirect (Electronic). Government Information Quarterly 25, 118–132 (2008)
35. Whitten, J.L., Bentley, L.D., Dittman, K.C.: Systems Analysis and Design Method, 7th edn. McGraw-Hill (2007)
36. Chongsuphajaisiddhi, V.: A framework for developing local e-government and information quality. Doctor of Philosophy (Information Technology), School of Information Technology, King Mongkut's University of Technology Thonburi, Thailand (2007)
37. Ndou, V.: E-Government for Developing Countries: Opportunities and Challenges. The Electronic Journal on Information Systems in Developing Countries (EJISDC) 18(1), 1–24 (2004)
38. Bakry, S.H.: Development of e-Government: A STOPE View. International Journal of Network Management 14(5), 339–350 (2004)
39. Abe, S., et al.: Estimation of Project Success Using Bayesian Classifier. In: International Conference on Software Engineering (ICSE 2006), Shanghai, China, May 20-28, pp. 600–603 (2006)
40. Wimmer, M.A.: A European Perspective towards Online One-stop Government: the eGov Project. Electronic Research and Applications 1(1), 92–103 (2002)
41. Heeks, R.: Most eGovenment for Development Project Fail: How Can Risks be Reduced? iGovernment Working Paper Series, Paper No.14 (2003), http://unpan1.un.org/intradoc/groups/public/documents/NISPAcee/UNPAN015488.pdf (November 30, 2008)
42. Bureau of the Budget. Prime Minister, Analysis of the Success of the Implementation of the Budget (2005), http://www.bb.go.th (April 30, 2005)

43. Montagna, J.M.: A Framework for the Assessment and Analysis of Electronic Government Proposals. Electronic Commerce Research and Applications 4(3), 204–219 (2005)
44. Habermann, F., Scheer, W.A.: Knowing the Impacts of Information Technology: Towards an Organizational Memory System as a Tool for IT-Management. In: Proceedings of the 33rd Hawaii International Conference on System Sciences, vol. 7, p. 7032 (2000)
45. Project Management Institute: PMI. A Guide to the Project Management Body of Knowledge (PMBOK® Guide), Pennsylvania USA (2004)
46. IT Governance Institute and Information Systems Audit Control Association: ISACA, COBIT (2007), http://www.isaca.org/cobit (November 7, 2007)
47. Thai Farmers Research Center. E-Government: The Way to Success 10(1617), 4–8 (2004)

Online Tender Evaluation: VietNam Government e-Procurement System

La Anh Tuan and John Debenham

QCIS, University of Technology, Sydney, Australia
tuanla@mpi.gov.vn, john.debenham@uts.edu.au

Abstract. Automatic tender evaluation is arguably one of the most critical functions for the success of a comprehensive government e-procurement system. A pilot e-procurement system was initiated in VietNam in 2009 that included an e-bidding component. In the pilot system tender evaluation was conducted manually which created a barrier for user adoption. To secure the trust of the users the automation of tender evaluation must fully respect the existing manual procedures and their cultural context. This paper evaluates the manual tender evaluation procedures which are currently been using in VietNam, and identifies limitations of them when taking automatic tender evaluation into account. The paper describes an automated approach to online tender evaluation that strikes a balance between computational efficiency and cultural expediency.

1 Introduction

The VietNam e-procurement system is being introduced in a seven year plan divided into two phases. Phase 1, from 2009 to 2011, is the 'pilot phase' that is being developed with the cooperation of three VietNam public sector organisations. Phase 2, from 2012 to 2015, the 'extended phase' will deploy the developed system nationwide. Phase 1 is now complete and includes the establishment of a pilot e-GP system. The pilot system consists of two parts which are: an e-bidding component and a user management function built in a separate Public Key Infrastructure (PKI) system. The system was business process re-engineered to take account of the local VietNam conditions, and was implemented compulsorily in three VietNam public sector organisations.

The pilot phase of the government e-procurement in VietNam ended in late 2011. It is established partly on the Korea online e-procurement system (KONEPS) [1]. KONEPS handles tender evaluation with a modified lowest price method by using a lottery mechanism that aims to support small and medium enterprises (SMEs) and to avoid collusion from investors/procuring organisations. The first author is a lead consultant on this project. We report here on the evaluation of tenders that is being incorporated into the system during its current development phase. This paper describes the manual tender evaluation method

A. Kő et al. (Eds.): EGOVIS/EDEM 2012, LNCS 7452, pp. 44–51, 2012.

used in VietNam[1]. We also review the Korea methodology in the KONEPS system, and then evaluate both advantages and disadvantages of the method. One of our over-riding concerns is to secure the trust of the users by ensuring that the automation of tender evaluation fully respects the principles behind the existing manual tender evaluation process. We then describe the online tender evaluation for the government e-procurement in VietNam that solves the limitations of the current manual method.

The vendor rating process is a critical step in supplier selection, which is in turn perhaps most important purchasing function for any organisation. With the aim of achieving benefits already established in the private sector, governments are deploying innovative technologies for supplier selection especially used for their own government e-procurement systems. In contrast to the private sector, organisations must follow prescribed procedures and maintain transparency in public procurement [2]. Tender evaluation is often a highly complex process when price and technical specifications are taking into account [3]. As the number of participating bidders is large on the public procurement, the award process may be time-consuming process. This is more emphasised when processing imprecise and qualitative data such as quality and performance, reputation or rating the potential suppliers [4]. Although many governments have implemented the e-procurement systems, there is no such system that can fully handle online tender evaluation.

In Section 2 we discuss the manual tender evaluation process in VietNam and highlight limitations of current method. Section 3 reviews the Korea methodology of online tender evaluation which is implemented in the KONEPS system with a discussion of its efficiency in term of economic sense and its ability to encourage SMEs as is the method's aim. Section 4 presents our approach to overall online tender evaluation within the public procurement context in VietNam. Finally, Section 5 outlines further work and proposes an efficient model of online tender evaluation in VietNam.

2 Existing Manual System in VietNam

The manual evaluation process of bids is structured into three steps. Firstly, bids are pre-qualified by rejecting irregular bids or bids that do not satisfy basic conditions prescribed on the tendering document. Secondly, a technical evaluation process is conducted to identify bids that qualify technical requirements of the tendering document. Lastly, bids that pass through the first two steps are then evaluated by comparing and ranking proposals [5]. For tenders of goods and constructions, the evaluation method described on the tendering documents is used to determine a lowest bidding price (after correcting errors and adjusting mistakes) or a lowest evaluated bidding price or an economically most advantageous offer. With tenders of consulting services, procuring organisations use combined

[1] Enterprises with extensive experience have good profiles and good relationships with investors and procuring entities. So manual evaluation is used to identify collusion which is a major issue in VietNam.

price and technical evaluation to compare then rank participating bids. However, for tenders requiring high technical specifications, two suppliers who are ranked best on the technical evaluation will then be ranked on the basis of price.

There are seven key limitations to the current manual evaluation method of bids that need taking to account when establishing an automatic tender evaluation for the government e-procurement system.

(1) If there are n bidding proposals participating in a tender, after the three steps of tender evaluation, procuring organisations need in general to perform $(2m + n)$ evaluations where m is the number of suppliers who have passed the pre-qualification step. From that calculation, it is clear to see that the current manual evaluation of bids consume a lot of time and seems to be inefficient. Normally, a government tender in VietNam takes at least one month to process tender evaluation. (2) In addition, with that evaluation, only enterprises with long and strong experience can normally be winners of tenders. It means that SMEs find it hard to win a tender if there is no collusion from investors which results in the corruption on government procurement [6]. (3) Moreover, the current method shows extreme inefficiency on evaluating tenders that their technical requirements have been standardised or tenders in which price comparison is the only and most important factor. This is because tendering organisations still have to evaluate technical then price steps leading to the fact that each tendering document needs to be evaluated twice. (4) Another problem with current method is that the law and decree regulating on manual procurement evaluation is flexible for investors to prescribe their own bidding documents due to classifying into a lot of evaluating types. (5) One limitation needs to be noted here is that with decentralised procurement, investors have their own right and obligation to conduct their tenders. They can themselves do organising and evaluating participating bids or authorise procuring organisations to do all the process which leads to unfairness on bidding results [7]. (6) Furthermore, with lowest bidding awards, participating suppliers can try to offer lowest prices to win the tenders with no confirmation of successful capability of the implementing projects. (7) Lastly, when considering an online tender evaluation, the e-procurement system can not handle all issues or criteria that need the evaluation of human beings, procurement experts in this case.

3 Korea Approach of Online Tender Evaluation

The e-procurement solution adopted by Korea was studied in detail during the design of the VietNam solution. One aspect of the approach used by Korea on their online tender evaluation for Korea online e-procurement system (KONEPS) was studied in detail; it aimed to support SMEs in price evaluation by a random factor as described below.

Korea identifies four different kinds of tenders: tenders with unlimited participants, tenders with limited participants, direct appointment and shopping on procurement of goods. All four types of tenders are processed in two steps. In step one the bids are ranked on the basis of price or a combination of price and

technical specification. In step two the highest ranked suppliers from step one are evaluated as being reliable on a "pass/fail" basis to determine the winner.

During step one bid prices are converted into scores using the formula:

$$Price\ Score = Score_{\max} - 2 \times \left| \left(\frac{88}{100} - \frac{P_{\text{bid}}}{P_{\text{estimate}}} \right) \times 100 \right| \tag{1}$$

where P_{bid} is the bid price offered; $Score_{\max}$ is the greatest score that can be obtained; P_{estimate} is the price determined by the system based on a basic price which is identified by the administrators as described below, and *Price Score* is the resulting score for a given P_{bid}. The fraction $\frac{88}{100}$ is an arbitrary constant.

Now in greater detail. When a tender is submitted it is accompanied by a budget that is the maximum the pricing agency will pay. The KONEPS administrators adjust this budget to obtain the basis price P_{basic} — this adjustment is intended to counter any pre-tender communication and possible high tender evaluation in a collusive agreement between the tendering body and a potential supplier. For example a budget of $1000 could be shaded down to $995. The administrators then calculate the interval $[P_{basic} \times (1-\delta), P_{basic} \times (1+\delta)]$ where δ is either 3% or 5% depending on the value of the tender and is determined by law. The interval $[P_{basic} \times (1-\delta), P_{basic} \times (1+\delta)]$ is then divided into 15 equal sub-intervals.

When an organisation submits a bid P_{bid}, they are also required to select 2 out of 15 numbers that identify the sub-intervals. Then the four numbers that are most selected by suppliers are decoded back to four respective prices $\{p_1, \ldots, p_4\}$. Then $P_{\text{estimate}} = \frac{\sum_i p_i}{4}$. The justification for the randomly selected numbers to add random noise to the calculation that may assist SMEs to increase their probability of winning tenders. The closer to $\frac{88}{100}$ the ratio of $\frac{P_{\text{bid}}}{P_{\text{estimate}}}$ is, the nearer to $Score_{\max}$ the Price Score is. After ranking the supplier list, the best supplier is sent an invitation of performance evaluation. In case of supplier ranked number one is not qualified the performance test, the supplier next on the list is invited to evaluate.[2]

A further justification of the randomisation is to prevent collusion [8]. Korea experts established the approach with aims to reduce the number of documents of bids needed to evaluate by using the evaluation sequence of price considered first. In addition, with considering the price offered in the first step, the approach can increase the number of suppliers participating in tenders. The approach used the threshold of $\frac{88}{100}$ to avoid bidders bidding low and then being unable to deliver goods of the required quality. It also aimed to support SMEs to have a better chance of winning tenders by using randomly selected numbers for calculating the estimated price as stated above. The VietNam government has also an interest in stimulating the growth of SMEs.

[2] Regarding to tenders with multi-criteria evaluation, the Korea approach still used the manual method of procurement with the evaluation sequence of combine price and technical evaluation first, and then suppliers who ranked first are invited to a performance check.

Realising this in the e-procurement system requires some sort of discriminatory mechanism. The approach used by Korea has been described and criticised in favour of grounding any discrimination in economically sound principles [9]. Discrimination may be achieved using standard economic methods by quantifying the the types of the participating users. This approach is theoretically neat but is practically flawed unless the agreement of the participating users may be secured on the quantification of their types.

We favour an open approach that uses the structure of the existing government e-procurement system. Discrimination may be simply achieved by requiring that the goods or services be produced and supplied by an organisation of a specified limited size — this requirement is imply part of the technical specification. The randomisation that is part of the Korean solution could be implemented in the spirit of largesse by offering tenders with a price set by the government to a winner determined by a lottery. Such an approach makes little economic sense but may be a politically expedient way of stimulating interest in government procurement in the SME community.

4 Automatic Evaluation of Tenders

In the interests of improving the efficiency of government procurement, we have designed a comprehensive approach for *all* tenders of goods, construction and consulting services. The approach incorporates: tenders with unlimited participants, tenders with limited participants, and shopping for procurement of goods; it solves the drawbacks of the current evaluation method. The approach addresses two cases: price-only tenders and tenders requiring multi-criteria evaluation, and is illustrated in Figure 1.

- **Evaluation of Price-Only Tenders.** This method used is lowest price selection; it is applied to small-scale tenders that are nominated price-only, or other tenders without multi-criteria requirements. This case is processed automatically and so offers great efficiencies. The use of lowest price is in the context of Government legislation that prescribes substantial penalties if suppliers offer low prices and then can not produce the goods at the required quality, or if they exhibit other disruptive behaviour. The supplier who ranked first on price is then invited to participate in the post-tender reviewing step during which officials from the department "go and check" that the goods is as required in every way. If no issues are raised during the post-tender review the supplier is then announced as the winner. Otherwise, the supplier who was ranked second is considered in the same way.
- **Evaluation of Multi-criteria Tenders.** For multi-criteria tenders there will be no single evaluation process because some criteria, such as reputation and prior experience, can only be evaluated by experts manually, also the case in which the quality required for the tender is aggregated from multi elements that are offered by suppliers differently on each item supplied may also require manual evaluation. In the interests of obtaining the best available for

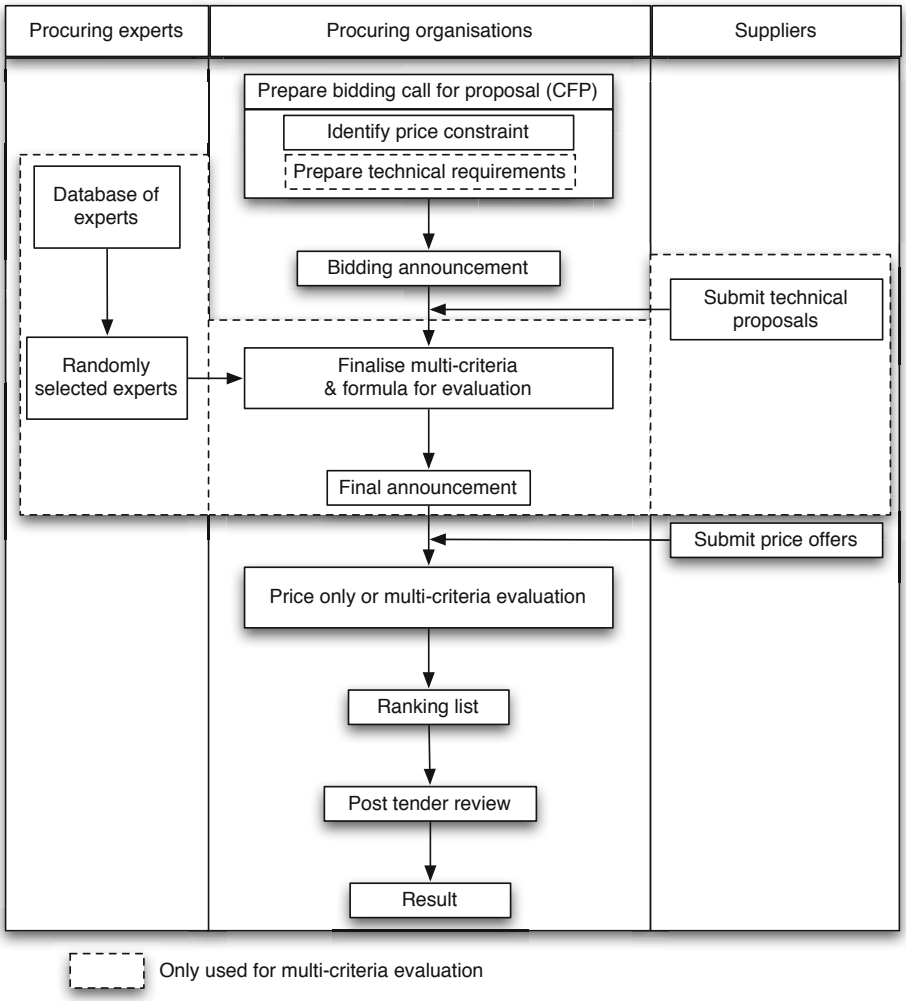

Fig. 1. Tender evaluation of the e-procurement system

the price, we have designed a two round approach. In the first round suppliers to submit their technical proposals and the tenderer then considers what is on offer before committing to the final criteria set for the tender process. When the issue set and associated utility function is published suppliers submit detailed proposals including price. A pre-qualification assessment step may be used in the first round to reject suppliers who did not meet basic requirements of the tender. The tender is managed by a team of experts randomly selected from a database of procurement specialists which is regulated strictly by the Government. The formulas applied here are different on tenders and based on technical proposals of suppliers to solve each case efficiently. As shown in Figure 1, after the final announcement has been made

multi-criteria tenders are processed as for price-only tenders. A post tender review checks the potential winner before awarding the contract.

Any trading mechanism should address the question of establishing the *bona fide* of the players. This is particularly so in government procurement where the stakes are high and so too is the cost of preparing bidding documents. If a procurement process goes sour then this has a negative impact on the players' willingness to participate in future [10]. There are essentially two methods of addressing this issue.

The good faith of players may be managed by legislation that applies large penalties to organisations who disrupt the marketplace with commitments that are not backed by he ability to fulfil them. That is the players' bona fide is established *ex ante* up-front usually by a registration process that gives an organisation the right to participate. For this to work the penalties for disruptive behaviour, such as bidding on tenders and then failing to deliver, need to be sufficient to deter such behaviour. This can only be achieved on a national scale with suitable legislation.

In VietNam the government encourages trade with SMEs. Small SMEs, or those entering the field of government procurement, may find it difficult to establish a sufficient level of credibility. In this case it may be prudent to establish the credibility of players *ex post* after bids have been received and to wear the risk of occasional failures to deliver.

We recommend the second *ex post* method whilst attracting SMEs and to accept the occasional collapse of a bid. For all other tenders we use the first method. Besides SMEs stimulation obtained, the approach to tender evaluation presented above avoids the limitations of current manual tender evaluation discussed above:

- less time is spent processing tender evaluations because each bid document assessed by the team of procurement experts once only;
- there are only two types of evaluation needed to process all cases which can be easier for government on regulating and users on participating to;
- collusion between investors can be diminished because suppliers, and even investors/procuring organisations, do not know the identify of the procurement experts to process their tenders. The system automatically selects procurement experts from the database of experts;
- randomly selected experts prevent any unlawful dissemination of information concerning evaluation prior to submission, and help to reduce the risk of unlawful communication during the evaluation period;
- the application of strict penalties for disruptive behaviour is effective whilst preserving the economic sense of lowest price selection.

The implementation of the e-procurement system is currently under way along with the development of complete legislation and regulations to create an open and trusting environment to encourage user adoption [11].

5 Future Work

This paper describes the approach to online tender evaluation in the VietNam e-procurement system. It categorises tenders into two types: price-only tenders and multi-criteria tenders. Current and future work is concerned with the implementation of the system. We are also focussing on the classification of tenders in practical VietNam to establish criteria that determines when a tender may be classified as price-only. The number of tenders with un-standardised technical requirements is currently high. The use of standardised technical requirements leads to greater efficiency but can only be achieved with ontological and regulatory frameworks to provide the basis for standardisation. We are also keeping an open mind concerning the evaluation of multi-criteria tenders as exceptions occur with the overall aim of achieving the most suitable approach for VietNam.

References

1. Lim, G., Kim, R., Lee, H.: Public e-procurement: the Korean on-line e-procurement system (KONEPS). In: 3rd International Public Procurement Conference Proceedings, pp. 743–759 (2008)
2. Panayiotou, N., Gayialis, S., Tatsiopoulos, I.: An e-procurement system for governmental purchasing. International Journal of Production Economics 90(1), 79–102 (2004)
3. Watt, D., Kayis, B., Willey, K.: The relative importance of tender evaluation and contractor selection criteria. International Journal of Project Management 28(1), 51–60 (2010)
4. Bombay, N.M.: PHILIPPINES: Case study on The Philippine Government Electronic Procurement System (PhilGEPS). Technical Assistance Consultant's Report (2011)
5. Hui, Z., Jianping, Y.: Research on Application of E-Tender in China. In: 2011 International Conference on Internet Technology and Applications (iTAP), pp. 1–3 (2011)
6. Holt, G.: Contractor selection innovation: examination of two decades' published research. Construction Innovation: Information, Process, Management 10(3), 304–328 (2010)
7. Padhi, S.S., Mohapatra, P.K.: Process evaluation of award of work contracts in a government department. International Journal of Electronic Governance 2(2), 118–130 (2009)
8. Brandon-Jones, A., Carey, S.: The impact of user-perceived e-procurement quality on system and contract compliance. International Journal of Operations & Production Management 31(3), 274–296 (2011)
9. Fudenberg, D., Villas-Boas, J.M.: Behavior-Based Price Discrimination and Customer Recognition. In: Handbook on Economics and Information Systems, pp. 377–436. Elsevier (2006)
10. Scholes, M.: Market-based mechanisms to reduce systemic risk. In: The Road Ahead for the Fed. Hoover Institution Press (2009)
11. Das, R.K., Patra, M.R., Panda, S.K.: An e-governance project monitoring initiative in India: a case study of e-procurement. In: Proceedings of the 4th International Conference on Theory and Practice of Electronic Governance, pp. 389–390. ACM, New York (2010)

Composable Modeling and Execution of Administrative Procedures

Sergiusz Strykowski and Rafał Wojciechowski

Department of Information Technology, Poznań University of Economics
Mansfelda 4, 60-854 Poznań, Poland
{strykow,rawojc}@kti.ue.poznan.pl

Abstract. One of the important objectives of e-government is to improve the quality and efficiency of the administrative procedure execution. The most often, this objective is supported by means of workflow systems which work according to monolithic models. During monolithic modeling and execution of administrative procedures, a number of problems arise; for example, susceptibility to errors, difficulties in adjusting procedure models to legislation changes, inconsistency in representing the same act in different procedure models. Courses of administrative procedures are regulated by legislation, and thus the course of a single administrative procedure can be influenced by multiple acts, while a single act can be applied to a number of different procedures. In this work, we propose a novel approach to modeling and execution of administrative procedures based on composition of elementary processes. The elementary processes correspond to unit legal aspects. During realization of administrative procedures, elementary processes are being composed and executed according to legal circumstances relevant to specific cases.

Keywords: e-government, administrative procedures, workflow.

1 Introduction

One of the important objectives of electronic government is to increase the quality of public services delivered to citizens and businesses [1]. To achieve this, two main types of activities should be carried out: increasing the quality of access to public services and increasing the quality of public service execution.

The activities of the first type result in establishing Internet e-government portals where there is published all kinds of information that can be found useful for citizens and businesses. These are mainly lists of procedures carried out by various public agencies, descriptions of procedure courses, lists of attachments required when submitting application in particular cases, application files ready to be downloaded and printed. Increasingly, there are also electronic forms which can be filled out by applicants directly on the website. Looking at the proliferation of these activities, they should be assessed as well developed.

The activities of the second type should result in shorter administrative procedure execution times, reducing their costs and increasing transparency. Unfortunately the scale and scope of these activities are much smaller than the first type ones. As a

A. Kő et al. (Eds.): EGOVIS/EDEM 2012, LNCS 7452, pp. 52–66, 2012.

consequence, it is quite often that an application submitted electronically by filling out a web form at the e-government portal is printed on paper by a clerk and processed manually, exactly in the same way as applications submitted originally on paper.

Such a situation is mainly due to the fact that increasing the quality of public service execution is much more complex than increasing the quality of access to these services. Increasing the access quality needs mostly static actions (mainly publishing materials on the website) and does not involve the transaction processing. It does not require to introduce radical changes in existing solutions, but only to supplement those solutions with new ones: traditionally, public offices have published information on the bulletin boards hanging inside their building, now they also publish this information on the web.

Increasing the quality of public service execution requires introducing a fundamental change in the way how public administration works. This change should consist in the assumption that information systems take over the execution of all routine procedures which are known in advance how to perform them. In the case of public administration, such procedures are primarily associated with information processing, which is perfectly suited to be taken over by computer systems. Humans–clerks should be released from routine operations and focus on making decisions based on information prepared and provided by information systems. This leads to the automation of administrative procedure execution, similarly as it happened in the eighteenth century when invention of the steam engine gave the impetus for the automation of production processes and replacement of human workers performing physical routine labor with machines.

The automation of administrative procedures by IT systems requires creating models of these procedures. These models must take into account all the possible variants of realization, and for each variant they should cover all possible operational activities. In the case of public administration, the possible variants follow from the provisions of law. According to the norm applicable in all countries adhering to the rule of law, public authorities perform their work by applying known legal principles. Classical methods of process modeling are based on a monolithic approach, where models have a form of end-to-end flows, even if the flows are broken down into submodels. Although theoretically possible, in practice creating administrative procedure models at the level of detail required for the automation is very difficult. Even though the monolithic models enable standardization of the courses of administrative procedures, this standardization can only be achieved at a high level of abstraction, which requires intensive human intervention. Therefore, it is necessary to develop new approaches to modeling and executing of administrative procedures, which enable creating models of the procedures at a level of detail sufficient for the their automaton in IT systems working without human supervision.

In this paper, a novel approach to modeling and execution of administrative procedures, called Composable Modeling and Execution of Administrative Procedures (CMEAP), is presented. This approach enables generation of the courses of administrative procedures consisting of all the operational tasks that must be performed for different cases due to the applicable legal circumstances. At the same time, the level of detail of the tasks is high enough that there is no need to interpret them by clerks, and thus it is possible to take over the execution of a large part of routine tasks by computers.

The paper is organized as follows. Section 2 presents the related work in the area of modeling and execution of processes. In Section 3, the architecture of the CMEAP approach and the system implementing the approach are described. In Section 4, a case study – the administrative procedure for issuing an ID card – is presented. Section 5 summarizes the paper.

2 Related Work

The monolithic approach to process modeling makes it virtually impossible to build complex models of administrative procedures that take into account all the possible variants of execution of these procedures. Furthermore, the models for each variant have to contain the detailed operations that have to be executed to ensure conformity with all legal regulations applicable to the variant.

This problem arises from the fact that administrative procedures are regulated by the provisions of law. The complexity of the provisions of law makes it very challenging to create models including all the details reflecting all possible variants of administrative procedures due to the fact that these models would have to be extensive and elaborate. In addition, there is a many-to-many relationship between legal acts and administrative procedures. One legal act may have an impact on a number of administrative procedures, and thus on their models, and one administrative procedure usually depends on a number of legal acts. Using the monolithic approach to modeling, any change in the provisions of any legal act entails changes in the models of all procedures to which this act applies. Thus, a problem of the inconsistency in the representation of the same legal provisions in the models of different administrative procedures arises.

Due to these problems, currently the models of administrative procedures are usually created at a high level of generality. Such models do not include detailed actions, and therefore are easy to create, rather small in size, and slightly susceptible to updates reflecting changes in legislation. For example, at the beginning of most administrative procedure models there is an activity named “Check the completeness and correctness of an application and all required attachments”. A model containing such an activity does not specify the conditions under which the specific attachments are required, or what conditions should be met by these attachments. Also, another typical activity occurring in the middle of administrative procedure models is “Inform the relevant authorities of the action taken” or “Turn to the appropriate authorities for review and agreement”. The models containing the activities defined at a high level of generality remain valid even in the case of multiple changes in legislation.

The models created in accordance with the monolithic approach can be used to automate the administrative procedures using workflow systems [2], but such automation is very limited. Clerks using these systems are able to monitor the course of the procedures, and undertake and complete human tasks. However, the execution of the tasks defined at a high level of generality requires intensive participation of clerks, because they have to analyze and interpret the general specifications of tasks contained

in the models, and decide how to translate these specifications into operational activities for different cases. In this way, a detailed model of the administrative procedure performed for a specific case is created ad hoc by clerks at runtime.

Currently, there are a number of solutions in the area of business process management (BPM), which can be used for modeling of administrative procedures and automation of their execution [3]. The key components of these systems, which are required to automate the administrative procedures, are: a modeling tool, a workflow system, a human task engine, a graphical user interface for monitoring processes and carrying out human tasks.

The modeling tools allow the graphical definition of business process models using a graphical notation. Currently, the dominant graphical notation for modeling business processes at a conceptual level is BPMN [4]. Before the advent of BPMN a dominant graphical notation was EPC since the early 90's [5]. The models defined at a conceptual level can be used to automate business processes using workflow systems. For this purpose, the models in a graphical form have to be transformed into an executable form accepted by workflow systems [6].

BPMN 1.0, officially accepted in 2006, is a standardized graphical notation for modeling business processes, whereas the issues related to executing business processes are beyond the scope of this standard. Therefore, the automation of business processes requires transforming the models in BPMN 1.0 into an executable form that is compatible with an execution engine. Until recently, the most popular executable form of business processes was BPEL [7]. The situation changed dramatically with the advent of BPMN 2.0 at the beginning of 2011 [8]. BPMN 2.0, as opposed to the version 1.0, also standardizes an executable XML-based form of business process models. Models designed in BPMN 2.0 are automatically saved in a form that can be used to execute them by workflow systems. At the same time, it is still possible to transform models in BPMN 2.0 to another execution language such as BPEL. Therefore, nowadays the two most widely used languages for executing business processes are BPMN 2.0 and BPEL. The process of transforming business process models from a graphical notation to an executable form can be performed automatically or semi-automatically. In the latter case, user involvement is required to complete the models with the implementation details necessary for successful business process execution.

One of the modeling elements included in the BPMN standard is a Business Rule Task which represents the use of a decision rule engine to evaluate data appearing during process execution. Typically, the next element in a process model after this task is a gateway with several outgoing flows. The business rule task allows the use of a sophisticated decision-making mechanism for selecting process flow, but does not alter the essence of the monolithic approach: the process flow during runtime can be selected only from the static set of those which were created during the design phase.

As a response to the limitations imposed by the monolithic approach, Aalst et al. in [9] [10] propose a concept of proclets. The proclet can be seen as a solution for modeling and executing processes that are composed of fragments performed at different speeds and copying with different levels of information and data granularity. Such fragments are called proclets. In the approach, tasks of different proclets can interact with each other

according to requirements which emerge in a specific process instance. Adams in [11] presents a concept of worklets. Based on Activity Theory, he assumes that each task of a process can be performed in several different ways. The ways are called worklels and consist of operations needed to complete the task. The worklet selection is performed at runtime and is based on examining contextual information related to the given process instance.

The above approaches assume that there is a top-level process model and focus on the dynamic selection of appropriate ways to accomplish tasks in this process and its subprocesses. The CMEAP approach presented in this paper does not presuppose the existence of the top-level process model; on the contrary, for each administrative procedure instance such top-level model is dynamically composed of elementary processes during runtime phase.

Currently, there are a variety of BPM products available in the market, both open source and commercially licensed. Examples of the solutions that allow modeling of processes using BPMN 2.0 and automatic transformation to BPEL are IntaliolBPMS [12] and ActiveVOS BPM [13]. The most common systems that use BPMN 2.0 for both modeling and executing are JBoss jBPM [14], Activiti BPM Platform [15], and BizAgi BPM [16]. One of the most flexible BPM solutions available on the market is Oracle BPM Suite 11g [17], which enables both modeling and executing business processes using BPMN 2.0, but also it allows transforming BPMN models to BPEL for execution. In the category of systems supporting the EPC notation, the most prominent example is ARIS Platform [18]. The models in EPC can be transformed to BPMN or BPEL, and then executed by a workflow system offered by other BPM vendors.

All these systems enable modeling and execution of business processes according to the monolithic approach. This significantly limits the use of these systems for the advanced automation of administrative procedures including support for tasks defined at a high level of detail in accordance with the provisions of law.

3 The CMEAP Approach

The CMEAP approach–Composable Modeling and Execution of Administrative Procedures–abandons administrative procedure modeling based on a monolithic approach where the course of each procedure is depicted as a single end-to-end model or a set of firmly connected models and sub-models. Instead of that, the CMEAP approach is based on modeling legislative provisions in a form of elementary processes, decision rules, and domain ontology. The course of the administrative procedure for a specific case is dynamically composed from elementary processes based on current legal circumstances occurring during execution of that procedure. The legal circumstances are represented by instances of ontology concepts and recognized by decision rules. In this way, every execution of an administrative procedure has its own unique model, closely corresponding to the specifics of the case the execution applies to. Therefore, in CMEAP approach, modeling of administrative procedures consists in creating elementary processes, modeling ontology, and defining decision rules.

The elementary process is a sequence of actions determined by law to be executed in a course of an administrative procedure and constituting an operational entity. Actions of the elementary process can be performed by humans, IT systems or both; i.e., IT systems assisted by humans. An example of an elementary process is checking whether the person in a photo intended to be placed in an ID card wears dark glasses and if so, verifying the disability certificate prescribing continuous use of such glasses.

The ontology is a conceptual model of a specific domain describing concepts of this domain [19]. The instances of ontology concepts are called facts and represent real or abstract objects which can occur during the execution of administrative procedures for cases of the domain. An example of a real object is an applicant named John Brown represented by the fact being an instance of the domain concept named *Applicant*; an example of an abstract object is the legal capacity of the applicant John Brown represented by the fact being an instance of the domain concept named *LegalCapacity*. The concepts in the ontology may have attributes describing their characteristics. The *Applicant* concept attributes are *firstName*, *lastName* and *SSN* which for the applicant John Brown take actual values, e.g.: *John*, *Brown*, and *518-84-4887* respectively. The *LegalCapacity* concept has an attribute *type*, which for John Brown's legal capacity takes value *full* while other possible values are *partial* and *none*.

The decision rules determine legal circumstances which when occur during the course of the administrative procedure make necessary to execute a specific elementary process. The legal circumstances in the administrative procedure execution are represented by facts. A single decision rule is a structure consisting of two sections, the *when* section (often also called the *if* section) and the *then* section. The *when* section contains conditional expressions relating to the existence (or absence) of certain facts and to the attributes of these facts. The *then* section contains a set of actions. The conditional expression in the *when* section is considered to be true if there is a fact which attribute values are consistent with the values specified in the condition of the *when* section. The rules having the *when* section evaluated to the true value are selected to be fired. Firing a rule involves executing actions included in the *then* section. Because the rules are independent of each other, it is possible to select more than one rule to be fired.

The CMEAP approach has been implemented as an information system called CMEAP Platform. The logical architecture of the system together with the behavior of the main components is presented in Fig. 1. The system consists of the following components: Knowledge base, Composition server, Process server, Administrative case portal, and Modeling environment.

Knowledge Base. The Knowledge base is a centralized repository storing knowledge artifacts of administrative procedures; i.e., elementary processes, ontology, and decision rules. The knowledge is divided into *terminological* and *assertional*. The terminological knowledge includes elementary process models, ontology model, and decision rule definitions. The assertional knowledge includes instances of elementary processes, facts (instances of ontology concepts), and instances of decision rules.

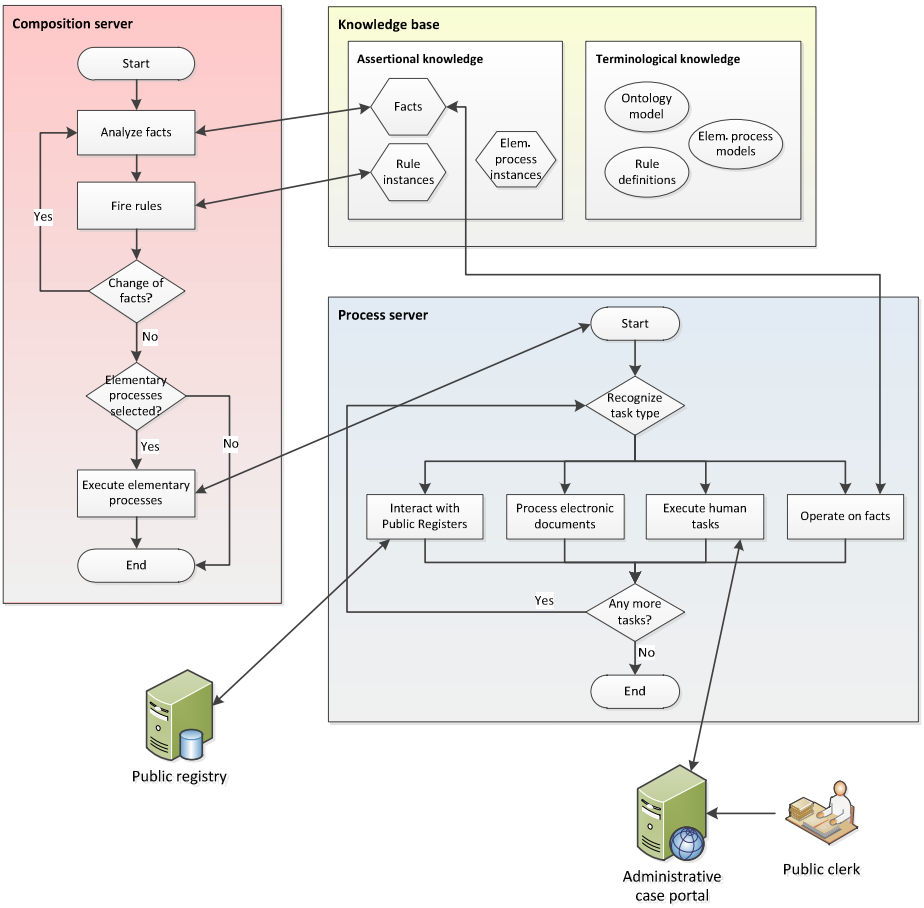

Fig. 1. The CMEAP approach architecture

Composition Server. The Composition server is the main component of the whole system, supervising and steering all other components. The server is responsible for dynamic composition of administrative procedure courses. The server operates according to the following algorithm.

The first phase of the algorithm is the analysis of facts which emerge at a given moment of administrative procedure execution. Based on the analysis results, there is made a choice of decision rules to be fired. Firing a rule involves executing actions included in its *then* section. The result of executing a single action can be asserting, updating or retracting a fact (a change of facts in general), or selecting the elementary processes which should be executed at this stage of the administrative procedure execution.

If as the result of firing a rule the change of facts has occurred, the Composition server goes back to the fact analysis phase and checks if this change has evaluated any rules to be fired. The loop is repeated until the facts and rules reach the stable state; i.e., there are no rules evaluated to be fired.

Process Server. If as the result of firing rules there are elementary processes selected, the Composition server triggers the Process server to execute them. The tasks included in the elementary processes can be divided into four types: interactions with public registers, processing electronic documents, executing human tasks, and operating on facts.

Interactions with public registers include accessing and processing information collected in these registers. A public register is a collection of information on citizens, businesses, things, or entitlements. Examples of information collected in the public registers are: date of birth, marital status, date of death, names of persons entitled to represent a company, lists of decisions issued by public authorities. Examples of the decision lists are the following: a list of building permits issued, a list of professional licenses authorizing their holders to deliver certain types of services, details of a local spatial development plan. According to legal circumstances that occur in the course of an administrative procedure, interaction with public registers include updating existing data, inserting new data, or reading data for further use in the course of the administrative procedure. In the latter case, data retrieved from the public register is inserted into the Knowledge base as assertional knowledge.

Processing electronic documents includes an analysis of their content. In order to make such analysis feasible, electronic documents must have a structured form; i.e., the semantics of each piece of information included in them must be precisely specified. The appropriate technology here is XML Schema [20]. Information retrieved from electronic documents can be fed into public registers and/or can be inserted into the Knowledge base as facts because this information is an essential source of legal circumstances relevant in the execution of the administrative procedure and therefore it can affect its further course.

Human tasks represent activities to be performed by humans (clerks). In an ideal electronic government based on the administrative procedure automation, human tasks involve only non-routine activities, i.e., those that cannot be implemented as a software package executed by a computer system. The principle activity of this type is decision-making. Nowadays, however, human tasks, also often include routine activities which, due to technical problems, cannot be implemented as software. These activities include processing of paper documents or unstructured electronic ones, and processing data in public registers which do not have interoperable interfaces for external IT systems. As the process of replacing paper documents with electronic ones is developing and the number of public registers with interoperability capabilities increases, human tasks will involve a declining number of routine activities.

Operating on facts includes tasks of technical nature related to reading, inserting, updating, and deleting facts from the assertional part of the Knowledge base.

If as the result of executing an elementary process, a change in facts occurs, the Composition server starts carrying out its algorithm. The composition of a whole administrative procedure model completes, and therefore the execution of the procedure, when the whole system reaches the stable state; i.e., as a result of firing rules there are no elementary processes selected for execution, and as a result of executing elementary processes there are no changes in facts.

The Knowledge base and the Composition server have been implemented in Java programming language. For decision rule management and execution, JBoss Drools engine was used [21]. Both components are running within Tomcat application server. Their communication interfaces have been implemented using the Web Service technology based on the Axis2 framework. As the Process server, Intalio|BPMS Server [22] was used, which is based on Apache ODE [23], an open source implementation of a WS-BPEL engine.

Modeling Environment. The Modeling environment is a graphical tool used by process analysts to model administrative procedures. The models are developed based on the legislation analysis and consultation with lawyers and employees of public offices. According to the assumptions of CMEAP approach, the models are represented in the form of the following types of artifacts: elementary processes, decision rules, and ontology concepts (fact classes). The artifacts are deployed into the terminological part of the Knowledge base.

The modeling environment has been implemented as a set of plugins for the Eclipse platform. The primary component of the modeling environment is the CMEAP perspective, which consists of three views: Elementary Processes, Decision Rules, and Ontology.

A key component of the Elementary Processes view is a graphical editor for creating models of elementary processes. The editor is based on Intalio|BPMS Designer [24], which is a part of Intalio|BPMS – one of the most widely deployed Business Process Management Systems (BPMS). The editor enables designers to create models of elementary processes at the management level using the BPMN 2.0 notation. The BPMN models are automatically translated to the executable form in BPEL. These models can then be deployed to the terminological part of the Knowledge base.

The Decision Rules view is used to design and manage units of the decision rules. Each unit consists of a set of decision rules related to a specific legal issue; e.g., determining legal capacity of an individual.

A key component of the Decision Rules view is an editor of the Drools business rule management system. The rule definitions can be specified in the general Drools language or in a domain-specific language.

The Ontology view is used to design and manage fact classes. Each class definition consists of attributes which can be of simple types or reference types related to other fact classes. The fact classes are created using the wizard that automatically generates their definitions in the form of JavaBean components.

Also, the Modeling environment allows designers to create the forms used to carry out human tasks by clerks in the Administrative case portal. A tool for creating forms is based on the General Interface library. General Interface is a set of tools that enable users to build Web applications using Ajax technology.

Administrative Case Portal. The Administrative case portal is an intranet tool intended for public clerks to execute administrative procedures. The portal allows clerks to perform the following activities: initiate administrative procedures for cases of citizens and businesses, perform human tasks, and read notifications about the status of administrative procedure execution.

To start a new execution of an administrative procedure for a case, a clerk has to select an appropriate case type in a hierarchy of the case types falling within the range

of duties of a specific office. During the administrative procedure execution, clerks can claim and perform human tasks. After selecting a task, a form that allows a clerk to complete this task is displayed.

4 Case Study

In the study, a detailed model of the administrative procedure for issuing an ID card was developed using the CMEAP approach. This procedure is a universally understandable example for readers from different countries, because it is one of the most widely spread administrative procedures for citizens. The model of this procedure was created under the Polish legislation, but most of the laws governing the course of this procedure is similar to the laws in other countries. The CMEAP approach is general and, therefore, can be applied to any administrative procedures governed by the laws of different countries.

The model of the administrative procedure for issuing an ID card consists of the artifacts reflecting the relevant legislative provisions regulating this procedure. These artifacts include both the basic elements, such as elementary processes, decision rules, ontology, as well as the auxiliary elements, such as document schemas and electronic forms. In the remainder of this section, the part of the model related to the requirement for personal presence at the submission of an application is presented.

Based on the model, several scenarios characterized by diverse legal circumstances were evaluated. The aim of this study was to experimentally verify the validity of the CMEAP approach for modeling and executing administrative procedures.

4.1 Procedure of Issuing Identity Document

An identity document is a document that proves the identity and citizenship of its holder. An identity document in the form of a plastic card is called an ID card. In many countries there is a formal national identity document issued by a government. National identity documents are in use in many countries around the world including most European countries. In some countries, the possession of a national identity document is mandatory, whereas in others it is voluntary. However, there are also countries in which there is no national identity document in fear of compromising an individual's right to privacy and the misuse of governmental power. The most significant representatives of such countries are the United States, the United Kingdom, Canada, and Australia. In those countries in order to confirm the identity of an individual other documents with a photograph are used, such as driver's license, passport, insurance card, or birth certificate.

In the countries where a national identity document is obligatory, it is mandatory for every person who is a citizen residing in the country and meets the following conditions: the person is an adult; i.e., has reached a specific age, usually the age of 18; or the person is a child that reached a specific age, usually the age of 15, and if the child is involved in an employment relationship, or does not live together with the people that have parental responsibility or guardianship for it, or it is not under parental responsibility or guardianship.

Moreover, a person who has reached a certain age, usually 13 years, has the right but not the obligation to receive a national identity document. On a justified request from the parents or guardians a national identity document can be issued to a child

under 13 years of age. This means that, at the request of the parents or guardians a national identity document can be issued to a few weeks old child.

Administrative procedures for issuing identity documents seemingly belong to the simplest type of administrative procedures. However, a thorough analysis of the legislation governing these procedures indicates that there are numerous different circumstances specific to particular cases, which affect the procedure model. The model of the administrative procedure for the issuance of an identity document depends on a number of circumstances relating to the person whose identity is to be confirmed by the document.

4.2 Assumptions

The model of the administrative procedure for issuing a national ID card at the operational level was designed in accordance with the practice widely accepted in Polish public administration. Some of the documents used while the administrative procedure is executed are provided in paper form. In order to automate the administrative procedure the information contained in those documents have to be rewritten by a clerk into a computer system.

Often only paper documents have legal force, so they have to be stored in a briefcase. In order to improve the functioning of an office, each paper document is scanned and the resulting digital copy is stored in a computer system. However, this digital copy has no legal force and therefore in the event of a problematic situation it cannot be evidence in the case. The need for collection and processing of paper documents implies a need for intensive human work.

Public registries often work in physically separated IT networks and therefore the CMEAP platform is not able to cooperate with these systems in an automatic maintenance-free mode. Thus, in the study, the assumption has been made that the registries held and managed by public administration offer their functionality in accordance with the principles of Service-Oriented Architecture (SOA) [25]. Therefore, the execution server can cooperate with these registries in an automated way, without having to involve humans in this cooperation. The assumption is in most cases true for the large urban centers and large and medium-sized municipalities. However, the state registries managed by the central administration often do not provide their content and functionality according to the SOA principles. It is only possible to access these systems using a graphical user interface, requiring human attention.

4.3 Legal Aspects

The legal aspects of administrative procedures can be divided into two groups: conditions common to all administrative procedures regardless of a case type to which they relate, and conditions specific to a case type; e.g., the issue of a national ID card.

In the first group the following conditions are distinguished: venue competence, applicant's capability to perform legal actions, parental responsibility, or guardianship of an applicant. In the second group of conditions specific to the issue of an identity document the following requirements are distinguished: for photos of an applicant, for copies of civil status acts, for the applicant's signature on the application form in the presence of a clerk.

Due to the large size of the model of the administrative procedure for issuing an ID card, only the fragment of the model that concerns the requirement for the personal presence during the application submission is presented in the remainder of this section. The requirement for the personal presence at the submission of an application for issuing of an ID card is dependent on the following circumstances: age, marital status, family situation, being under guardianship, being on probation, legal incapacitation, disability, current state of health, etc.

For example, in the case of minors under a specific age, usually the age of 13, the application is submitted by both parents or guardians appointed by a court or one of the parents or guardians with a written consent of the other parent or guardian. If the application is submitted by one or both guardians then a court order establishing the guardianship is required. As a general rule, it is required for a minor who has completed 5 years of age to be present when applying for an ID card. The requirement for the presence of both parents during submission of the application can be waved under some circumstances. Above the age of 13, the application can be submitted by one parent or a guardian in the presence of a minor.

4.4 Model for Personal Presence Verification

A detailed model of the administrative procedure for issuing an ID card is composed of 21 elementary process models, and 15 decision rule units, and 45 fact classes. To illustrate the CMEAP approach and the CMEAP platform, the part of the administrative procedure model aimed at verifying the personal presence aspect is presented in the remainder of this section. The personal presence is one of a number of aspects that must be verified by a clerk during the submission of an application for issuing an ID card.

The elementary process models related to the personal presence at the submission of an application for issuing of an ID card are the following:

- Entering individual's personal data into a web form,
- Entering information on the individual's incapacitation into a web form,
- Retrieving the current individual's marital status from the national vital records,
- Verifying that the application is submitted by both parents or guardians,
- Verifying that the application is submitted by one of the parents or guardians,
- Verifying that the application is submitted by both parents,
- Verifying that the application is submitted by a guardian,
- Verifying that the application is submitted by a probation officer,
- Verifying the personal presence of the individual.

The decision rule units related to the personal presence at the submission of an application for issuing of an ID card are the following:

- Individual Data:
  - If there are no individual's personal data in the knowledge base then execute the individual data elementary process.
- Legal Status:
  - If the individual's age is under 18 then assign the minority legal status.
  - If the individual's age is over 18 then assign the majority legal status.

- Legal Capacity:
  - If the individual's legal status is majority then assign the full legal capacity.
  - If the individual's legal status is minority and the age is over 13 then assign the limited legal capacity.
  - If the individual's legal status is minority and the age is under 13 then assign the lack of legal capacity.
- Marital Status:
  - If the individual has the limited legal capacity then execute the marital status elementary process.
  - If the individual has ever committed the act of marriage then assign the majority legal status (regardless of the age or the fact if the current individual's marital status is unmarried).
- Incapacitation:
  - If there are no facts about incapacitation in the knowledge base then execute the incapacitation elementary process.
  - If the individual is completely incapacitated then assign the lack of legal capacity.
  - If the individual is partially incapacitated then assign the limited legal capacity.
- Applying Individuals:
  - If the individual's age is under 13 then execute the elementary process verifying presence of both parents or guardians.
  - If the individual's age is between 13 and 18 and he/she is not incapacitated then execute the elementary process verifying presence of one of the parents or guardians.
  - If the individual is completely incapacitated remaining under parental authority then execute the elementary process verifying presence of both parents.
  - If the individual is completely incapacitated not remaining under parental authority then execute the elementary process verifying presence of a guardian.
  - If the individual is partially incapacitated then execute the elementary process verifying presence of a probation officer.
- Personal Presence:
  - If the age of the individual to which an ID card should be issued is over 5 then execute the elementary process verifying the personal presence of the individual.

In the study, we investigated a number of scenarios with extremely different circumstances relating to an individual applying for an ID card. The aim of each case was to create and execute the administrative procedure for issuing an ID card. For each scenario, we examined the correctness of the selection of elementary processes according to the legal circumstances applicable to the scenario.

5 Conclusion

The use of the CMEAP approach significantly reduces the complexity of the administrative procedure models compared to the traditional monolithic approach. Thus, the process of updating models in order to reflect the changes in legislation is much easier; i.e., in the

case of a change in a legal act, instead of modifying a number of administrative procedure models, merely a single or few elementary processes have to be altered. In this way, the process of updating administrative procedure models due to the changes in legislations becomes less time consuming, less expensive, and less prone to errors. Furthermore, the replacement of the monolithic models of administrative procedures with the elementary process models corresponding to particular aspects regulated by the provisions of law contributes to elimination of inconsistencies in the representations of the same provisions in the various procedure models.

At the same time, compared to the traditional approach, the final models of administrative procedures created with the system implementing the CMEAP approach provide a significantly higher level of detail, which is essential to the automated execution of administrative procedures. Therefore, the adoption of the proposed approach in public administration can contribute to the proliferation of the electronic government that is based on replacement of human labor with work of IT systems in performing routine activities.

For advanced automation of administrative procedures to become a reality it is necessary to develop appropriate solutions for continuous updating of elementary processes in accordance with the ever changing legislation. It is an open question, whether these models should be developed by legislative bodies, e.g., as attachments to the legal acts, or should be developed and distributed by independent third parties on a commercial basis.

Another challenge when it comes to the administrative procedure automation is the issue of discrepancies in operating practices in various public agencies, to implement the same provisions of law. These discrepancies can arise from a different organizational structure, various IT infrastructure, and different technical capabilities to access public registries in different agencies.

References

1. OECD: The E-government Imperative: Main Findings, OECD Observer (March 2003), http://www.oecd.org/dataoecd/60/60/2502539.pdf
2. van der Aalst, W., van Hee, K.: Workflow Management: Models, Methods, and Systems. MIT Press (2002)
3. van der Aalst, W.M.P., ter Hofstede, A.H.M., Weske, M.: Business Process Management: A Survey. In: van der Aalst, W.M.P., ter Hofstede, A.H.M., Weske, M. (eds.) BPM 2003. LNCS, vol. 2678, pp. 1–12. Springer, Heidelberg (2003)
4. Business Process Modeling Notation (BPMN), Object Management Group, http://www.bpmn.org/
5. Event-driven process chain (EPC), http://www.ariscommunity.com/event-driven-process-chain
6. Ko, R.K.L., Lee, S.S.G., Lee, E.W.: Business Process Management (BPM) Standards: A Survey. Business Process Management Journal 15(5), 744–791 (2009)
7. Web Services Business Process Execution Language (WS-BPEL) 2.0, OASIS Standard, http://docs.oasis-open.org/wsbpel/2.0/OS/wsbpel-v2.0-OS.html
8. Business Process Modeling Notation (BPMN) 2.0, http://www.omg.org/spec/BPMN/2.0/

9. van der Aalst, W.M.P., Mans, R.S., Russell, N.C.: Workflow Support Using Proclets: Divide, Interact, and Conquer. IEEE Data Engineering Bulletin 32(3), 16–22 (2009)
10. van der Aalst, W.M.P., Barthelmess, P., Ellis, C.A., Wainer, J.: Proclets: A Framework for Lightweight Interacting Workflow Processes. International Journal of Cooperative Information Systems 10(4), 443–481 (2001)
11. Adams, M.: Dynamic Workflow. In: ter Hofstede, A.H.M., van der Aalst, W.M.P., Adams, M., Russell, N. (eds.) Modern Business Process Automation: YAWL and its Support Environment, pp. 123–145. Springer, Heidelberg (2010)
12. Intalio|BPMS, http://www.intalio.com/bpms
13. ActiveVOS BPM, http://www.activevos.com/
14. JBoss jBPM, http://www.jboss.org/jbpm
15. Activiti BPM Platform, http://www.activiti.org/
16. BizAgi BPM, http://www.bizagi.com/
17. Oracle BPM Suite 11g, http://www.oracle.com/
18. ARIS Platform, http://www.softwareag.com/
19. Strykowski, S., Wojciechowski, R.: Ontology-based Modeling for Automation of Administrative Procedures. In: Grzech, A., Borzemski, L., Świątek, J., Wilimowska, Z. (eds.) Information Systems Architecture and Technology. Service Oriented Networked Systems, pp. 80–97. Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław (2011)
20. XML Schema, http://www.w3.org/XML/Schema
21. JBoss Drools, http://www.jboss.org/drools
22. Intalio|BPMS Server, http://www.intalio.com/bpms/server
23. Apache ODE, http://ode.apache.org/
24. Intalio|BPMS Designer, http://www.intalio.com/bpms/designer
25. Strykowski, S., Wojciechowski, R., Świerzowicz, J., Baszuro, P.: Service-Oriented Architecture for Public Administration Organization. In: Ambroszkiewicz, S., Brzeziński, J., Cellary, W., Grzech, A., Zieliński, K. (eds.) SOA Infrastructure Tools: Concepts and Methods, pp. 397–417. Poznań University of Economics Press, Poznań (2010)

A Design Framework for Collaboration in Systems of Systems

Igor T. Hawryszkiewycz

School of Systems, Management and Leadership
University of Technology, Sydney

Abstract. Many government and industry enterprises are growing in complexity and must provide solutions that address combination of many systems that make up the enterprise. Such solutions require a variety of stakeholders to agree on visions and collaborate to work towards achieving this vision. This work must combine the knowledge created in different stakeholder knowledge domains while being moderated by values and goals of other stakeholders. Such stakeholders often have differences in opinions which must be resolved through collaboration to lead to commitments and behavioral changes needed to achieve the vision. In many situations this is achieved by developing a policy that defines what is expected of each community. Information technology is increasingly suggested to support such policy processes to achieve satisfactory results in minimal time. The paper then proposes a framework for such policy processes using technology. It defines the process characteristics found in system of systems and defines the role structures needed to maintain sustainable collaboration. It describes a way for analysts to create a collaborative architecture that defines the roles and responsibilities of participants within the policy formation process and illustrates with some examples.

Keywords: Collaboration, System Modeling, Living System.

1 Introduction

Government and business enterprises are becoming increasingly complex as they must address wider goals and satisfy a wide range of stakeholders and integrate operations of a large number of loosely connected systems. In government these include the management of resources such as water supply or supply of services such as housing to needy people [1] land and food policies [2,3,4] health planning [5], or environment preservation [6]. In business they include strategic planning for innovation [7] or managing evolving business networks [8, 9]. The term system of systems or wicked systems is often used to describe these emerging systems. Often each system proceeds independently of other systems using its own processes and IT support. Any issues between systems must be socially resolved. For example studying water systems often requires knowledge generated in a number of systems. One system is weather prediction. Another is the study of runoffs and storage of water. A third is the delivery of the water to residential or agricultural users and the crops they plan to grow. Each of

A. Kő et al. (Eds.): EGOVIS/EDEM 2012, LNCS 7452, pp. 67–78, 2012.

these can be seen as a system and requires expertise to develop knowledge about the system. Each of these systems often follows their own process in capturing and processing knowledge and usually building a model to study behavior in their area of interest. Provision of services also is also composed of a number of systems. One for example is contact with clients, another getting the resources to provide the service and still a third is provision of the actual service. There are also other systems here such as financial planning or human resource management.

This paper proposes that information systems in complex environments often require greater focus on policy than on process. This in turn requires a collaborative architecture to reach agreement on a policy. Such collaboration is needed for knowledge captured and represented as models by each community to be combined for decision making purposes. In this case it may be whether a dam is needed and how to allocate the water to various clients. This calls for a policy formulation to provide services in the best possible way. Thus rainfall in an area is part of the analysis. So is the water flow. Combining the models is here called policy research and analysis. The combination itself requires a process that combines knowledge in a systematic manner.

What are the characteristics of processes found in systems of systems and how to support them with technology? One is the continuous gathering of intelligence and identifying issues, then adjusting systems to address the issues to create new programs. This often includes a number of communities that must share knowledge and reach decisions satisfactory to all communities. Information technology can support such processes as it can assist in the formulation of domain models. One example is Tips processes [10] that define a combination of knowledge through scenario analysis and agreed criteria. Walter and others [11] identify collaboration and communication as essential to this process.

This paper focuses on developing collaborative architectures for policy planning as a system of systems. The paper presents a way to model such tainable collaboration. The collaborative architecture brings together many systems to create an environment where all systems can collaborate, thrive and surviveenvironments using living systems theory [12] as a framework to create sus. It includes systems ways to respond to environment changes either from external events or from newly generated knowledge in the process itself.

1.1 Describing Systems of Systems

An important consideration in a system of systems is social structures [13]. In loosely coupled system of systems interface issues are often resolved through social collaboration between participants of each system. The emphasis then is on greater involvement of social inputs through social structures. Thus, as shown in Figure 1, there are often many processes in a system. Each process has its social community. The combination of processes and communities together make the system of systems. It is possible for individuals to participate in more than one system.

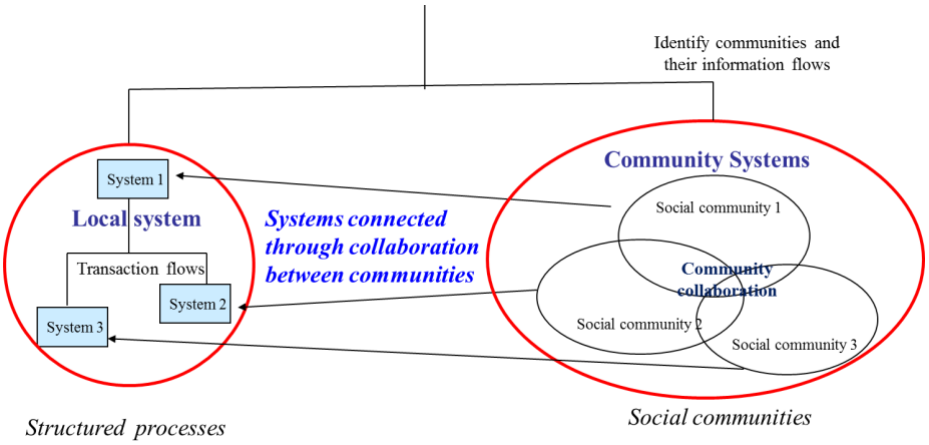

Fig. 1. Connecting Processes and Communities

With the increasing complexity of systems it is often the communities that drive the change and ensure integration as new opportunities arise and value systems change. Here each community or group can be seen as an expert group that develops a model based on their area of expertise. Now each process can communicate with each other process. There are many groups and much collaboration in such systems. Communication must go beyond simply exchanging documents. It must consider the impact of change in one system on that of other systems. For example, we are looking at water management and how water can be distributed between the populations. Often complexity theory [14] provides guidelines for such processes.

1.2 What Are the Policy Development Activities

The processes and their relationships are shown in Figure 2. The goal is to bring communities together to work together to a common vision through a policy process.

It shows three levels:

Level 1 – Knowledge Communities that create the knowledge needed in each community. There are knowledge communities on all the aspects included in water management. The relationships between tasks often require discussions to come to an acceptable outcome. Study of water capture terrain can identify a totally new path that can lead. This calls for the creation of a totally new activity or the reorganization of current communities.

Level 2 – Policy processes that include the three major phases of policy formation, namely,

Policy research gathers intelligence from the environment and provides this intelligence to policy analysis.

Policy Analysis uses the collected intelligence to build models and create options for decision making. Different stakeholders may have different perspectives. A person working on a model may focus on the knowledge perspective, especially on sources of knowledge to construct and verify their model.

Policy Decision where decisions are made to select one of the options.

Level 3 – Organizing for sustainability in system of systems. This concerns providing the collaboration structures to moderate knowledge communities with policy processes. Sustainability here implies that the collaboration continues over extended periods of time not just to resolve current issues and that all communities contribute to policy formulation. An earlier paper [15] identified the kinds of communities in the community ecosystem. These include:

The coordinating group is an overriding planning or coordinating body that sets wider goals such as developing new housing estates with adequate traffic and water facilities,

The monitoring group reports any difficulties within and between the communities. They also monitor the external environment.

The assistant group, which facilitates the collaboration between knowledge communities. The need for such assistance is outlined.

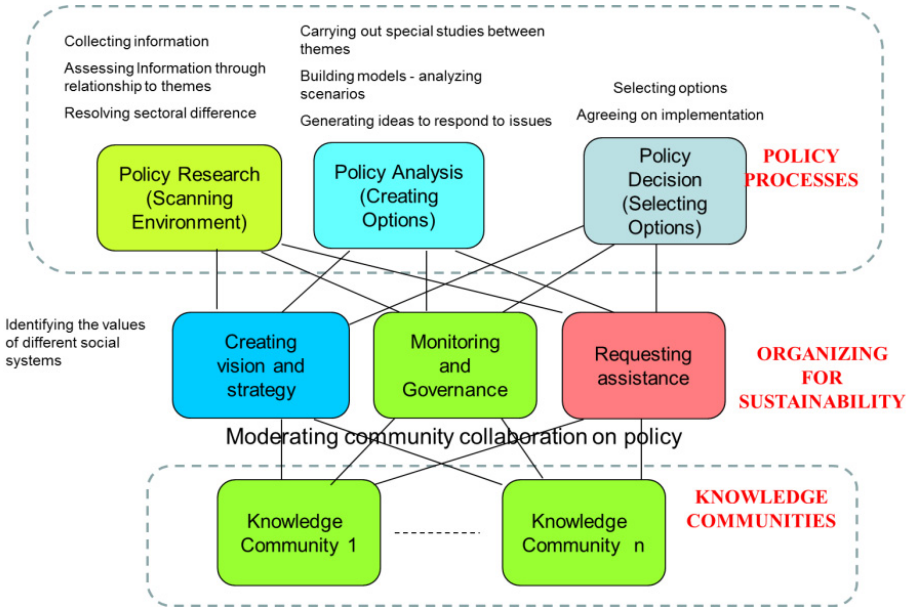

Fig. 2. Activities in Policy Planning

Sustainability calls for assigning responsibility for the different activities and that each knowledge community group is represented. This paper refers to this collaborative structure as the *collaborative architecture* [16]. The coordinating group for example needs representatives from each of the knowledge communities to agree on a vision. There needs to be some role responsible for arranging such meeting and facilitating or moderating progress to an acceptable outcome. There need to be roles assigned to monitoring and reviewing progress. Such roles exist in processes in all processes. Such roles must also exist in a system of systems, except now they must deal with problems that do not have clear solutions.

2 Modeling a System of Systems

This paper proposes that a complex environment is many of a number of interacting systems [12] of different kinds. These are:

Society as a whole,

Communities within the society such as local communities, professional groups, sporting associations, that makes up society as a whole. Communities to same extent can be seen as setting standards of behavior in participants of the community.

Organizations such as corporations that include levels of decision making and can include other organizations,

Groups that have a well-defined goal and work within the parameters set by a higher level structure such as business units, committees, teams, or task forces.

Activities in groups that carry out well defined tasks.

The levels do not in any sense suggest a hierarchical organization. The difference in the layers is on kinds of processes and responsibilities within the level. Thus groups usually address one function that requires one or two levels of decision making. The organizational level differs from the group level in that they have more than two levels of decision making. Communities are where systems can collaborate to identify common goals. An activity is where a group engages in such as to decide how to arrange a software module. People in these systems continually exchange messages, talk about ideas to each other, and work out ways to work together. Figure 3 shows the contemporary complex environment with a number of systems. Each system is shown by a clouded shape. Here for example:

The enterprise is seen as an organization,

The enterprise, which is an organization, is made up of three units that are also organizations. These are service design, client management and service delivery.

It has also set up three groups for policy making – policy research, policy analysis and policy decision making.

There is an organization for policy coordination between them.

There are also organizations and groups set up for collaboration and an organization set up for policy coordination. There also two other collaborations – arranging service changes between service design and client management; and arranging deliveries between client management and delivery management.

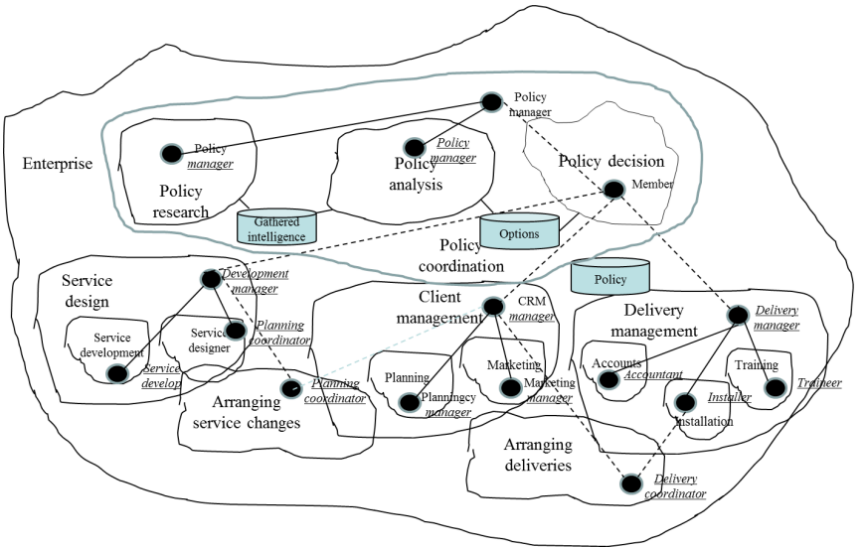

Fig. 3. The Enterprise as a System of Systems

Figure 3 also illustrates knowledge flows boundary flows between systems that exchange knowledge between the systems. It is a different representation of organizations than normally found. The common organizational structure is shown in Figure 4. The difference is in the implied knowledge flows. In Figure 3 the knowledge flows are across all the boundaries shown in the diagram – here called the system of systems diagram. In Figure 4 knowledge flows follow the hierarchical structure. Thus in Figure 3 knowledge flows between the sales and delivery groups take place directly between them; in Figure 4 they go through sales organization unit. The trend in industry is more towards the structures shown in Figure 3 as they model a freer flow of knowledge now found in industry.

The paper focuses on the structure shown in Figure 3. This provides a basis for flexibility through a framework where knowledge flows can be directed to specialized systems where they are interpreted. Flows between systems can be rearranged when different multidisciplinary interpretations are needed.

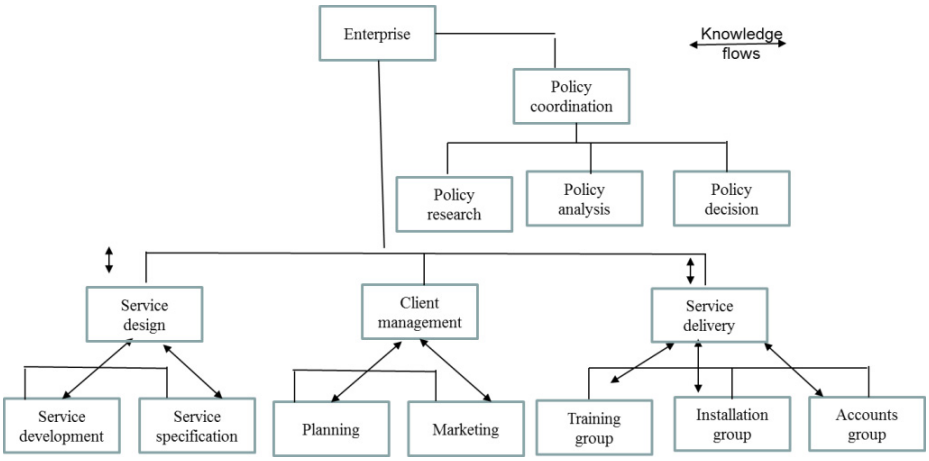

Fig. 4. Hierarchical Structure

3 Defining the Detailed Collaborative Architecture

One goal defined in Figure 3 is to create the collaborative architecture to bring together stakeholder knowledge groups to work towards a common vision. Figure 5 illustrates methods used to create a detailed model that illustrates role responsibilities and knowledge flows. It uses concepts from collaboration modelling [17] to describe the systems in mode the detailed communication processes. The model in Figure 5 is not complete but illustrates the modelling concepts. A complete model is developed using the modelling tool described in the following section.

The model shown in Figure 5 shows roles modelled by black dots, artifacts modelled as disk shapes. Role names are underlined in Figure 5 and their responsibilities shown in the square boxes next to the role. However, it should be noted that Figure 4 does not include all the detail needed as this is not possible to show this on one diagram. In Figure 5:

- It shows a more detailed elaboration of each system.
- It is a generalized model for service design and collaboration with client management. The model shows how to model the collaborative architecture between different systems. For example service provision includes two groups, one for service design, and the other for service acquisition.
- The collaboration between the two organizations has a role called development coordinator, whose responsibility is to agree on service changes. This role is shared between the development manager and client manager.
- In modeling the collaboration the roles in the collaboration are taken be people in roles in the participating organizations.

Figure 5 only shows two systems and the collaboration between them. Of course in most networks there can be any number of organizations systems and many collaborative environments. The roles are chosen to facilitate knowledge sharing and collaboration using brokers [18].

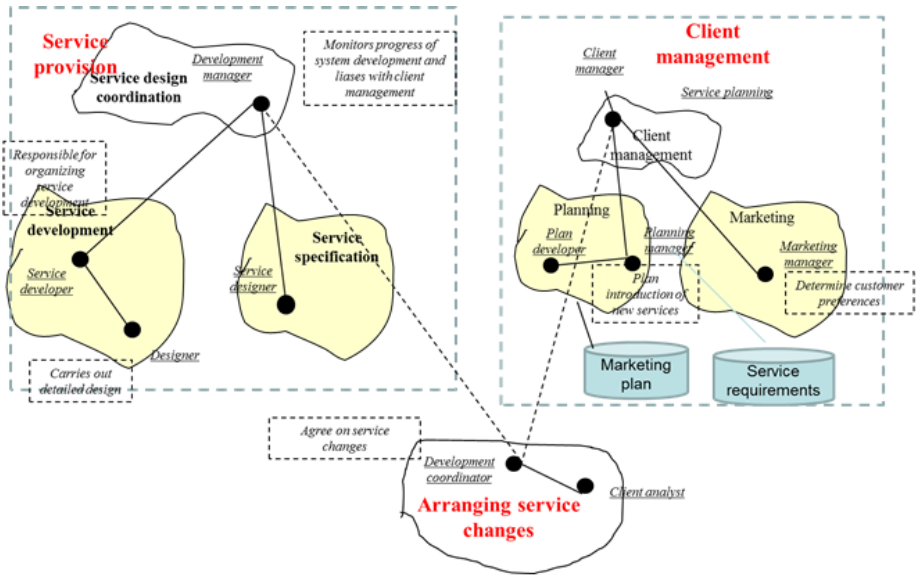

Fig. 5. Aligning Systems for Collaboration

3.1 Modeling Knowledge Flows Using Information Subsystems

Living systems theory also includes the definition of how information flows between the layers and how the information flows are related to resource flows. The information flows are modelled as messages that are interpreted, analysed to see their relevance, associated with other messages and artifacts, Decisions are then made on any action to be taken and these decisions are then transmitted to effected parties. A typical scenario here is sown in Figure 6.

S1 client contacts client manages about their need
S2 the client decodes the message to see its relevance to the services currently in place and send and interprets whether the request is consistent with policy,
S4 the client manager transmits to the development coordinator for consideration whether the request can be accommodated,
S4 the development coordinator request a detailed analysis by the client analyst
S3, S5 the client analyst stores the request and prepares an analysis outlining possible changes,
S6, S7 the client analyst and development coordinator analyse possibilities and recommend an option.
S8 the development coordinator transmits the decision to the development manager for action.

You should note here that the development coordinator is a joint collaborative role where the managers of the two systems work together to agree on an action. The decision transmitted to the development manager is an agreement for the service provision group to undertake any requested changes.

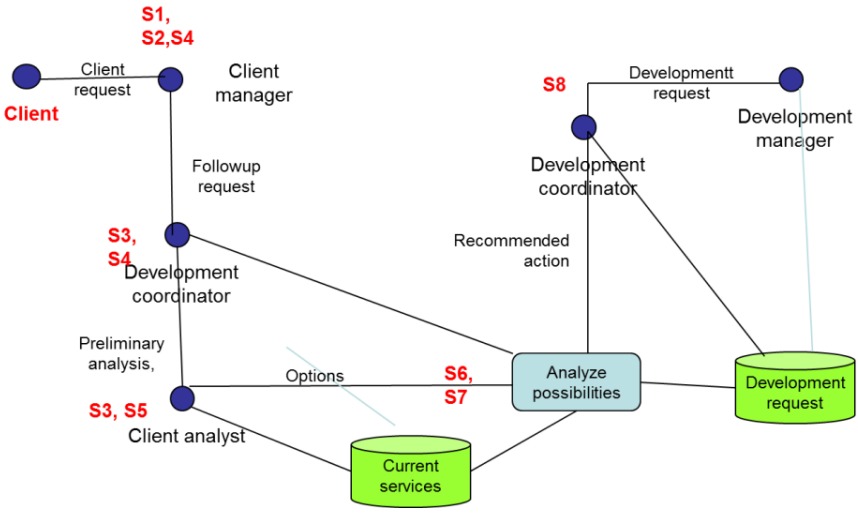

Fig. 6. Modeling information flows

4 Using a Modeling Tool

The modelling method described here needs a modelling tool to support it. The modelling method described here is implemented on the open modelling platform at the University of Vienna. The method known as MelCa allows models to be set up from different perspectives and maintains cross references between models as allowed by the open modelling platforms. Figure 7 shows the way MelCa can be used to model a system of systems in more detail. The basic principle used in the model in Figure 7 is to show each layer as an activity. Each systems is shown as an aggregation of level in the square box. Each business then is seen as community. Collaborative environments are shown in square boxes with dotted lines. The roles assigned to collaborative environments are shown as arrows.

Using a modelling tool provides further advantages in ensuring sustainability and providing alternate models from different perspectives. The interaction between systems can be studied from a number of perspectives [19]. Figure 3 shows the perspective based approach especially for those involved in managing the policy. Build models from different perspectives and then integrate. These often depend on the stakeholder. Those concerned with developing models will more focus on the knowledge perspective.

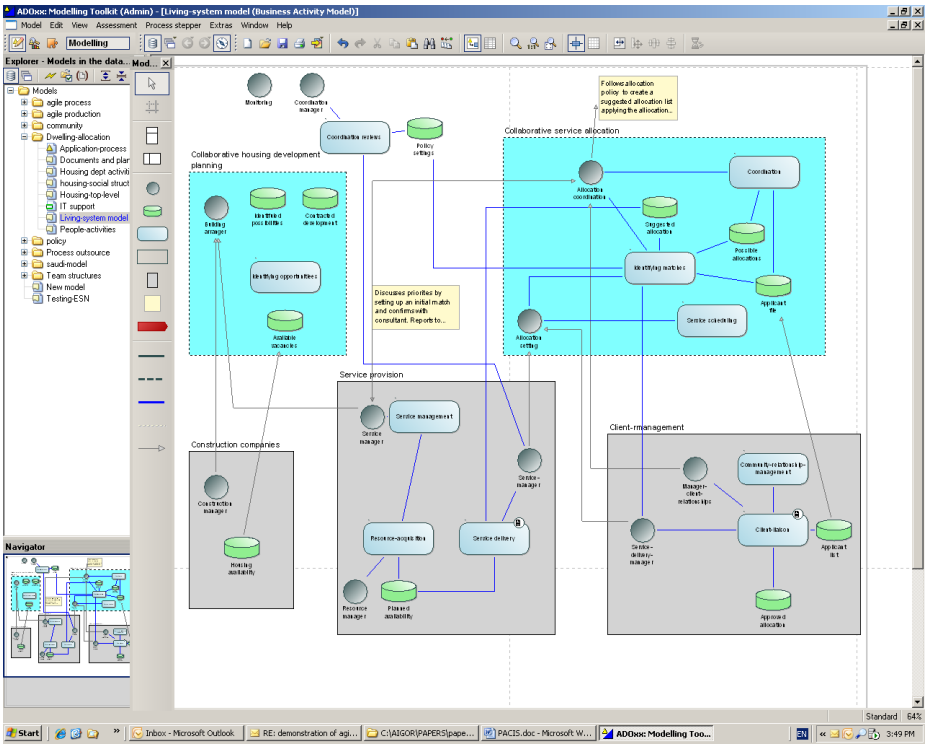

Fig. 7. A detailed model using a modelling tool

5 Implementation in the Cloud

One increasingly important consideration is ways that technology can be used to support the communication needed in resolving cross disciplinary issue as in any social interactions needed that lead to joint acceptable options. Figure 6 shows a strategic approach where the collaborative environments are in the cloud. Each of the business organizations manage their own systems and only share required knowledge through the cloud.

Returning to Figure 2 what is needed is facilitation of the discussion and other discussions in ways that they lead to a sustainable collaboration. These can be included in the cloud for each community.

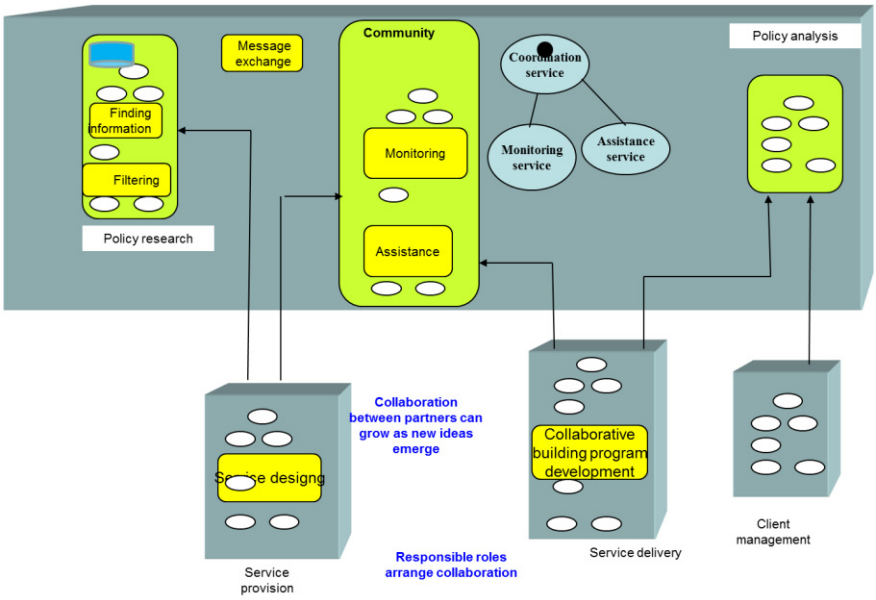

Fig. 8. Mapping to an implementation

6 Summary

The paper described a framework for modeling the collaboration. It showed how living systems theory can be used to develop a framework to model and build such systems. The paper illustrated how the three levels can be modeled using ideas from living systems theory and in particular ways to focus on collaboration and implement a collaborative architecture.

References

1. Yoo, C.-B., Hawryszkiewycz, I.T., Kang, K.-S.: Multi-perspective Framework to Improve the Knowledge Flow. In: Proceedings of the 12th European Conference on Knowledge Management, pp. 988–996 (2011)
2. Farmar-Bowers, Q., Lane, R.: Understanding farmers strategic decision-making processes and the implications for biodiversity conservation policy. Journal of Environmental Management 90, 1135–1144 (2009)
3. Wognum, P.M., Bremmers, H., Trienekens, J.H., van der Vorst, J., Bloemhof, J.M.: Systems of sustainability and transparency of food supply chains – Current status and challenges. Advanced Engineering Informatics 25, 65–76 (2011)
4. Thow, A.M., Swinburn, B., Colagiui, S., Diligolevu, M., Quested, C., Vivilt, P., Leeder, S.: Trade and food policy: Case studies from three pacific island countries. Food Policy 35, 556–564 (2010)

5. Siddiqi, S., Masud, T., Nishtar, S., Peters, D.H., Sabri, B., Bile, K., Jama, M.: Framework for assessing governance of the health system in developing countries: Gateway to good governance. Health Policy 90, 13–25 (2009)
6. Dao, V., Langella, I., Carbo, J.: From green to sustainability: Information Technology and an Integrated sustainability framework. Journal of Strategic Information Systems 20, 63–79 (2011)
7. Camillus, J.C.: Strategy as a Wicked Problem. Harvard Business Review, 99–106 (May 2008)
8. McAfee, A.P.: Enterprise 2.0: The Dawn of Emergent Collaboration. MIT Sloan Management Review, 21–28 (Spring 2006)
9. Cova, B., Salle, R.: Marketing solutions in accordance with S-D logic: Co-creating value with customer network actors. Industrial Marketing Management 37, 270–277 (2008)
10. Wiek, A., Walter, A.I.: A Transdisciplinary Approach for formalized integrated planning decision-making in complex systems. European Journal of Operations Research 197, 360–370 (2009)
11. Walter, A.I., Helgenberger, S., Wiek, A., Scholz, R.W.: Measuring societal effects of transdisciplinary research project: Design and application of an evaluation method. Evaluation and Program Planning 30, 325–338 (2007)
12. Miller, J.: Living Systems. Mc-Graw-Hill, New York (1978)
13. Prahalad, C.K., Krishnan, M.S.: The New Age of Innovation. McGraw-Hill (2008)
14. Merali, Y., McKelvey, B.: Using Complexity Science to effect a paradigm shift in Information systems for the 21st century. Journal of Information Technology 21, 211–215 (2006)
15. Hawryszkiewycz, I.T.: Community Structures for Large Scale Collaboration. In: Andersen, K.N., Francesconi, E., Grönlund, Å., van Engers, T.M. (eds.) EGOVIS 2011. LNCS, vol. 6866, pp. 161–172. Springer, Heidelberg (2011)
16. Pisano, G.P., Verganti, R.: What Kind of Collaboration is Right for You. Harvard Business Review 83(8), 80–86 (2008)
17. Hawryszkiewycz, I.T.: A Metamodel for Modeling Collaborative Systems. Journal of Computer Information Systems XLV(3), 63–72 (2005)
18. Sheate, W.R., Partidario, M.R.: Strategic approaches and assessment techniques – Potential for knowledge brokerage towards sustainability. Environmental Impact Assessment Review 30, 278–288 (2010)
19. Hawryszkiewycz, I.T.: Knowledge Management: Organizing the Knowledge Based Enterprise. Palgrave-Macmillan (2010)
20. Australian Government publication: Tackling Wicked Problems, http://www.apsc.gov.au/publications07/wickedproblems.pdf

A Study of Factors Influencing e-Government Service Acceptance Intention: A Multiple Perspective Approach

Chih-Hui Hsiao[1], Hui-Chih Wang[2], and Her-Sen Doong[3,*]

[1] Graduate Institute of Marketing and Logistics/Transportation, College of Management, National Chiayi University, Chiayi 60054, Taiwan
chihhui@mail.ncyu.edu.tw
[2] Institute of Information Management, College of Management, National Chiao Tung University, Hsinchu 30010, Taiwan
hcwang1@gmail.com
[3] Department of Management Information Systems, College of Management, National Chiayi University, Chiayi 60054, Taiwan
hsdoong@mail.ncyu.edu.tw

Abstract. Japan is the leading country in Asia, and its development in e-Government (electronic government) service was reported to be in the top nine worldwide by Brown University in 2006. However, in 2007, its ranking in the same annual study suddenly dropped to the top 40, which may have indicated the problem hidden behind the implementation of e-Government services. The current study proposes a theoretically based model depicting how personal innovativeness may shape Japanese citizens' e-Government service acceptance intention via perceived usefulness and ease of use. More specifically, Japanese citizens' trust in e-Government was integrated into the model to demonstrate its impact on perceived usefulness and ease of use. Based on a sample of 112 Japanese citizens, this study has uncovered fruitful findings that will benefit practitioners in implementing e-Government services across Japan and future studies in this area.

Keywords: Electronic Government, Technology Acceptance Model, Trust, Innovativeness.

1 Introduction

Governments' ability to serve their citizens has been transformed by the advent of e-Government (electronic government) services. For example, focusing on service efficiency, Brown and Brudney [6] defined e-Government services as the use of technology, especially Web-based applications, to enhance the accessibility and delivery of government information and services. Looking into the inter-relationship aspect, Means and Schneider [25] defined e-Government services as "the relationships between governments, their customers (businesses, other governments, and citizens), and their

* Corresponding author.

A. Kő et al. (Eds.): EGOVIS/EDEM 2012, LNCS 7452, pp. 79–87, 2012.

suppliers by the use of electronic means". Building a successful e-Government services has become a focal issue for government administration worldwide because e-Government is believed (1) to be a cost-efficient channel [30]; (2) to enhance efficiency, improve effectiveness and reduce bureaucracy in government affairs [7]; (3) to improve citizens' interaction with government by reducing the time spent on paperwork, traveling to a government office and waiting in line [21].

However, scholars contend that the promised benefits of e-Government may continue to be an elusive dream in many cases. In particular, governmental agencies in Switzerland, Canada, Australia, and the Netherlands have reported that there was still a high volume of contacts via traditional service channels such as telephone and face-to-face (e.g., [4]). That is to say, if citizens prefer to consistently apply face-to-face or telephone channels, the cost-efficient benefits of building e-Government cannot be realized. It is thus crucial to understand the antecedents of the adoption of e-Government services.

Past studies have tended to apply the supply-side perspective to explore e-Government development. Reddick [31] argued that the demand side, especially from the citizen's perspective, has been largely overlooked. This fact indicates why many countries have experienced difficulty in attaining any significant degree of success in their e-Government implementation [36]. Indeed, even the best e-Government infrastructure cannot guarantee widespread adoption and continuous usage [7]. Government officials must recognize the importance of the promotion of e-Government services in their implementation.

The Japanese government, for example, has paid great attention to the promotion issue. Whilst officials claim that nearly all the applications and forms used by the government are now available online (http://www.e-gov.go.jp/), citizen usage remains scarce. The IT Strategic Headquarters was thus established to deal with the marketing of e-Government services. For example, an action plan for expanding e-Government service usage in terms of forms frequently used by the public/businesses, and forms that are continuously used by businesses, was published on September 12, 2008. More recently, the New IT Reform Strategy was launched, aiming to enhance the proportion national and local government paperwork completed online up to at least 50 percent by 2010. The calls of the Japanese government were understandable. According to the Annual Global e-Government Study conducted by Brown University [5], Japanese e-Government service development saw a huge drop from the top nine worldwide in 2006 to the top forty worldwide in 2007.

To respond to the urgent demand of the Japanese government, this research was designed to provide a citizens' view of emerging individual innovativeness, citizens' trust in e-Government services and the Technology Acceptance Model [9] to investigate citizens' intentions to accept e-Government services. Findings will be able to help Japanese officials to better understand their citizens' personal attitudes towards e-Government services and tailor the marketing strategies for their e-Government services accordingly. Further, this study will add value to the existing literature by studying the experience of Japan, a leading country in Asia, in e-Government administration and implementation strategies.

2 Research Model and Hypotheses

The research model proposed is illustrated in Figure 1 below and the related literature discussion and hypotheses building are proposed accordingly.

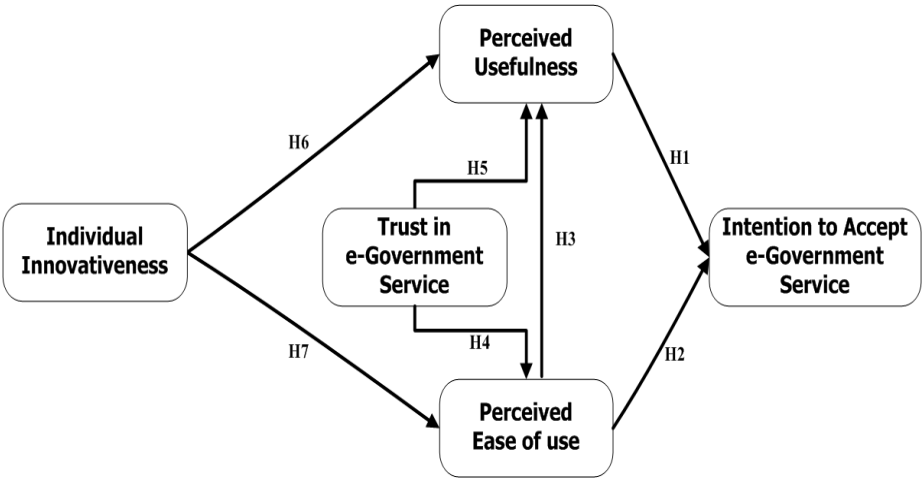

Fig. 1. Research Model

2.1 Technology Acceptance Model

Back in 1989, Davis and his colleagues reviewed the theory of reasoned action [2], which explained individuals' behavioral intentions. These authors decided to propose a more concrete model to predict personal behavioral intention specifically in the context of new technologies or information systems. The Technology Acceptance Model (TAM) was thus established [9] by proposing that behavioral intention is determined by two personal perceptions of a new technology: perceived usefulness and perceived ease of use. In the past two decades, the TAM has been widely applied to test personal acceptance of a range of different technologies: for a detailed review of empirical studies using the TAM, refer to [22].

Perceived usefulness refers to the extent to which an individual feels that using the specific information system will improve his/her performance [35]. For example, Gwebu and Wang [17] reported that in terms of the adoption of open source software, perceived usefulness was found to strongly related to behavioral intention. Similarly, based on a study of 240 salespersons who used a customer relationship management system, Avlonitis and Panagopoulos [3] found that perceived usefulness significantly predicted acceptance of this system. Moreover, Lee, Park, Chung, and Blakeney [23] examined the factors shaping the intention to utilize mobile financial services and revealed that perceived usefulness preceded the adoption intention. Considering that e-Government is also a type of information system, H1 is proposed based on the discussions above:

- H1: Citizens' perceived usefulness of e-Government services is positively associated with their intention to accept e-Government services.

Perceived ease of use addresses the extent to which an individual feels that using the specific application system is without difficulties. Past studies have consistently demonstrated the impact of perceived ease of use on personal intention to accept the technologies. For instance, Crespo and Rodriguez del Bosque [8] examined the antecedents of consumers' adoption of business-to-consumer e-commerce and uncovered that perceived ease of use was a significant predictor of their behavioral intention. Consistently, Kwahk and Lee [20] contended that perceived ease of use strongly influence users' intention to accept enterprise resource planning systems. More recently, Liu, Li, and Carlsson [24] revealed that perceived ease of use is a crucial predictor of personal adoption intention with regard to mobile learning. As such, it is hypothesized that:

- H2: Citizens' perceived ease of use of e-Government services is positively associated with their intention to accept e-Government services.

Various studies have also shown a positive relationship between perceived ease of use and perceived usefulness. That is, the easier a user feels that utilizing a new information system such as e-Government services will be, the more useful he/she may perceive the e-Government services to be. In support, Kuo and Yen [19] asserted that consumers' perceptions of ease of use regarding the 3G mobile value-added services are positively related to their perceptions of how useful this service is to them. Further, Lee et al. [23] also reported that an individual's perceived ease of use significantly influences perceived usefulness with regard to the usage of mobile financial services. Accordingly, it is proposed that:

- H3: Citizens' perceived ease of use of e-Government services is positively associated with their perceived usefulness of e-Government services.

2.2 Trust

Trust has long been a major issue, being investigated across the disciplines of sociology, psychology, marketing, and more recently, e-commerce. Moorman, Deshpande, and Zaltman [26] define trust as "a willingness to rely on an exchange partner in whom one has confidence." In other words, the importance of confidence and reliability in the conception of trust is addressed. In fact, scholars have argued that there is a positive relationship between perceived ease of use and trust. For example, while investigating consumers' intentions to purchase at a webstore, Gefen, Karahanna, and Straub [13] proposed a model integrating trust into the TAM and found empirical evidence that repeat customers who trusted the webstore more also perceived the webstore to be easier to use. That is, when the consumers present great

trust in a webstore, they also trust the webstore to have the ability to develop an easy-to-use interface. Consistent with this, Thatcher, Mcknight, Baker, Arsal, and Roberts [33] also indicated that trust preceded users' perceived ease of use toward a knowledge management system. Given that e-Government services can also been regarded as an information system, it is proposed that:

- H4: Citizens' trust in e-Government services is positively associated with their perceived ease of use of e-Government services.

Many others, especially within the online context, have reached the same conclusion (e.g. [14, 29]). The feeling of confidence and assurance that goes along with trust will result in an increased belief in the benefits that could be achieved from a technology system. The link between trust and perceived usefulness has also been demonstrated. For example, Gefen et al. [14] tested consumers' intentions to use online shopping as an alternative purchase channel and reported that trust plays an important role in enhancing consumers' perceived usefulness of the online shopping channel. Later, Pavlou and Gefen [28] also found that when a client has greater trust in an information technology (IT) vendor, they also tend to feel that the vendor's IT is more useful. Building on this discussion, when citizens trust the government more, it is expected that they will regard the online services provided by the government as more useful. Thus, it is hypothesized that:

- H5: Citizens' trust in e-Government services is positively associated with their perceived usefulness of e-Government services.

2.3 Personal Innovativeness

Innovativeness can be conceptualized as innovative individual behavior or early adoption of new products [11]. Kirton [18] proposed that individuals who present a high degree of innovativeness can be referred to as "innovators". Innovators who solve problems by thinking creatively, and are easily bored by routine tasks, are often the earliest adopters of new products [15]. The higher innovativeness an individual has, the more likely he/she is to be an innovative consumer across a wide range of products and services [16]. Thus, managers are keen to understand this small group of consumers/users, because identifying innovators is crucial to new product marketing. As a huge cost is always associated with the development of new technology, innovators' attitudes or perceptions toward the specific new technology not only serve as a useful indication of the market response to that new technology but also are crucial to the successful diffusion of the new technology.

Agarwal and Prasad [1] were the pioneers in examining personal innovativeness in the domain of information technology. They defined personal innovativeness as "the willingness of an individual to try out a new information technology (p. 206)". Vandenbosch and Huff [34] shown that managers' levels of innovativeness affected their perceptions of the usefulness of executive information systems. In support of this, Robinson, Marshall, and Stamps [32] tested the way salespeople use technology

and revealed that the innovativeness of the salespeople positively shapes their perceived usefulness of that technology. Since e-Government is also a type of technology, it is hypothesized that:

- H6: Citizens' level of innovativeness is positively associated with their perceived usefulness of e-Government services.

Innovativeness was also linked to personal perceptions of ease of use. Nagasundaram and Bostrom [27] verified the effect of employees' innovativeness levels and their usage of group support systems for idea generation and found that innovativeness significantly improved the perceived ease of use of the system. More recently, Gwebu and Wang [17] also reported that users' innovativeness positively influences the perceived ease of use of open source software. Building on the above discussion, it is hypothesized that:

- H7: Citizens' level of innovativeness is positively associated with their perceived ease of use of e-Government services.

3 Research Results

3.1 Subjects and Instrumentation

A field study using a convenience sample was employed to examine the proposed research hypotheses. The unit of analysis was the individual who worked and lived in Japan. A total of 112 valid questionnaires were received. Five constructs were measured in the current study. These items used five-point Likert-type scales with anchors ranging from strongly disagree to strongly agree. All measurement items were adapted from previous information system and e-government research.

3.2 Analysis of the Research Model

Validation of measures used in this study was carried out in two stages by using the partial least squares (PLS) technique. This study's results met all requirements for criteria of construct validity proposed by Fornell and Larcker [12]. The path significance of each association in the research model and the hypotheses testing were assessed using the PLS approach with bootstrap estimates. The analysis result shows all the hypothesized associations were found to be significant at $p<0.05$.

Citizens' perceived usefulness ($\beta = 0.42$, $p < 0.01$) was found to be the strongest predictor of their intention to accept e-Government services, followed by their perceptions of ease of use ($\beta = 0.26$, $p < 0.01$). These two constructs explained 47 percent of the variance in e-Government acceptance intention. Hence, hypotheses 1 and 2 were supported. The beta coefficients show that citizens' perception of usefulness is the dominant factor in intention to accept e-Government services. Further, both citizens' trust in e-Government services ($\beta = 0.22$, $p < 0.05$) and level of innovativeness ($\beta = 0.18$, $p < 0.05$) significantly affected their perceptions of ease of use, explaining a total of 25% percent of the variance. Thus, hypotheses 4 and 7 were

confirmed. Moreover, citizens' perceived ease of use ($\beta = 0.38$, $p < 0.01$), trust in e-Government services ($\beta = 0.21$, $p < 0.05$), and innovativeness levels ($\beta = 0.24$, $p < 0.05$) were all statistically significant in explaining their perceived usefulness of e-Government services. These three constructs were able to explain 45 percent of the variance in the perception of usefulness of e-Government services. Therefore, hypotheses 3, 5, and 6 were all supported.

4 Conclusions and Managerial Implications

As the development of e-Government services has played an increasingly important role in nations' international competitive ability and economic and social development index, this study's findings have contributed both to academics and government practitioners. First, this study is among the first to reveal that citizens' innovativeness levels significantly influence their perceived ease of use and usefulness of e-Government services. Second, this study has reported that although all the associations were significant, the effect of trust on perceived usefulness was weaker than that of innovativeness and perceived ease of use. More specifically, citizens' perceived ease of use was found to have the highest impact on perceived usefulness of e-Government services for the surveyed Japanese citizens. Third, it was also interesting to find that while both trust and innovativeness significantly predicted perceived ease of use, the effect of trust was again weaker than that of innovativeness. Last, both perceived usefulness and ease of use were significant predictors of Japanese citizens' intentions to accept e-Government services, but the former was stronger than the latter.

This study has shown that whilst personal trust has been argued to be one of the most crucial factors in shaping personal adoption of e-commerce, the effects that trust has on perceived usefulness or perceived ease of use were both weaker than the effect of innovativeness. That is to say, trust may not be a key indicator in the adoption of e-Government services among Japanese citizens. This is a very interesting finding and warrants further investigation. It may be due to the impact of culture, since Japan is a collectivist culture, in contrast to the individualism of western European countries or the United States of America. Future studies may investigate the impact of culture and social influence on citizens' acceptance of e-Government services.

Moreover, personal innovativeness was found to play a significant role in shaping Japanese citizens' intentions to accept e-Government services. It is thus crucial for the Japanese government to propose a hierarchical plan to accelerate the diffusion of e-Government services across Japan. More specifically, officials may select regions with higher concentrations of highly educated people whose personal innovativeness towards information systems are consistently reported to be the highest among the general population (e.g., [10]) as the initial target areas for implementation. If these citizens become familiar with the benefits of e-Government services, they may therefore become the best communicators of these benefits, introducing e-Government services to their family members or acquaintances, as individuals with higher innovativeness also tend to be the opinion leaders in their social groups.

Furthermore, as perceived ease of use was found to be a major predictor of Japanese citizens' perceptions of the usefulness of e-Government services, it is also important for officials to ensure an easy-to-manage interface when developing e-Government systems. Advertising that emphasizes how easy the e-Government services are to use may also

become an important strategy. Future studies are required to clarify the issue of whether it is more effective to address the usefulness or ease of use of e-Government services to encourage significant growth in citizen adoption.

The current research is not without limitations. First, Japanese e-government was the major application investigated in our study. Further research should extend to other countries to enrich our understanding of the acceptance of e-Government services. Further, a relatively small sample was examined in our empirical survey. Future studies should conduct surveys on a wider scale to enhance the generalizability of findings.

References

1. Agarwal, R., Prasad, T.: A Conceptual and Operational Definition of Personal Innovativeness in the Domain of Information Technology. Information Systems Research 9(2), 204–215 (1998)
2. Ajzen, I., Fishbein, M.: Understanding Attitudes and Predicting Social Behavior. Prentice-Hall, Englewood Cliffs (1980)
3. Avlonitis, G.J., Panagopoulos, N.G.: Antecedents and Consequences of CRM Technology Acceptance in the Sales Force. Industrial Marketing Management 34(4), 355–368 (2005)
4. Bongers, F., Holland, C., Vermaas, K., Vandeberg, R.: Burgers Aan Bod. In: Elektronische Overheidsdienstverlening in Het Perspectief Van De Vraagzijde, Utrecht, Dialogic (2004)
5. Brown University, Delaware and Michigan are best states for American e-government (2007), http://www.brown.edu/Administration/News_Bureau/2007-08/07-010.html (access February 5, 2012)
6. Brown, M.M., Brudney, J.L.: Achieving Advanced Electronic Government Services: An Examination of Obstacles and Implications from an International Perspective. In: National Public Management Research Conference Bloomington (2001)
7. Chan, C.M.L., Lau, Y.M., Pan, S.L.: e-Government Implementation: A Macro Analysis of Singapore's e-Government Initiatives. Government Information Quarterly 25(2), 239–255 (2008)
8. Crespo, A.H., Rodriguez del Bosque, I.: Explaining B2C E-commerce Acceptance: An Integrative Model Based on the Framework by Gatignon and Robertson. Interacting with Computers 20(2), 212–224 (2008)
9. Davis, F.D.: Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology. MIS Quarterly 13(3), 319–340 (1989)
10. Doong, H.S., Wang, H.C., Foxall, G.R.: Psychological Traits and Loyalty Intentions towards e-Government Services. International Journal of Information Management 30(5), 457–464 (2010)
11. Dowling, G.R.: Consumer Innovativeness. In: Earl, P.E., Kemp, S. (eds.) The Elgar Companion to Consumer Research and Economic Psychology, pp. 111–115. Edward Elgar, Cheltenham (1999)
12. Fornell, C., Larcker, D.F.: Evaluating Structural Equations with Unobservable Variables and Measurement Error. Journal of Marketing Research 18(1), 39–50 (1981)
13. Gefen, D., Karahanna, E., Straub, D.W.: Potential and Repeat e-Consumers: The Role of and Trust vis-Xa-vis TAM. IEEE Transactions on Engineering Management 50(3), 307–321 (2003)
14. Gefen, D., Karahanna, E., Straub, D.W.: Trust and TAM in Online Shopping: An Integrated Model. MIS Quarterly 27(1), 51–90 (2003)
15. Goldsmith, R.E., Hofacker, C.F.: Measuring Consumer Innovativeness. Journal of the Academy of Marketing Science 19(3), 209–221 (1991)

16. Goldsmith, R.E.: Using the Domain Specific Innovativeness Scale to Identify Innovative Internet Consumers. Internet Research 11(2), 149–158 (2001)
17. Gwebu, K.L., Wang, J.: Adoption of Open Source Software: The Role of Social Identification. Decision Support Systems 51(1), 220–229 (2011)
18. Kirton, M.: Adaptors and Innovators: A Description and Measure. Journal of Applied Psychology 61(5), 622–629 (1976)
19. Kuo, Y.F., Yen, S.N.: Towards an Understanding of the Behavioral Intention to Use 3G Mobile Value-added Services. Computer in Human Behavior 25(1), 103–110 (2009)
20. Kwahk, K.Y., Lee, J.N.: The Role of Readiness for Change in ERP Implementation: Theoretical Bases and Empirical Validation. Information and Management 45(7), 474–481 (2008)
21. Lean, O.K., Zailani, S., Ramayah, T., Fernando, Y.: Factors Influencing Intention to Use e-Government Services among Citizens in Malaysia. International Journal of Information Management 29(6), 458–475 (2009)
22. Lee, Y., Kozar, K.A., Larsen, K.R.T.: The Technology Acceptance Model: Past, Present, and Future. Communications of the Association for Information Systems 12(1), 752–780 (2003)
23. Lee, Y.K., Park, J.H., Chung, N., Blakeney, A.: A Unified Perspective on the Factors Influencing Usage Intention toward Mobile Financial Services. Journal of Business Research (2011), http://dx.doi.org/10.1016/j.jbusres.2011.02.044
24. Liu, Y., Li, H., Carlsson, C.: Factors Driving the Adoption of M-learning: An Empirical Study. Computers & Education 55(3), 1211–1219 (2010)
25. Means, G., Schneider, D.: The E-business Revolution and the Design of 21st Century Companies and Markets. Meta-Capitalism. John Wiley & Sons Inc., New York (2000)
26. Moorman, C., Deshpande, R., Zaltman, G.: Factors Affecting Trust in Market Research Relationships. Journal of Marketing 57(1), 81–101 (1993)
27. Nagasundaram, M., Bostrom, R.P.: The Structure of Creative Processes Using GSS: A Famework for Research. Journal of Management Information Systems 11(3), 87–104 (1994)
28. Pavlou, P.A., Gefen, D.: Building Effective Online Marketplaces with Institution-based Trust. Information Systems Research 15(1), 37–59 (2004)
29. Pavlou, P.A.: Consumer Acceptance of Electronic Commerce: Integrating Trust and Risk with the Technology Acceptance Model. International Journal of Electronic Commerce 7(3), 101–134 (2003)
30. Pieterson, W., Ebbers, W.: The Use of Service Channels by Citizens in the Netherlands: Implications for Multi-channel Management. International Review of Administrative Sciences 74(1), 95–110 (2008)
31. Reddick, C.G.: Citizen Interaction with e-Government: From the Streets to Servers? Government Information Quarterly 22(1), 38–57 (2005)
32. Robinson, L., Marshall, G.W., Stamps, M.B.: Sales Force Use of Technology: Antecedents to Technology Acceptance. Journal of Business Research 58(12), 1623–1631 (2005)
33. Thatcher, J.B., McKnight, D.H., Baker, E.W., Arsal, R.E., Roberts, N.H.: The Role of Trust in Postadoption Exploration: An Empirical Investigation of Knowledge Management Systems. IEEE Transactions on Engineering Management 58(1), 56–70 (2011)
34. Vandenbosch, B., Huff, S.L.: Searching and Scanning: How Executive Obtain Information from Executive Information Systems. MIS Quarterly 21(1), 81–105 (1997)
35. Venkatesh, V., Davis, F.: A Theoretical Extension of the Technology Acceptance Model: Four Longitudinal Field Studies. Management Science 46(2), 186–204 (2000)
36. Yildiz, M.: E-government Research: Reviewing the Literature, Limitations, and Ways forward. Government Information Quarterly 24(3), 646–665 (2007)

Towards User-Friendly e-Government Solutions: Usability Evaluation of Austrian Smart-Card Integration Techniques

Thomas Zefferer and Vesna Krnjic

e-Government Innovation Center Austria,
Inffeldgasse 16a, 8010 Graz, Austria
{thomas.zefferer,vesna.krnjic}@egiz.gv.at
http://www.egiz.gv.at

Abstract. Security and usability are key requirements of e-Government solutions. Security requirements are often met by reliance on smart card technology. In Austria, the open source components *MOCCA Local* and *MOCCA Online* facilitate the integration of smart cards into national e-Government applications. While MOCCA Local and MOCCA Online guarantee security, their capability to meet given usability requirements has not been assessed so far.

To bridge this gap, the usability of MOCCA Local and MOCCA Online has been evaluated by means of a usability test. The obtained results show that MOCCA Local and MOCCA Online basically meet given usability requirements. Still, some minor issues have been identified that threaten to reduce the usability of these components.

In this paper we introduce the basic architecture of MOCCA Local and MOCCA Online and present results of the conducted usability test. Based on these results we identify existing usability issues and derive possible improvements.

Keywords: E-Government, Smart cards, Usability, MOCCA.

1 Introduction

Secure authentication of citizens and creation of electronic signatures are common requirements of e-Government applications. These requirements are perfectly met by smart cards as they support the secure storage of authentication information and can be used as *Secure Signature Creation Devices (SSCD)*. This way, smart cards fulfill the requirements of qualified electronic signatures according to the Directive 1999/93/EC of the European Parliament and of the Council on a Community framework for electronic signatures [1].

Besides their security enhancing features, their wide acceptance is another key advantage of smart cards. Bank institutes have recognized the potential of smart card technology early and nowadays provide customers with multi-functional bank account cards. In various countries, smart cards are also used in the health sector. For instance, in Austria citizens are supplied with health

A. Kő et al. (Eds.): EGOVIS/EDEM 2012, LNCS 7452, pp. 88–102, 2012.

insurance cards that facilitate use and charging of public health services. Due to their various fields of application, smart cards can nowadays be regarded as well accepted and approved technology.

Its wide acceptance and its capability to fulfill given security requirements make smart card technology perfectly suitable for e-Government solutions. It is thus less astonishing that e-Government strategies of various European countries foresee the use of smart cards. In Austria, smart cards are used in e-Government applications as they are able to meet given legal requirements such as the Austrian Signature Act [2] and the Austrian e-Government Act [3]. Also in numerous other European countries smart cards are an integral part of current e-Government solutions. A comprehensive overview of national eID solutions is given in [13].

Unfortunately, the use of smart cards in e-Government applications also raises various challenges for citizens, governments, and application developers. For governments, the implementation of appropriate card roll-out and personalization processes is a serious challenge as this usually involves significant organizational and financial efforts. For citizens, the need for appropriate card reader devices often represents a serious barrier as off-the-shelf PCs and laptops do usually not support this functionality by default. The integration of smart card technology into e-Government applications also raises several technological challenges for application developers. For instance, in[4], Orthacker et al. have discussed accessibility challenges that arise with the use of smart cards in e-Government applications. So far, less attention has actually been paid to usability aspects of smart card based solutions. Although smart card vendors often advertise the usability of their products, there is still a lack of scientific research on this topic.

Nevertheless, usability is a crucial factor that heavily influences user acceptance. Since e-Government applications allow for more efficient administrative and governmental proceedings, a high degree of user acceptance is desirable to improve efficiency and to save costs. The requirement for user acceptance directly leads to the demand for an appropriate level of usability in e-Government solutions. Significant effort has already been made to optimize the usability of Web based e-Government solutions. Related work has been discussed in [5] and [6]. At the same time, less attention has been paid to the usability of different approaches to integrate smart cards into these applications. We filled this gap by conducting a comprehensive usability analysis of established smart card integration methods of the Austrian e-Government infrastructure. In this paper we present results of the conducted usability analysis and propose several enhancements that can help to improve the usability of existing smart card integration approaches.

This paper is structured as follows. In Section 2 we discuss relevant concepts of the Austrian e-Government infrastructure and introduce MOCCA Local and MOCCA Online in more detail. We provide details of the methodology that has been followed to evaluate the usability of these components in Section 3. Results of the conducted usability test are presented in Section 4 and discussed in Section 5. Finally, conclusions are drawn.

2 Smart-Card Integration: The Austrian Approach

The integration of smart cards is a serious technological challenge for developers of e-Government applications. In this section we introduce different approaches that are followed in Austria to overcome this challenge. Usability aspects of these approaches will be discussed later in this paper.

Austrian e-Government solutions are based on the so called *Citizen Card* concept. The Citizen Card represents a token that allows citizens to authenticate at remote services and to create qualified electronic signatures according to the EU Signature Directive. Although the term Citizen Card might suggest the use of smart cards, the Citizen Card concept is actually technology-independent and can also be applied to e.g. mobile phones[1]. Despite of its technology-neutral nature, smart cards still play an important role in the Austrian Citizen Card concept. Currently, Citizen Card implementations that rely on health insurance cards, bank account cards, or special signature cards are available in Austria.

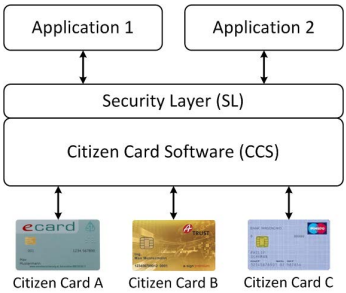

Fig. 1. The Security Layer provides e-Government applications a common interface to different Citizen Card implementations

The support of different cards is beneficial for citizens as they can use their preferred card type. However, this flexibility significantly complicates the integration of Citizen Card functionality into e-Government applications, as support for each card type has to be implemented separately. With a growing number of Citizen Card implementations (i.e. smart card types), development of new and maintenance of existing applications increase complexity and cause additional costs.

To overcome this problem, the Austrian Citizen Card concept follows a middleware approach and defines the so called *Security Layer (SL)* interface as shown in Fig. 1. The Security Layer has been introduced in [7] and represents a common XML based interface between e-Government applications and different Citizen Card implementations. The Security Layer interface is implemented by the so called *Citizen Card Software (CCS)*. This software provides access to all Citizen Card implementations and makes their functionality available to e-Government

[1] A Citizen Card implementation using mobile phones has been introduced in [8].

applications through the common SL interface. This way, application developers are released from integrating and maintaining different smart card types, as this task is outsourced to and implemented by the CCS.

The middleware approach shown in Fig. 2 raises the question about possible implementation variants for the CCS. Following the most obvious approach, the CCS is often implemented as software running on the user's local system (cf. Fig. 2). This way, the CCS has access to locally connected smart cards through the system's PC/SC interface. Following this approach, the SL interface is provided by the CCS through a local network port. This way, also Web based e-Government applications can easily access the SL interface through the user's Web browser. Since all specifications of the SL interface are open and publicly available, there are already various CCS implementations from different vendors available on the market. Some of these solutions such as the A-Trust a-sign client [9] are for free, others charge a license fee. The only open source CCS available in Austria so far is called *MOCCA Local* and has been introduced in [10]. MOCCA Local represents one of the main outcomes of the MOCCA (Modular Open Citizen Card Architecture) project [11] that aims to provide Austrian citizens with Java based open source CCS implementations. Fig. 3 shows MOCCA Local's GUI that allows users to review data to be signed and to confirm it by pressing the *Sign* button.

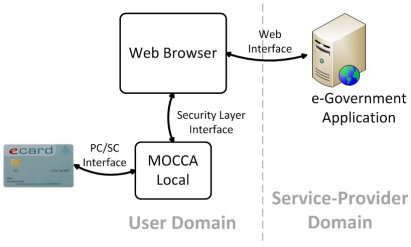

Fig. 2. MOCCA Local is a software that runs on the user's local system and acts as intermediary between the Web browser and locally connected smart cards

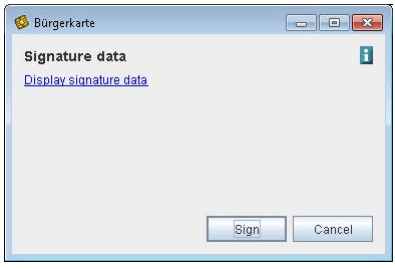

Fig. 3. The GUI of MOCCA Local allows users to review data to be signed and to start the signature creation process

All solutions mentioned above including MOCCA Local follow the approach shown in Fig. 2 and make use of software running on the user's local system. While this approach works fine from a functional point of view, it raises several problems for citizens. Especially inexperienced users sometimes have problems to carry out software installations on their own. In some cases, users do not even have the privileges to install software on the computer they are currently using. To overcome these issues, a minimal footprint CCS implementation has been developed in the course of the MOCCA project. According to this minimal footprint approach, users are not required to install software on their local

system. To underline the installation-free nature of this approach, this solution has been named *MOCCA Online*. Similar to MOCCA Local, MOCCA Online is based on the Java framework. Java has been chosen as underlying technology for all MOCCA components in order to achieve platform independence. Reliance on Java requires a current Java Runtime Environment (JRE) to be installed on the user's local system.

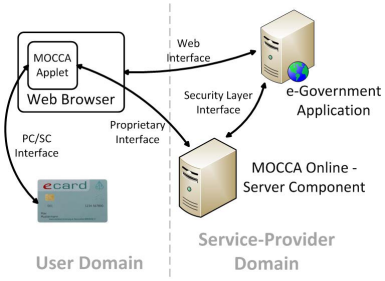

Fig. 4. MOCCA Online follows a distributed approach and consists of a server component and a Java Applet

Fig. 5. The GUI provided by MOCCA Online's Java Applet allows users to review data to be signed and to start the signature creation process

MOCCA Online has been introduced and discussed by Centner et al. in [10]. The basic architecture of MOCCA Online is shown in Fig. 4. The main idea behind MOCCA Online is to split the entire CCS functionality into two core components. The first component runs on a server and implements the SL interface. E-Government applications communicate with this server component to access smart card functionality. A Java Applet represents the second core component of MOCCA Online. The Java Applet runs in the user's Web browser and implements smart card communication based on the PC/SC protocol. Furthermore, the Applet provides a GUI through which users can review and confirm the data to be signed. The Applet's GUI is shown in Fig. 5 and has been designed similar to the GUI provided by MOCCA Local (cf. Fig. 3). This way, a similar user experience is achieved irrespective of the used MOCCA variant. Typically, the Applet is integrated into Web based e-Government applications by means of a HTML IFRAME tag. The two components of MOCCA Online, i.e. the server component and the Java Applet, communicate with each other over a proprietary interface.

Currently, MOCCA Local and MOCCA Online are among the predominating CCS implementations in Austria. During the past few years, much effort has been invested to assure and improve the security of these components. Less attention has been paid to usability aspects so far. To bridge this gap, we have conducted an extensive usability analysis of MOCCA Local and MOCCA Online in order to identify usability problems and to further improve the user acceptance of these components. In the following section we discuss the applied methodology of the conducted usability test.

3 Methodology

Approved usability evaluation methods have been applied to analyze the usability of MOCCA Local and MOCCA Online. This section defines a set of research questions and discusses the followed methodology to answer them by means of the conducted usability test.

3.1 Research Questions

The following research questions have been defined in order to cover all relevant usability aspects of the evaluated components.

Q1 Does reliance on Java technology cause additional usability problems?
Q2 What are the main usability problems that have been encountered during the installation of MOCCA Local and which user groups are especially affected?
Q3 Once MOCCA Local is correctly installed, what are the main usability problems that have been encountered during the usage of MOCCA Local and which user groups are especially affected?
Q4 What are the main usability problems that have been encountered during the usage of MOCCA Online and which user groups are especially affected?
Q5 Which MOCCA variant appears more secure and trustworthy to users and are there significant differences between different user groups?

3.2 Test Method and Setup

To find answers to the predefined research questions, a thinking-aloud test has been conducted. A Thinking-aloud test is an approved method to evaluate the usability of software products or websites and has been discussed by Nielsen in [12]. In a thinking-aloud test, test users are asked to carry out a set of well-defined tasks with the software to be evaluated and to articulate their thoughts during the test run. This way, users' interactions with the software under test can be observed and valuable user feedback can be collected. Since the users' emotional state can also be of interest, test users are usually recorded with a camera during the test.

Thinking-aloud tests typically consist of two phases. During the *test phase*, test users are asked to carry out predefined tasks. In the subsequent *analysis phase*, data recorded and collected during the test phase is analyzed in order to identify common usability problems and to find answers to predefined research questions.

We have used special software during both phases. During the test phase, the used software assisted in recording and collecting relevant data by tracking test users' mouse movements and keyboard inputs. Furthermore, the used software has automatically related additionally recorded video and sound data

to the tracked user inputs. During the test phase, additional user feedback has been collected by means of different questionnaires and a conclusive interview. Recorded user sessions and collected user feedback have been analyzed in the subsequent analysis phase. Again, the used software has facilitated an efficient analysis of the collected data sets and the application of statistical methods.

All tests have been carried out on an off-the-shelf PC with Microsoft Windows 7 operating system. Test users were asked to use the Microsoft Internet Explorer 8 Web browser. We have chosen this system configuration as it represents a common OS/Web browser combination. To facilitate a systematic analysis of the collected data and to ease comparisons between different test users, we did not give test users the opportunity to choose their preferred operating system or Web browser configuration.

3.3 Test Users and User Groups

In total, 20 test users participated in the conducted usability test. In order to achieve convincing and sound results, test users have been chosen in a way that they approximately form a representative sample of the Austrian society. All test users have been asked to carry out the following three tasks using their personal smart card based Citizen Card.

T1 Install MOCCA Local using a provided Java Web Start based installing routine.
T2 Use MOCCA Local to carry out a given e-Government procedure including identification and signature creation.
T3 Use MOCCA Online to carry out a given e-Government procedure including identification and signature creation.

To avoid the influencing of results by learning effects, test users were split into two groups. Group A was asked to carry out the tasks in the order given above and hence started with installation and usage of MOCCA Local. Contrary, Group B was asked to carry out task T3 first, followed by task T1 and task T2. Thus, test users of Group B started with an evaluation of MOCCA Online first.

Both MOCCA Local and MOCCA Online require a current Java Runtime Environment (JRE) to be installed on the client system. As we were also interested in the usability of the Java installation process and its integration in the evaluated MOCCA components, the test system was provided without an installed JRE. Test users were requested to install the required JRE during the test. Depending on their assigned group, Java had to be installed either during the installation of MOCCA Local or during the first usage of MOCCA Online. This way, we were able to compare the usability of the Java installation processes of MOCCA Local and MOCCA Online.

The assignment of test users to Group A and Group B was completely random. Additionally, all test users have been subdivided into different user groups according to different characteristics. This way, we were able to assess the impact

of given usability flaws on different user groups. The following table summarizes user groups that have been analyzed separately. Details of the obtained results are discussed in the next section.

Table 1. Test users have been classified according to four different characteristics

ID	Description	Users
Group ALL	This group comprises all test users.	20
Group A	Test users of this group started with the evaluation of MOCCA Local.	10
Group B	Test users of this group started with the evaluation of MOCCA Online.	10
Group 30+	Test users of this group are more than 30 years old.	8
Group 30-	Test users of this group are 30 or less years old.	12
Group U	Test users of this group have a university degree.	12
Group NU	Test users of this group have no university degree.	8
Group T	Test users of this group are technicians.	7
Group NT	Test users of this group are no technicians.	13

4 Results

All results provided in this section have been obtained by analyzing data collected during the usability test. The obtained results are presented in the following subsections.

4.1 Installation of the Java Runtime Environment

Both MOCCA Local and MOCCA Online represent Java based solutions. To answer research question Q1, we assessed whether the given dependency on Java raises additional usability issues. Both MOCCA Online and MOCCA Local automatically check for an installed JRE upon start-up. If no JRE can be detected, MOCCA Local automatically redirects the user to the Java installation page provided by Oracle[2]. Similarly, MOCCA Online provides users an appropriate error message containing a link to the Java installation page. Users have to follow this link manually.

Surprisingly, it turned out that without exception all test users were basically aware of Java. When being requested by MOCCA Local or MOCCA Online to install a JRE, 95% of the test users started the Java installation process using the provided link or button. Only 5% did not know what to do in this situation.

[2] `http://www.java.com/en/download/`

After starting the Java installation process, 20% of all test users had problems to successfully complete it. These users mostly successfully downloaded Java but did not realize that the downloaded installer file had to be executed afterwards. User group specific results are illustrated in Fig. 6 and show that the Java installation process was especially problematic for older and non-graduate users. As expected, also test users without technical background were more prone to problems during the Java installation process. Interestingly, users of Group B, i.e. users who had to install Java in the course of using MOCCA Online, had more problems with the Java installation compared to users of Group A.

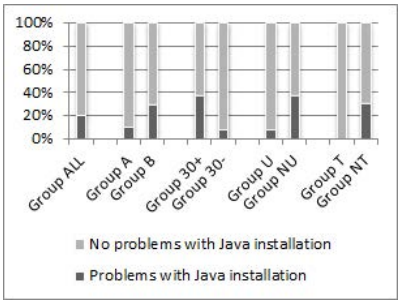

Fig. 6. The installation of Java was problematic especially for users of Group 30+, Group NU, and Group NT

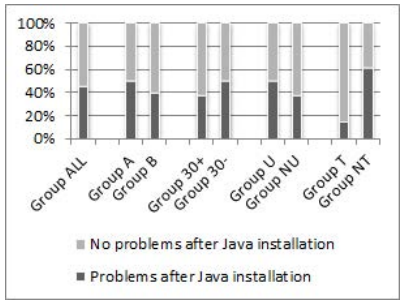

Fig. 7. Especially users of Group NT had problems to proceed after the Java installation process

After completion of the Java installation process, users had to manually restart the Java Webstart based installation process of MOCCA Local or to manually reload the Java Applet of MOCCA Online. It turned out that this was problematic for 45% of all test users. The group specific results illustrated in Figure 7 show that especially technically inexperienced users had problems in this situation. This time, users of Group A were slightly more prone to usability problems. Obviously, after completion of the Java installation process it was more intuitive for users to manually reload the website containing the Java Applet of MOCCA Online than to manually restart the installation procedure of MOCCA Local.

4.2 Installation of MOCCA Local

The installation of MOCCA Local is based on Java Webstart technology. Hence, test users simply had to click a provided button on a website to start the installation process. This was intuitive for 95% of all test users. After completion of the Java Webstart based installation process, a new Web-browser tab was opened automatically. The website shown in this tab asked test users to install a certificate into their Web browser[3]. The certificate to be installed was provided

[3] This certificate is required to establish an appropriate trust status between the Web browser and MOCCA Local.

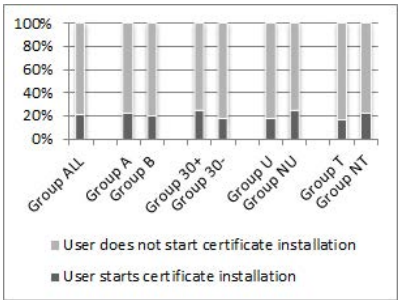

Fig. 8. No significant differences between different user groups could be observed regarding the installation of certificates

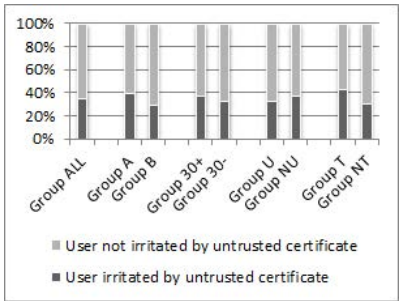

Fig. 9. Users of all user groups were irritated by untrusted certificates

via a link. 20% of all test users just ignored this message and didn't install the certificate at all. Fig. 8 shows that this affected all user groups. 15% of all test users downloaded the certificate but did not install it. Another 10% were not able to complete the certificate installation process on their own.

The certificate to be installed was not recognized as trusted by the used Web browser. Hence, a security warning was shown during the installation process. 35% of all test users felt irritated by this security warning and were not sure whether to proceed with the installation process or not. Fig. 9 shows that again there were only marginal differences between different user groups.

4.3 Card Reader Interaction

MOCCA Local and MOCCA Online support both smart card reader devices with and without integrated PIN pads. Experience has shown that usually devices with integrated PIN pad cause more usability problems. Thus, we have used a Reiner SCT card reader device with integrated PIN pad during the conducted usability test.

It turned out that 25% of all test users had problems to enter the PIN through the integrated PIN pad correctly. In most cases, users didn't realize that entered PINs had to be confirmed using a green OK button. Fig. 10 shows that especially graduated users had problems to enter the PIN correctly. Interestingly, test users starting with the evaluation of MOCCA Local (Group A) were also more prone to problems during the entering of PINs.

A significant learning effect could be observed. Test users, who ran into an timeout because of not confirming the PIN entry by pressing the OK button, did not make the same mistake twice. Already the second PIN entry could be completed successfully by all test users.

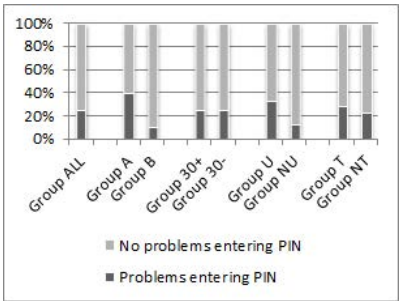

Fig. 10. Users of Group A had significantly more problems to enter the PIN correctly

4.4 Usage of MOCCA Local

In order to test the usability of MOCCA Local, test users were asked to carry out a typical e-Government procedure using their Citizen Card and MOCCA Local. This procedure comprised the reading of identification data from the user's smart card and the electronic signing of an application form.

Usually, when MOCCA Local is requested to access the locally connected smart card, there is a short delay until MOCCA Local starts up its GUI. However, it turned out that only 5% of all test users were irritated by this delay.

The GUI basically serves two purposes. First, it allows users to enter secret PINs if no card reader with integrated PIN pad is used. Furthermore, it allows users to review the data that is about to be signed during a signature creation process. Users can follow a link labeled "Signature Data" in order to open a separate window that finally contains the data to be signed. Interestingly, the conducted usability test revealed that only 40% of all test users were interested in the provided signature data and followed the shown link to inspect them. All other test users just completed the signature process without reviewing the data to be signed. Fig. 11 shows that this affected all user groups. Interestingly, test users with technical background showed most interest in the provided signature data.

In general, all test users were able to carry out the e-Government procedure using MOCCA Local. Severe usability issues did not arise. The usability, security, and trustworthiness of MOCCA Local has also been attested by the test users. Most of them perceived MOCCA Local as secure and trustworthy. Fig. 12 illustrates group specific results.

4.5 Usage of MOCCA Online

Similar to MOCCA Local, the usability of MOCCA Online has been evaluated by requesting test users to carry out a typical e-Government procedure. Again, this procedure comprised the reading of identity data from the user's smart card and the electronic signing of an application form.

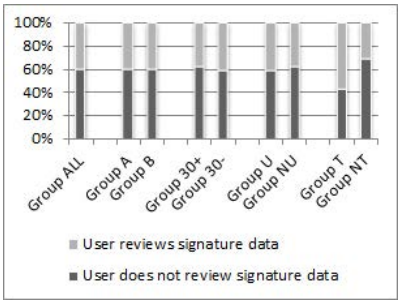

Fig. 11. The majority of all test users was not interested in the data to be signed

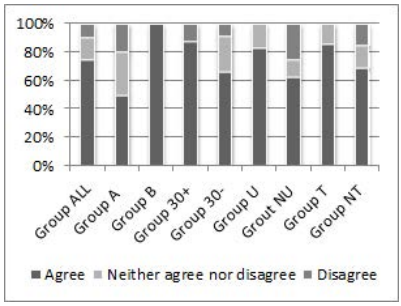

Fig. 12. Most users perceived MOCCA Local as secure and trustworthy

On the client system, a Java Applet represents the key component of MOCCA Online. The Applet implements access to the locally connected smart card and offers the user a GUI. Again, this GUI can be used to enter PINs (if a smart card reader without integrated PIN pad is used) and to access and review data to be signed. Compared to MOCCA Local, the Java Applet usually takes more time to load and to provide the user with the GUI. In total, 20% of all test users were irritated by the delay caused by the Applet loading process.

Since the used Java Applet requires access to local resources (i.e. the smart card), the Applet needs to be signed. For the conducted usability test we used a test instance of MOCCA Online that was signed with a test certificate only. This certificate was not recognized to be trusted by the used Web browser. Hence, during the loading of the Java Applet a security warning was shown. 35% of all test users were irritated by this security warning and considered to cancel the loading process. Fig. 13 illustrates group specific results and shows that especially non-graduated users were irritated by the displayed security warning.

Similar to MOCCA Local, only a small percentage of all test users showed interest in the provided signature data. 80% completed the electronic signing process without verifying the data to be signed. Fig. 14 shows that escpecially non-graduated test users were not interested in the data to be signed.

As shown in Fig. 15, the majority of all test users perceived MOCCA Online as secure and trustworthy. Especially older and well-educated test users rated the security and trustworthiness of MOCCA Online positively.

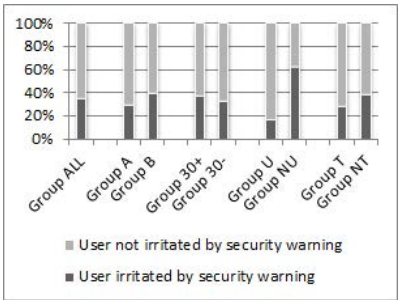

Fig. 13. Especially users of Group NU were irritated by the shown security warning

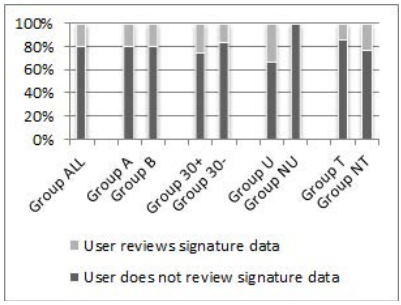

Fig. 14. The majority of all users was not interested in the data to be signed

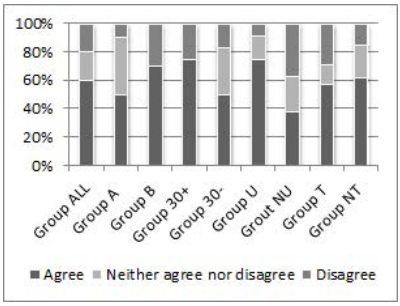

Fig. 15. Most users perceived MOCCA Online as secure and trustworthy

5 Discussion

The conducted usability test yielded various interesting results. In this section we interpret these results to answer the five predefined research questions. Furthermore, we sum up the most relevant lessons learned and derive possible improvements for the evaluated CCS implementations.

To answer research question Q1, we can conclude that reliance on Java technology does not automatically lead to usability problems. All test users were aware of Java and most of them were able to complete the Java installation process successfully. Still, usability problems could be identified regarding the integration of the Java installation process. After completion of the Java installation process, some users did not know how to proceed. This especially applied to technically inexperienced users. In order to overcome this problem and to improve the integration of the Java installation process, users should be provided with more information and guidance during the installation process.

Regarding research question Q2, the conducted usability test revealed that the Java Webstart based installation process of MOCCA Local does not cause severe usability problems. Most users were able to install MOCCA Local without

assistance. However, several users had problems with the subsequent certificate installation that had to be carried out in the used Web browser. Again, this problem can be overcome by providing users with more information and guidance during the installation process. Additionally, used certificates should always be chosen such that their trust status is recognized by common Web browsers. Otherwise, displayed security warnings might irritate users and lead to an abort of the certificate installation process.

The use of MOCCA Local turned out to be unproblematic for users. Minor problems occurred only during the first PIN entry, when users did not know that entered PINs had to be confirmed using the green OK button on the card reader device. To avoid possible errors already during the first use of MOCCA Local, users should be informed appropriately if a PIN confirmation is required. It also turned out that most users did not verify provided signature data before electronically signing them. To solve this issue, the link that has to be followed in order to display the signature data should be placed more prominently in the shown GUI window (cf. Fig.3). Despite these minor issues, we can answer research question Q3 by concluding that MOCCA Local is usable for most users without problems.

Similar results have been obtained for research question Q4. Evaluation of MOCCA Online has shown that additional information about an expected confirmation of PIN entries could improve usability. Similar to MOCCA Local, signature data to be signed was hardly ever reviewed by test users. A more prominent placement and design of the shown link that leads to the signature data (cf. Fig. 5) thus seems reasonable. The conducted usability test has also shown that users are often irritated by displayed security warnings. Hence, it should be guaranteed that the trust status of used signing certificate of the MOCCA Applet is recognized by common Web browsers.

To answer research question Q5, we can conclude that both security and trustworthiness of MOCCA Local and MOCCA Online have been rated positively by most test users. A direct comparison of the results obtained for MOCCA Local and MOCCA Online shows that MOCCA Local has been rated slightly better than MOCCA Online. Interestingly, older and graduated users rated both evaluated CSS implementations better than younger and non-graduated users. According to the obtained results, technicians rated the security and trustworthiness of MOCCA Local higher. For users without technical background MOCCA Online appeared to be more secure and trustworthy. For both CCS implementations, it turned out that the use of untrusted certificates significantly reduces the perceived security and trustworthiness. Hence, it is crucial that CCS implementations rely on certificates that are recognized as trusted by common Web browsers.

6 Conclusions

The conducted usability evaluation of MOCCA Local and MOCCA Online has led to valuable findings. The obtained results show that both MOCCA Local and MOCCA Online basically fulfill given usability requirements. Most test users

were able to successfully install and use the evaluated components without assistance.

Still, some minor usability problems could be identified. Provision of more detailed information and improved guidance through installation routines will probably solve most of the identified issues. Additionally, reliance on certificate being recognized as trusted by common Web browsers is crucial for the perceived security and trustworthiness of MOCCA Local and MOCCA Online.

All obtained results and findings will be incorporated in future releases of the evaluated CCS implementations. This way, the conducted usability test will contribute to the usability of MOCCA Local and MOCCA Online and will help to improve the user acceptance of e-Government applications that rely on these components.

References

1. Directive 1999/93/EC of the European Parliament and of the Council of 13 December 1999 on a Community framework for electronic signatures. Offcial Journal of the European Communities L 013, 12–20 (2000)
2. Austrian Federal Act on Electronic Signatures. Federal Law Gazette, part I, Nr. 137/2000, last amended by Nr. 59/2008 (2000)
3. Austrian Federal Act on Provisions Facilitating Electronic Communications with Public Bodies. Federal Law Gazette, part I, Nr. 10/2004 (2004)
4. Orthacker, C., Zefferer, T.: Accessibility Challenges in e-Government: an Austrian Experience. In: Proceedings of the Forth International Conference on Internet Technologies and Applications (ITA 2011), pp. 221–228 (2011)
5. Garcia, A.C.B., Maciel, C., Pinto, F.B.: A Quality Inspection Method to Evaluate E-Government Sites. In: Wimmer, M.A., Traunmüller, R., Grönlund, Å., Andersen, K.V. (eds.) EGOV 2005. LNCS, vol. 3591, pp. 198–209. Springer, Heidelberg (2005)
6. Sørum, H.: An Empirical Investigation of User Involvement, Website Quality and Perceived User Satisfaction in eGovernment Environments. In: Andersen, K.N., Francesconi, E., Grönlund, Å., van Engers, T.M. (eds.) EGOVIS 2011. LNCS, vol. 6866, pp. 122–134. Springer, Heidelberg (2011)
7. Leitold, H., Hollosi, A., Posch, R.: Security Architecture of the Austrian Citizen Card Concept. In: Proceedings of the 18th Annual Computer Security Applications Conference, pp. 391–400. IEEE Computer Society, Washington, DC (2002)
8. Orthacker, C., Centner, M., Kittl, C.: Qualified Mobile Server Signature. In: Proceedings of the 25th TC 2011 International Information Security Conference, SEC 2010 (2010)
9. a.sign client (2012), `https://www.a-trust.at/default.aspx?lang=GE&ch=1&node=765`
10. Orthacker, C., Centner, M.: Minimal-Footprint Middleware to Leverage Qualified Electronic Signatures. In: Filipe, J., Cordeiro, J. (eds.) WEBIST 2010. LNBIP, vol. 75, pp. 60–68. Springer, Heidelberg (2011)
11. Modular Open Citizen Card Architecture (2012), `http://mocca.egovlabs.gv.at/`
12. Nielsen, J.: Usability Engineering. Morgan Kaufmann Publishers (1993)
13. Siddhartha, A.: National e-ID card schemes: A European overview. Information Security Technical Report 13, 46–53 (2008)

Unique Identity Enabled Service Delivery through NSDG

Swapnil Shrivastava, Zia Saquib, Gopinath P., and Peeyush Chomal

Centre for Development of Advanced Computing, Mumbai, India
{swapnil,saquib,gopinath,peeyush}@cdac.in

Abstract. Unique Identity (Aadhaar) is issued by Unique Identification Authority of India (UIDAI) to the residents of India. With Aadhaar enrolment happening in full swing across the country, there is a strong need to formulate and furnish Aadhaar-enabled Service Delivery for the citizens. The National e-Governance Service Delivery Gateway (NSDG) as a messaging middleware provides Integrated Service Delivery based on Service Oriented Architecture for various government services. By positioning NSDG as Authentication User Agency (AUA) in Aadhaar Authentication Ecosystem, it can cater Aadhaar Authentication Service to all the government departments who wish to offer Aadhaar-enabled services and benefit schemes to the citizens. NSDG as AUA will provide Aadhaar authentication in conjunction with service access portal authentication process. With this NSDG can deliver Aadhaar-enabled Services to citizens based on online identity verification, thus improving efficiency, reliability and transparency in service delivery to the citizens. In this paper we will present integration of Aadhaar Authentication service with Messaging service of NSDG and its benefits.

Keywords: NSDG, Aadhaar Authentication, Unique Identity, Service Delivery, Aadhaar-enabled Service Delivery.

1 Introduction

"Make all Government services accessible to the common man in his locality, through common service delivery outlets, and ensure efficiency, transparency, and reliability of such services at affordable costs to realise the basic needs of the common man." [1]

This is the vision statement of the National e-Governance Plan (NeGP) which was formulated by the Department of Information Technology (DIT), Government of India (GoI), for implementation of e-Governance across the country. India, the world's largest democracy is a federal republic comprising of states and union territories [3]. NeGP comprises of 27 Mission Mode Projects (MMPs) to be implemented at the Central, State and Local Government levels and 8 Common Core and Support Infrastructure [1-2]. In this paper we will discuss integration of key features of two MMPs viz. Authentication service of Aadhaar with Messaging service of National eGovernance Service Delivery Gateway (NSDG) in order to provide Aadhaar-enabled Services via NSDG.

A. Kő et al. (Eds.): EGOVIS/EDEM 2012, LNCS 7452, pp. 103–111, 2012.

In general, to avail certain service offered by government department, a citizen is required to prove his/her identity. In such situation, an authentication process precedes service delivery. Authentication in a traditional sense could be carried out by verifying credentials owned by the citizen. These credentials could be physical documents such as an identity card, passport and so on. Sometimes signature or thumb impression that is unique to a citizen may also be used. Lately authentication can also be done by verifying citizen's biometrics such as fingerprint or iris. On successful verification of the citizen's credentials, requested service is delivered to him/her.

In e-Governance, similar service delivery process is automated and can be accessed online by the citizen. Under NeGP, various e-Governance applications are being implemented in order to provide speedy delivery of government services to the citizens at affordable costs [4-5]. NSDG is an integrated MMP executed by DIT, GoI and implemented by CDAC Mumbai, India [1]. NSDG is a messaging middleware which enables interoperability and integration of various central government department services. It comprises a set of e-Governance Gateway specific protocols (IIP, IIS, IGIS) that are based on open standards (XML and SOAP) [8]. To integrate e-Governance application as a service with NSDG, front-end and back-end functionalities of this application is identified as service access portal and department server/back office respectively. These entities then become connected with NSDG by implementing SAP (Service Access Provider) and SP (Service Provider) connectors. Detailed discussion of these components and integration of a service with NSDG will be discussed in section 2. Go Live of NSDG happened in August 2008 and integration of services such as Trademark Service and Uttar Pradesh State's e-District is complete. There are several integrations underway such as Police Verification and Permanent Account Number (PAN) Verification.

Aadhaar (UID) project is a central MMP which aim to provide unique identity (Aadhaar Number) to all the residents of India. Unique Identity Authority of India (UIDAI) [11] established by Government of India is the overseer and regulatory body of this project. UIDAI provides two services for the citizen viz. Aadhaar Enrolment Service and Aadhaar Authentication Service [1]. Aadhaar Enrolment Service initiates generation of Aadhaar Number for the citizens. Currently this service is available at many locations in the country. By the time this paper is written almost 17 crore Aadhaar Numbers are already issued [10]. With Aadhaar enrolment already taking place there is a strong need to formulate and make operational Aadhaar-enabled Service Delivery for the citizens. Aadhaar-enabled Service Delivery is to provide requested service to citizen after successful Aadhaar authentication. Aadhaar Authentication Service enables agencies (government/private) to verify identity of citizens using an online and electronic means [6]. The Aadhaar Authentication Ecosystem and types of authentication will be discussed in section 3.

By positioning NSDG as Authentication User Agency (AUA) in Aadhaar Authentication Ecosystem, it will provide Aadhaar authentication to all the government departments who wish to offer Aadhaar-enabled services and benefit schemes to the citizens. NSDG as AUA will use Aadhaar authentication in conjunction with service access portal authentication process. Aadhaar authentication will facilitate NSDG to

deliver Aadhaar-enabled Services to citizens based on establishing their identity, thus improving efficiency, reliability and transparency in service delivery to the citizen. Positioning of NSDG in Aadhaar Authentication Ecosystem is described in section 4.

2 Messaging Service of National e-Governance Service Delivery Gateway (NSDG)

Messaging service of NSDG provides secure and standard based communication channel for service request/ response between service access portal on Service Access Provider (SAP) side and department server/back office on Service Provider (SP) side. NSDG consists of four major components as shown in figure 1 and as described below:

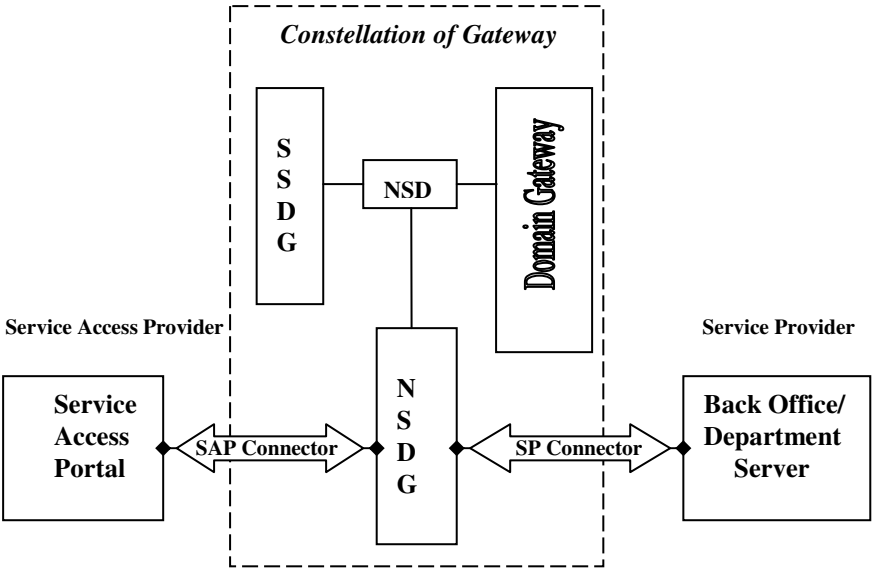

Fig. 1. NSDG Components

Service Provider (SP) is government department or any other third-party agency offering services to citizens and businesses, and to other government departments. Service Access Provider (SAP) is an entity, which facilitates government service access for citizens, by providing a front-end infrastructure. Access to service access portal (India Portal, State Portal and so on) is provided to citizen through Citizen Service Centre (CSC) available across the country. NSDG provides gateway for services offered by central government departments. The SSDGs' are the productized version of NSDG and will act as gateway for services offered by various state government departments. In addition, there are departmental applications gateways like MCA21, Passport which are identified as Domain Gateways. All these put together forms Constellation of Gateways. National Services Directory (NSD) provides a registry, which

acts as a service resolution point for all the services in the Gateway constellation [8]. This constellation is a novel constellation initiative in the world. It goes well with federated form of governance in India.

For integration of e-Governance application as a service with Gateway the SAP and SP connectors have to be implemented for the front-end and back-end functionalities of this application respectively. The SAP/SP connector wraps/unwraps the message into/from the e-Governance Gateway specific protocol. We will take an example of "Service Request" use case to explain message flow when a citizen applies for a service which is integrated with NSDG. The citizen visit CSC to put-up a request for service such as Age Certificate. The operator opens eform [9] of Age Certificate from service access portal and fills the required details of the citizen. Set of identity proof documents of the citizen are verified, scanned and uploaded along with the eform. When the operator submits eform application, SAP connector wraps the service request into IIP packet. This IIP packet will be routed to the SP connector of the corresponding department server/ back office through NSDG. The SP connector extracts service request from the received IIP packet and sends it for updation to Department Server. Department Server will send system generated application id after successful update or error message for failed update. The SP connector wraps the response received from department server in IIP packet. The response is routed to SAP connector of request originating SAP through NSDG. The SAP connector unwrap the service response and sends it to service access portal for display. The end-to-end message flow of this use case is also shown in figure 2:

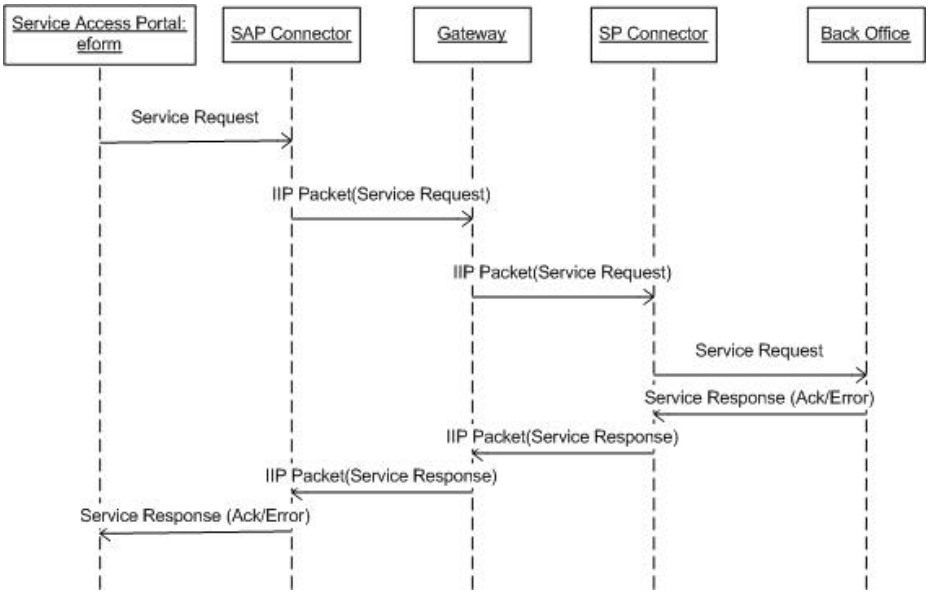

Fig. 2. End to end message flow for "Service Request" use case

NSDG offers number of benefits to the citizens as well as government departments. Some of them are listed below:

- NSDG is built on open standards and implemented using open source technologies and tools.
- It enables service delivery to citizen from a single point by facilitating an assortment of service models which supports one or more departments on SP side.
- It is a secure messaging middleware. It doesn't read or store the message body and thus ensure privacy and confidentiality of the data.
- It uses bidirectional SSL for end to end communication. This guarantees security during transmission of message.
- Gateway constellation will help the citizen to request for services offered by various central/state government departments from any part of the country.

3 Aadhaar Authentication Service

Aadhaar Authentication Service is an online process in which citizen's Aadhaar Number along with his/her personal identity information are submitted to CIDR for verification. Personal identity information can be a combination of biometric (fingerprints, iris) and/or demographic (such as Name, Date of birth, Address) and/or a secret PIN/OTP number known only to the citizen. During verification, the submitted details are matched with the data against the citizen's Aadhaar number in CIDR. If they match then CIDR sends "Yes" as response else "No" [6-7].

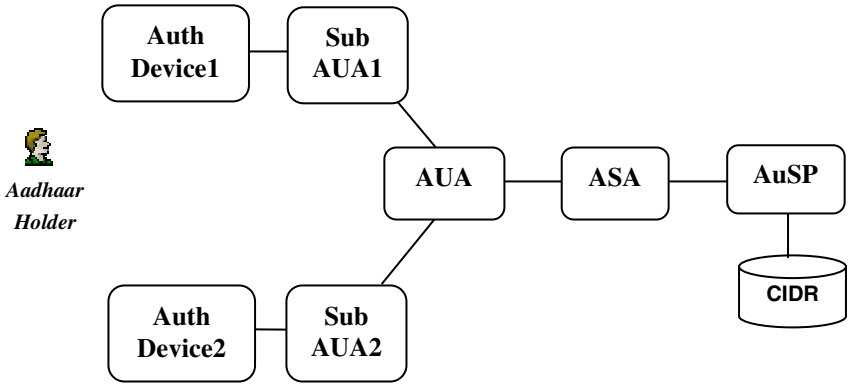

Fig. 3. Aadhaar Authentication Service Ecosystem

The key components of Aadhaar Authentication Service ecosystem are as shown in figure 3. *Aadhaar Holders* are those with a valid Aadhaar Number. CIDR contains the identity information of all Aadhaar holders. *Authentication Service Provider (AuSP)* offers Aadhaar based authentication service on behalf of UIDAI. *Authentication Service Agency (ASA)* establishes secure network connectivity (through leased line) with the CIDR. *Authentication User Agency (AUA)* uses Aadhaar authentication to enable

its services or transmit authentication requests from *Sub AUAs* to *ASA*. *Sub AUAs* access authentication service through an existing *AUA*. *Authentication device* collects the personal identity information, prepare the information for transmission, transmit the authentication packets through AUA and receive the authentication results from them.

UIDAI provides 5 types of Aadhaar-based authentication as listed below:

- Type 1:Demographic attributes (name and/or DoB and/or address and so on)
- Type 2:One Time Password (OTP/Mobile)
- Type 3: Biometric attributes (FingerPrint/Iris scan)
- Type 4 :OTP/Mobile and Biometric attributes (FingerPrint/Iris scan)
- Type 5 :OTP/Mobile and FingerPrint and Iris scan

The SubAUA/ AUAs can choose any of these authentication types based on their security requirements. The personal identity information captured by Aadhaar enabled Authentication Application running on Authentication Device are packaged into an XML termed as Personal Identity Data (PID) block.

Aadhaar has defined security policies and standards to protect personal identity information of Aadhaar Holder at the time Aadhaar authentication. They are as follows:

- The PID block should be encrypted and encoded before it is transmitted over network.
- Encrypted and encoded PID block, encrypted Session key and HMAC value of PID block are sent from device to prevent data loss or tampering due to any malicious attack at the network level.
- The key components (AUA, ASA) should log metadata of authentication request and response for audit purpose.
- PID block should not be stored in the Authentication Devices as well as audit logs.
- Secure transmission of data between the key components is recommended.

4 Positioning of NSDG in Aadhaar Authentication Ecosystem

In Aadhaar Authentication Ecosystem, NSDG is positioned as AUA and various government departments who wish to provide Aadhaar enabled services and benefit schemes to citizens through NSDG will become Sub AUAs.

Aadhaar-NSDG integration model is shown as block diagram in figure 4. Citizen can avail Aadhaar-enabled service by accessing service access portal from home via public devices and from CSC through terminal devices. Aadhaar Number, personal identity information and department service request specific attributes provided by the citizen will be entered in the eform by front office operator at the CSC. The personal identity information will be packaged in form of PID block. The device will send encrypted and encoded PID block along with security credentials (HMAC value, Session Key) and department service request data to Sub AUA. In case of public devices, citizen will enter necessary demographic information, OTP in addition to department service request specific attributes.

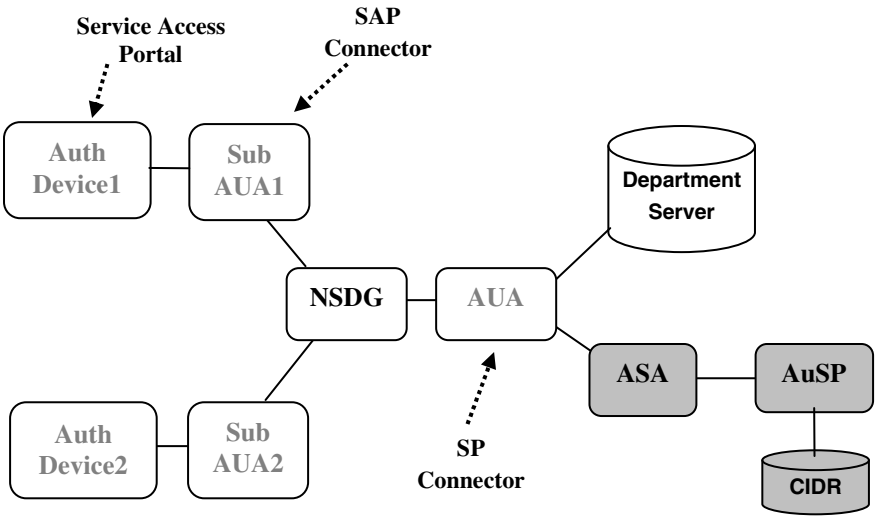

Fig. 4. Block diagram representation of Aadhaar-NSDG Integration Model

Sub AUA role is played by various government departments who wish to offer Aadhaar-enabled services and benefit schemes to citizens through NSDG. The set of job performed by Sub AUA is implemented in the SAP connector. The SAP connector package encrypted and encoded PID block along with security credential and department service request data as XML into the body of IIP packet as shown in figure 5.

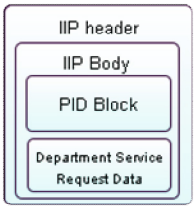

Fig. 5. IIP Packet structure of Aadhaar enabled Service Request

NSDG as AUA will provide Aadhaar Authentication service to Sub AUAs. The AUA's functionalities are implemented in NSDG SP connector. The IIP packet created at Sub AUA is routed to AUA via NSDG. AUA would validate, adds the necessary header to Authentication request and send it to CIDR via ASA. If CIDR's response is "Yes" then SP connector will perform certain additional tasks, such as it would extract department service request XML file from IIP packet, route and update it in the corresponding Department Server, and acknowledge to request originating SAP. The end-to-end service request flow for successful Aadhaar-enabled Service Delivery is as shown in figure 6. If CIDR's response is "No", then the SP connector will send the corresponding error message to the request originating SAP as indication of authentication failure.

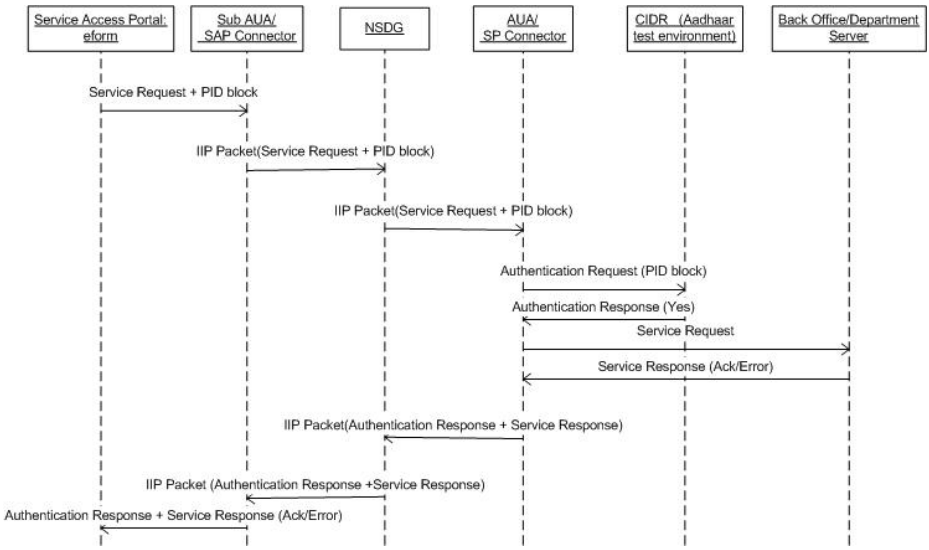

Fig. 6. End-to-end flow for Aadhaar-enabled Service in case of service request from CSC

A Proof of Concept (PoC) is implemented based on the proposed Aadhaar-NSDG integration model. In this PoC, Jammu & Kashmir state portal's Indira Gandhi Old Age Pension Scheme (IGNOAPS) service is made Aadhaar-enabled. Aadhaar type1, type 2 and type 3 authentications are implemented for this service. This PoC is successfully tested against test records as well as live Aadhaar Number record present in Aadhaar test environment.

5 Benefits

- The Constellation of Gateways enables service request/delivery from/to any location across the length and breadth of the country. As a result, Aadhaar-enabled Service Delivery via constellation may come in handy for services and benefit schemes such as Public Distribution System (PDS) especially for migrant workers.
- Aadhaar-enabled Service request processing via NSDG brings transparency in service delivery to the citizen. Since there is no dependency on any middle-man, the risk related to service delivery such as poor service or denial of service is reduced.
- Any government department wanting to offer Aadhaar-enabled Services become AUA and sign agreement with UIDAI as well as ASA. Rather, if integration model discussed in this paper is followed, the department as Sub AUA will merely need to register with AUA (NSDG).
- NSDG will not store PID block, since as a policy decision it doesn't log or store message body. NSDG would thus provide personal data protection which in turn is a critical security requirement in Aadhaar authentication environment.

6 Future Work

The Aadhaar-NSDG integration model can be extended further by integrating Mobile Service Delivery Gateway (MSDG) to provide Aadhaar Authentication through mobile devices. Recently Aadhaar Authentication Service was launched for Aadhaar live data. As a result proposed work can move into production phase. Though this model serves integration of Aadhaar Authentication with NSDG, still it cannot be moved in its present form into production. It is observed that implementation of AUA functionalities in SP connector will cause difficulty in compliance to security standards. Hence in production, AUA functionalities should be implemented in a service, which can be registered on SP side of the gateway. This slight deviation in approach will result in NSDG to provide Aadhaar Authentication as a Verification Service for all the government departments who are registered with it. It will also facilitate compliance of security standards at a single location.

Acknowledgements. As per the directions of DIT, CDAC conducted a study on positioning of NSDG in Aadhaar Authentication Ecosystem. We are grateful to eGovernance Group of DIT and NeGD for entrusting us with this opportunity. We would like to thank Dr Pramod K Varma, Chief Architect, UIDAI for his perpetual support and guidance. First and third author appreciate our team member Mr Ahmad Hassan for his valuable contribution and also extend our sincere thanks to Mr Ravi K Sinha, Mr B Ravi Kumar, Ms Anna Thomas and Ms Kriti Kulshrestha for their valuable contribution in resolving integration issues related to J&K state portal.

References

1. Saaransh- A compendium of Mission Mode Projects under NeGP, Department of Information Technology, Government of India (2011)
2. Mathur, D., Gupta, P., Sridevi, A.: Transforming Government e-Governance Initiatives in India. In: Bagga, R.K., Gupta, P. (eds.), pp. 3–50. The ICFAI University Press, Hyderabad (2009)
3. Chauhan, R.: National E-Governance Plan in India, Report No. 414, UNU-IIST, Macao (2009)
4. Monga, A.: E-government in India: Opportunities and Challenges. JOAAG 3(2) (2008)
5. Thapliyal, M.P.: Challenges in Developing Citizen-Centric E-Governance in India. In: International Congress on eGovernment, pp. 1–5 (2008)
6. Aadhaar Authentication Framework 2.0, http://www.uidai.gov.in/
7. Aadhaar Authentication API Specification - Version 1.5 (Revision 1) (September 2011), http://www.uidai.gov.in/
8. Official website of National e-Governance Service Delivery Gateway (NSDG), http://www.nsdg.gov.in
9. eFiling through Fulcrum and NSDG, http://eforms.gov.in
10. Aadhaar Portal, http://portal.uidai.gov.in/uidwebportal/dashboard.do
11. Official website of Unique Identification Authority of India (UIDAI), http://www.uidai.gov.in/

FedCohesion: Federated Identity Management in the Marche Region

Serenella Carota[2], Flavio Corradini[1], Damiano Falcioni[1], Maria Laura Maggiulli[2], Fausto Marcantoni[1], Roberto Piangerelli[2], Alberto Polzonetti[1], Barbara Re[1], and Andrea Sergiacomi[2]

[1] Computer Science Division
School of Science and Technologies
University of Camerino
62032 – Camerino (MC), Italy
{flavio.corradini,damiano.falcioni,fausto.marcantoni,
alberto.polzonetti,barbara.re}@unicam.it
[2] P.F. Sistemi Informativi e Telematici
Regione Marche
60125 – Ancona (AN), Italy
{serena.carota,mlaura.maggiulli,roberto.piangerelli,
andrea.sergiacomi}@regione.marche.it

Abstract. Federated identity management is a set of technologies and processes supporting dynamically distribute identity information. Its adoption in Public Administrations maintains organizations autonomy giving at the same time citizens support to access the services that are distributed across security domains.

In this paper, we propose the Marche Region experience for what concern federate identity management focusing on the regional authentication framework, named FedCohesion. It is bases on Security Assertion Markup Language standard and it results from Cohesion re-engineering. It is the old style legacy authentication framework. We first present resulting architecture showing supported identification process and pilot applications. Lessons learned and opportunities have been also presented.

1 Introduction

Identity management represents a critical issue both in public and private sectors. There are many reasons for solving such problem among the others the implementation of e-government services (such as cross-border services provision) in order to enable true mobility for citizens and freedom of movement for business within the single market. It is clear that citizens are the main beneficiaries, however thanks to public private partnership services could work on an interoperable basis. For citizens, who are also consumers and employees, the integration is potentially attractive. At the same time this could contributes to the success of companies and to the increasing adoption of fully interoperable customized and high-value e-government services.

A. Kő et al. (Eds.): EGOVIS/EDEM 2012, LNCS 7452, pp. 112–124, 2012.

Since many years both European and national governments recognize identity management as a problem. This is recently confirmed by Europe 2020 strategy [1] and related flagship initiatives such as the Digital Agenda for Europe [2]. Implementing the Stockholm Program the European action plan underlines the importance of an European strategy on identity management, including the need of legislative proposals on criminalization of identity theft and on electronic identity and secure authentication systems [3].

Focusing on e-government, identity management is a clearly addressed precondition [4]. In order to satisfy the application of mature European Interoperability Framework [5] moving from organization centric identity management to a federate identity management model [6] is a need. It is stated that the role of federation increases over the time mainly due to the ability of support independency among Public Administrations (PA) too often stressed by different political points of view [7].

Several architectures, technologies and projects related electronic identity management have been developed in Europe [8] [9]. In Italy there is a quite heterogeneous scenario that takes advantage of the already defined national interoperability framework [10] [11]. The most comprehensive example is given bu Secure idenTity acrOss boRders linKed[1] (phase I and II). It contributes to the realization of a single European electronic identification and authentication area establishing interoperability of different approaches at national and EU level, electronic identity for persons, electronic identity for legal entities and the facility to mandate.

Each Italian Region contributes from a bottom up perspective as the main actors in innovation policy making aimed at promoting applied research, innovation and technology transfer programs [12]. Regions develop their own innovation plans, although these need to be approved by the national government to ensure that they are in line with national policies. The regions have political and organization autonomy and at the same time they can aggregate and support local Public Administrations too often not suitable to be self-sustaining.

Among the others Marche Region has developed its own innovation plan. In order to adopt innovation actions an important aspect that we underline is the territory over which the Region spreads out, as it embraces both the high mountains environment of the Apennines, characterized by small towns with a low density of population, a large hill area, where the valleys are full of craft work, and the coastal area, where the most part population and of the industrial development lies. The governance and the technological choices are certainly influenced by the heterogeneity and diversity implicitly represented in the Region. So, working as a community it is an important aspect to spread digital society in such territory as well as to improve the interactions with other PAs outside of the Region and to contributes to the development and the use of fully interactive services. Innovation plan passes troughs IT supporting infrastructure such as those related digital identity. Marche Region reviews its identity management framework, named Cohesion, in order to support federate identity management.

[1] `https://www.eid-stork.eu/`

The novel framework, resulting from the re-engineering steps, is named FedCohesion. Its application is suitable to enable the creation of a community to support the great number of small and medium PAs and their relationships with citizens and businesses as well as other central PAs and Regions.

In this paper we present the Marche Region experience regarding federate identity management discussing technical and organization issues that drive the re-engineering step from the old style legacy system to the novel and more interoperable authentication framework. Here we will focus on the adopted design choices. As a result lessons learned from the application of a federate identity management system are presented.

The rest of the paper is organized as follows. The next Section presents European and national scenarios on federate identity management, whereas Section 3 introduces technical background. Section 4 presents the starting point in the Marche Region in term of authentication. Section 5 describes the innovation process that engages the Marche Region toward the adoption of FedCohesion. Some development issues are also introduced. Section 6 presents federation into practice. Concluding remarks and further development are discussed at the end of the paper.

2 Digital Identity from Europe to Marche Region

Federate identity management in Europe presents a quite heterogeneous scenarios [9]. It is not the case that every country decided to adopt a federated approach to identity management according to the culture and their relations with the local governments. For the countries that start such process (i) from the organizational point of view there is systematic approach starting from a reference framework to a communication plan and (ii) from technical issues the employment of Security Assertion Markup Language (SAML) [13] is a common requirement.

In Italy the adoption of European Interoperability Framework passes trough the definition of a national interoperability framework for applicative cooperation, named SPC-SPCoop [10] [11]. It represents a bottom-up approach till the adoption with Law decree of the Digital Administration Code. Focusing on federated identity management it is used to authorize and control the access to services over SPC-SPCoop. The federation is needed to reuse the already in-place identity management systems of several regional and national authorities. In such context the biggest project was Interoperability and Applicative Cooperation among Regions (ICAR). It started in June 2006 with 17 partners including 16 of 19 Italian Regions. The ICAR project was co-funded in the second phase of the Italian e-government plan for regionals and local authorities, which addresses the establishment of the so-called SPC-SPCoop. Among the others the project aims as following: "to establish the secure interconnection of regional Public Administration networks following the rules of SPC-SPCoop". This gives the opportunity to the Regions to start an innovation and shared process for what concern federate digital identity.

Starting from ICAR project several Italian Regions reviewed their policies and systems for digital identity. As an example we cite Umbria Region where a

platform has been created for the management of authentication, identity and roles from a federated viewpoint among the various bodies of the Region and with a view to inter-regionals connections within the ICAR platform. At the same time the identity provider for the citizens of the Lombardy Region provides the local bodies in Lombardy with a uniform and standardized infrastructure supporting the identification of users when they seek to access the services delivered by the local bodies. All the other Regions are going in similar directions, but for space reason [14], we cannot cite all of them.

In Marche Region digital identity means organize all the preconditions in order to support citizens to be on-line. Marche Region implements a citizens oriented community considering the municipalities, provinces, health organizations, etc. share common technological enablers and organizational process. This means provide to the community digital identification instruments, personal communication tools and authentication framework. The Region adopts a digital identification instrument such as "Carta Raffaello", a Regional Service Card. It is a microchip-based card distributed to citizens living in the Marche Region. It is an ideal authentication tool for e-government and e-health services according to the national standard and the requested security levels. "Carta Raffaello" constitutes not only an electronic identification document, but also a certificate of digital signature for the authentication of electronic documents. It is already distributed to regional citizens via Local Registration Authorities. At the same time Marche Region delivery Certified Electronic Mail (Italian acronym PEC, "Posta Elettronica Certificata") named "Posta Raffaello". It is an e-mail system, which allows dispatching electronic documents that have legal value and which confirms the dispatch and delivery of electronic documents. It supports citizens digital interactions with Public Administrations. For what concern the authentication framework Marche Region proposes FedCohesion resulting from a re-engineering step of the old style Cohesion framework as following presented. The framework integrates several applications. Just to cite a few we refer to:

Dodibox is a framework able to plan, realize and access to on-line form;

Sigfrido refers to the digitalization of the procedures related to European regional development found in order to avoid manual data input for founds assessment;

SIAR aims to introduce common rules and tools for the agricultural community in order to give them the possibility to apply for European Commission founds according to the regional development program;

CoMarche supports public and private employers in the communications with the centre for employment related to new job, extension of work period or firing;

GIUSTO enables on-line communications related to creation, sign, transmission, storage, verification and confirmation of documents submitted by regional employees requesting holidays, temporary absences, etc.

Summing up, Table 1 proposes some data regarding diffusion of digital identity device and services in the Marche Region.

3 Technical Background

Identity Management systems involve at least two types of entity, namely Identity Providers (IdP) and Service Providers (SP). An IdP is an entity in charge of user authentication and of managing all identity relevant information concerning users. An SP, on the other hand, is responsible for the specification and enforcement of the access control policies for the resources it offers. Federated identity management is a set of technologies and processes that let computer systems dynamically distribute identity information and delegate identity tasks across security domains [7].

As a result of the federation, organizations are now able to create identity-based cross-border applications. It can also offer users cross-domains Single Sign-On (SSO), which lets them authenticate once and thereafter gain access to protected cross-boundary resources. With SSO users can use the same authentication credentials for a seamless access to federated services, within one or multiple organizations. The notion of federated identity has been recently extended to include not only users login names, but also user properties, also referred to as user identity attributes.

From a technological point a view there are several standards that support federated identity making administrations partnership-ready [9]. We can cite Microsoft Live ID, Security Assertion Markup Language, Liberty Alliance, Information cards and WS* and OpenID. In particular, SAML defines the user credential (assertions) format that will give to an authority the possibility to assert something regard a subject, without take in consideration the specific authentication methods. The fact that a second authority recognizes or not such assertion depends on the trust with the first one. The standard also defines the protocols to be used to send this assertion, the binding and the profile. It defines also the metadata structure that guarantees trust relationships between federated authorities.

Table 1. Diffusion of digital identity in Marche Region (From 2007 to 2011)

Raffaello Card	
Number of distributed card	45.000
Help desk interactions (in a month)	175
Number of Local Registration Authorities	145
Raffaello Mail	
Diffusion	46.000
Help desk interactions (in a month)	75
Number of Sended PEC	274.000
Number of Received PEC	301.000
FedCohesion	
Number of Users in the Registry	61.000
Number of Integrated Systems	50

4 Cohesion Regional Authentication Framework

Since many time Marche Region supported authentication via a homemade framework named Cohesion. The framework guaranties different levels of security, as following presented.

- Level 1 = User ID and password (identity is based on what the users knows). It is the most common and simple authentication system to administrate, it offers a lot of advantages, for example it does not need special hardware devices but it also presents many disadvantages, the association between the identity of people and authentication data is not guaranteed. Typically, this method is used to trace the activity of the user (profiling) and it grants a low protection level services access.
- Level 2 = User ID, password and personal code (identity is based on what the consumer knows and a further security code). It is an authentication system that has a security level higher than the system above described. In this case, a further security code is assigned to the requester that must use to access the service.
- Level 3 = Smart cards (identity is based on what the consumer own). It is an authentication system based on physical support that guarantee the association between real identity and authentication data into smart cards. The security level can be further increase by a personal code that ensures the person from loss and robbery.

Cohesion provided intra-organization Single Sign-On functionalities and Profiling services. SSO permits regional employees, in a transparent way, to access to the reserved areas of the portals secured by the framework without the needed of authentication every time making authentication credentials and user profiling available to different application domains. Indeed, the user authentication verification is delegated to the Cohesion service; it validates the profile in respect to the access role. Profiling system is dedicate for the coordinated management of information on the users with credentials, logically divided in a static and in a dynamic subsystem, containing a series of attributes able to indicate the preferences of the user when accessing the services rather than informative areas on portals. A part of the attributes that compose the user base profile is requested during the registration in one of the portals, and another part is communicated after explicit request when a service is used.

In term of architecture Cohesion is composed by two main elements (Figure 1): the SSOLibrary, which implements the SP functionalities at service level, and the Cohesion IdP guarantees user authentication exchanging encrypted data with the SSOLibrary using a proprietary exchange protocol. In particular, the IdP have two main modules: Cohesion SSO that takes care of retrieving the user profile and manage the Single Sign-On functionalities, and System Authenticator (SA) that is responsible to check user credentials and authenticate the requester.

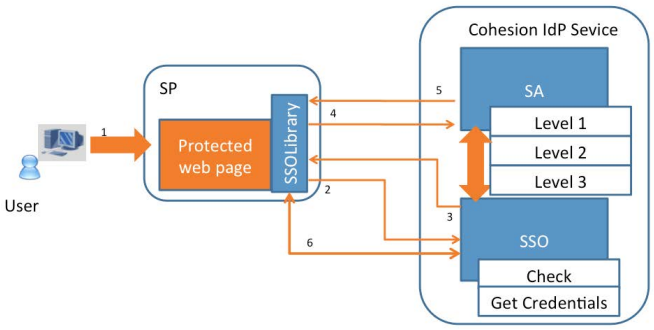

Fig. 1. Cohesion Architecture

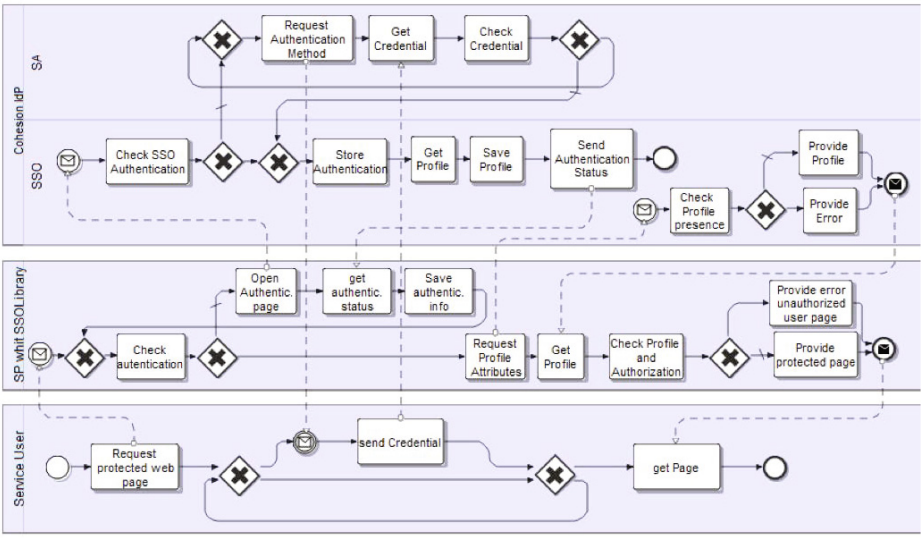

Fig. 2. Cohesion Process using BPMN language

According to such architecture authentication flow is following organized (Figure 2):

1. The user asks for a service secured by Cohesion;
2. The SSOLibrary receives such request and it interacts with SSO in order to check if the user is already authenticated;
3. The SSO gives back to the SSOLibrary the ID session, if the user is already authenticated the process go to the step 6 otherwise go to the step 4;
4. The SSOLibray forwards the authentication request to SA;
5. The SA gives back to the SSOLibray session ID;
6. The SSOLibrary using the session ID asks for credential via a secured channel and obtains it in order to give access to the service.

Even if several advantages are available mainly due to the mature and well tested Cohesion infrastructure, the main disadvantage is the lack of support regarding standards for federation. This is a need for the Marche Region in order to be in the wide community. Cohesion does not rely on SAML neither on other standards for federation, rather than it guarantees Single Sign On functionalities through an ad hoc flow secured by Microsoft Web Services Enhancement. The proposed scenario gives the ground to a re-engineering resulting in the FedCohesion framework as following described.

5 From Cohesion to FedCohesion

During the years Marche Region have made substantial investment on Cohesion framework so the choice of re-engineer prevailed over substitution with others framework SAML 2.0 compatible like Shibboleth [15] [16]. The main objective of the re-engineering step was moving from a legacy system to the SAML based [13] in order to support federation. It is important to underline that the upgrade to the standard SAML was made starting from zero, based on the standard XSD definition, without rely over existing commercial or open solutions. Resulting architecture is show in Figure 3.

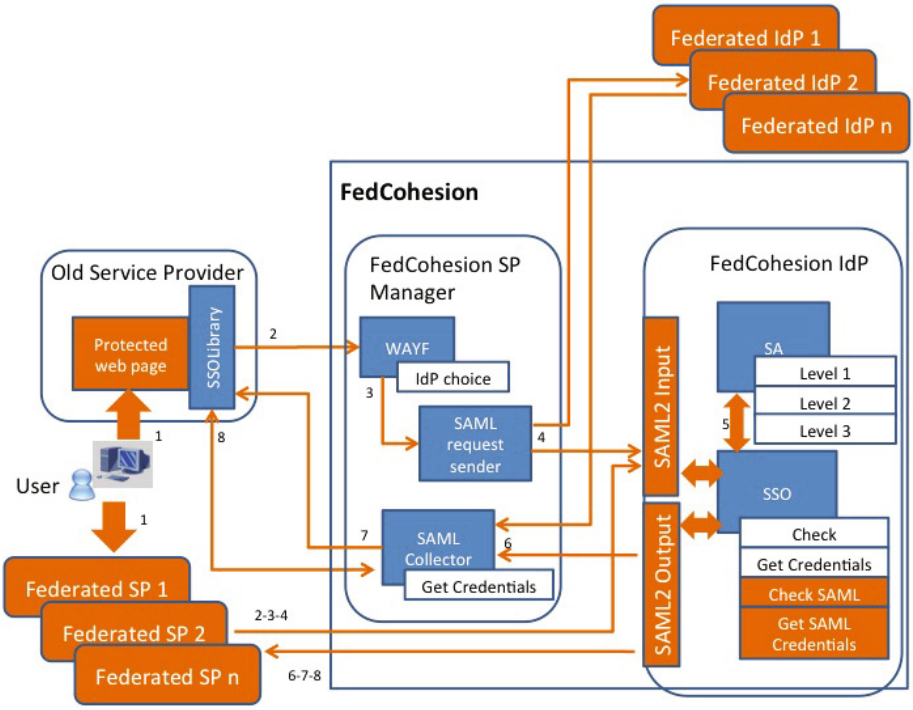

Fig. 3. FedCohesion Architecture

From an architectural point of view starting from a feasibility study, we realize that the easiest solution is propose a new SSOLibrary in order to support SAML standard and add two modules at the site of IdP to manage SAML requests and responses. Such ideal scenario fails if we consider backward compatibility. With this solution every service provider has to reinstall and reconfigure the SSOLibrary, so we decide to review the solution.

To reach the federation objective and be in line with regional requirements we decide to design and develop a module to centrally manage the old Service Providers that integrates the SSOLibrary and introduces specifics components to support SAML requests and responses. This module implements decoupling functionalities between the old Service Provider and the novel SAML based Fed-Cohesion IdP. The SAML collector converts IdP SAML response in the format supported by SSOLibray. Moreover to made the SSOLibrary ablest to work with the new environment we have replicated, in the Service Provider Manager, some interfaces already available in the Cohesion IdP such as Get Credentials functionality. The SAML request sender converts input requests from SP to SAML format. In order to fully and properly support functionalities, metadata are created for each component (IdP and Service Provider Manager). We also introduce ad hoc input-output interfaces for FedChoesion IdP. They are able to manage SAML input requests, convert them to the format internally recognized, and give back the user profile in the SAML response format. In particular, we have implemented Single Sign-On and Single Log-Out Protocols as part of the SAML Core standard.

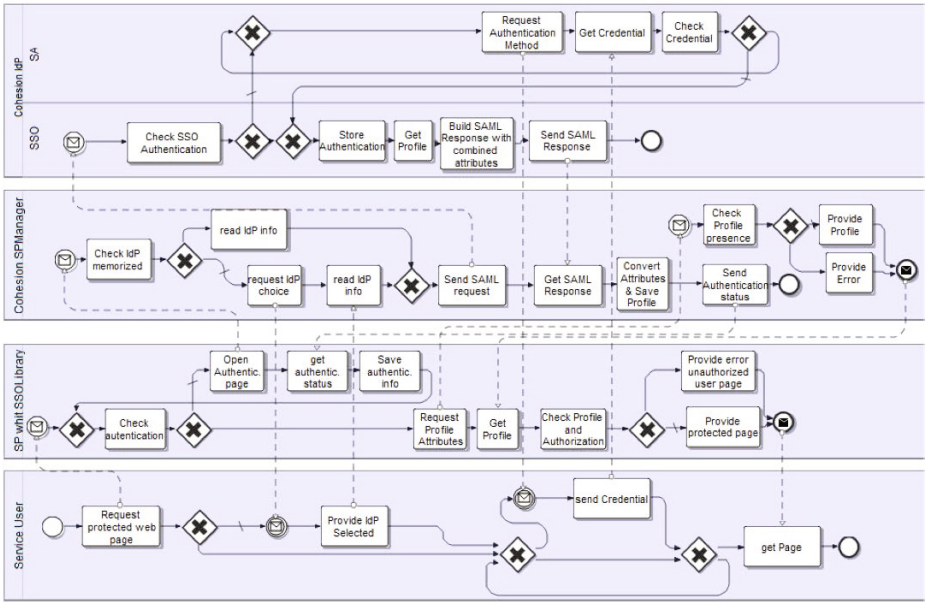

Fig. 4. FedCohesion Process using BPMN language

According to such architecture authentication flow is organized as following (Figure 4):

1. The user asks for a service secured by FedCohesion;
2. The SSOLibrary forward the request to the "Where are you from?" page where the user chose the IdP suitablest to authenticate him/her;
3. The "Where are you from?" page gives the control to the SAML manager that creates a SAML request and send it to the IdP;
4. If the IdP chosen by the user is FedCohesion him/her is redirect to the SAML request control page and SSO evaluate if session ID;
5. If session ID is available the process go to the step 7;
6. The control is redirected to SA where the user can choose a way to authenticate him/her;
7. SA gives the control to SSO that register the authenticated user and gives back the SAML response to the SAML Collector module that evaluates the response and if it is correct convert the credential into the SSOLibray compatible format;
8. SAMLCollector sends to SSOLibrary the session ID and call GetCredential functionalities;
9. The SSOLibray calls back the functionality GetCredential and it obtains the credentials, so that the user is authenticated and he/she can access service.

As already mentioned the proposed solution makes transparent to old service providers the re-engineered result. Thanks to the centralized metadata configuration all the old service providers can take advantage of the new functionalities, like federation, still using the old SSOLibrary. As a consequence the Service Provider Manager acts on behalf of such old service provider. So, every Service Provider that communicates with the Service Provider Manager must be registered and authorized by the Region that plays the role of technological intermediary and administrator respects to the authentication system governance.

In order to recognize and authorize external authorities in the community, both the IdP and the Service Provider Manager in FedCohesion share a common metadata where all the information regarding the federation is placed. As an affect if we add one more IdP, it will appear in the "Where Are You From?" page where the user asking for a resource can choose the federated authority suitable to support his/her authentication.

In order to be consistent respects to future development a novel version of SSOLibray is also available it works over SAML standard implementing the same core protocol used in the Service Provider Manager. Also in this case federation management is centralized with distributed metadata management for each SP.

6 Federations into Practice

FedCohesion represents an opportunity for PAs in the Marche Region, it can be reused by all the PA and make federation a reality in the Marche community as an authentication framework based on strict legal bases. The framework serves

82.247 citizens interacting with PAs for different services. FedCohesion functionalities have been successfully tested with well know Italian federations: IDEntity Management (IDEM) of the GARR network and INF3 federation of the Italian National Region resulting from the national ICAR project.

IDEM is an Italian federation born mainly to give professors, students and researchers a single way to access services provided by academics authorities. Many Italian universities have taken part as other research institutes, becoming one of the biggest Italian federation. Thanks to the close relationship between Marche Region and University of Camerino we decide to start such process and we conclude successfully compatibility tests. To pass the test FedCohesion profile attributes where update in order to support *LDAPv3*, *Cosine*, *inetOrgperson*, *eduPerson* attributes.

The INF3 task of ICAR project was born to add federation support for the other tasks INF1 and INF2 about applicative cooperation. It introduces in the authentication framework the concept of portfolio that is a SAML ready attribute manager, logically places between the IdP and the SP. This give the user the possibility to choose which attributes, obtained from IdP, want to send to SP and merge attribute obtained from different IdP, in a single SAML assertion. This gives the user the possibility to protect their privacy (the user know what info he share) and reduce redundant user data over different IdPs (the user attribute is present only on the authority that can certify this attribute). To made this functionalities work in FedCohesion we have integrated the INF3 software component in order to act as SP from the point of view of FedCohesion IdP and as IdP from the point of view of the FedCohesion SP. So when the users call a service protected by FedCohesion it will be forwarded to this component, than to the IdP, then back again to this component and finally to the SP that will authorize or not the user to access the resource.

7 Conclusion and Future Work

In this paper we present the experience of the Marche Region for what concern federate identity management. The solution presents several advantages. On one site it reduces the wide phenomenon of identity proliferation implementing the sharing principle. On the other site it enables interoperability among administrations in the Marche Region and it supports cross-administrations service delivery. Moreover it opens the ground to wide federations both at Italian and European level.

In the future we are planning to maintain and evolve the current version of FedCohesion improving its adoption. A comparative study made with Shibboleth the de facto standard architecture for the SAML protocol show some areas of improvement in our framework. Full support of SAML protocols is analysed and planned with reference to attribute authority and SOAP binding. The integration with INF3 software component shows overlapping functionalities with the service Provider Manager. Both have a decoupling function and we intend to join and implement all the INF3 functionalities directly in FedCohesion Service Provider Manager Module.

Finally, in the last years we recognize an increasing practice in the use of social network credential to access different kind of services provided by different entities. As an example we cite that using Google or Facebook credentials is it possible to access a lot of service. In the next future this could be a reality also for PA services in the Marche Region community thanks to the capabilities of FedCohesion. This may contribute to close the gab between availability and use of e-government services. As matter of fact, even if they are developed and provided using up-to-date technologies, they are not so widely used by citizens. Many official European Union statistics, such as those provided by Eurostat, generally testify such a situation. On the other site there is a wide diffusion social network among citizens. Citing some Facebook data as an example, after 7 years from its creation 600 millions are the users registered in the social network all over the world. In Italy the users registered in Facebook are 18 million versus 25 million that are the Italian Internet users. So we believe that the integration between e-government and social network could be a way for PA to be as close as possible to the citizens.

References

1. Communication from the commission to the European Parliament, the Council, t.E.E.: Europe 2020: A european strategy for smart, sustainable and inclusive growth. Technical report, European Commission, Brussels (2010)
2. Communication from the commission to the European Parliament, the Council, t.E.E., Committee, S., the Committee of the Region: A digital agenda for europe. Technical Report 245, European Commission, Brussels (2010)
3. Communication from the commission to the European Parliament, the Council, t.E.E., Committee, S., the Committee of the Region: Delivering an area of freedom, security and justice for europe's citizens action plan implementing the stockholm programme. Technical Report 171, European Commission, Brussels (2010)
4. Reddick, C.G.: Management support and information security: an empirical study of texas state agencies in the USA. EG 6(4), 361–377 (2009)
5. European Commission: European Interoperability Framework (EIF) Towards Interoperability for European Public Services (2011)
6. Lips, M., Pang, C.: Federated identity management systems in e-government: the case of italy. Technical report, Victoria University of Wellington (2008)
7. Maler, E., Reed, D.: The venn of identity: Options and issues in federated identity management. IEEE Security & Privacy 6(2), 16–23 (2008)
8. Fioravanti, F., Nardelli, E.: Identity management for e-government services. In: Digital Government. Integrated Series in Information Systems, vol. 17, pp. 331–352. Springer, US (2008)
9. Baldoni, R.: Federated identity management systems in e-government: the case of Italy. Electronic Government (2012)
10. Baldoni, R., Fuligni, S., Mecella, M., Tortorelli, F.: The Italian e-Government Service Oriented Architecture: Strategic Vision and Technical Solutions. In: Proc. of 6th International EGov. Conference, pp. 79–88 (2007)
11. Baldoni, R., Fuligni, S., Mecella, M., Tortorelli, F.: The Italian *e*-Government Enterprise Architecture: A Comprehensive Introduction with Focus on the SLA Issue. In: Nanya, T., Maruyama, F., Pataricza, A., Malek, M. (eds.) ISAS 2008. LNCS, vol. 5017, pp. 1–12. Springer, Heidelberg (2008)

12. Uyarra, E.: What is evolutionary about 'regional systems of innovation'? implications for regional policy. Journal of Evolutionary Economics 20, 115–137 (2010), doi:10.1007/s00191-009-0135-y
13. OASIS: Security assertion markup language, SAML (2002)
14. ForumPA, CISIS: RIIR rapporto sull'innovazione nell'italia delle regioni 2010 (2010)
15. Pfitzmann, B., Waidner, M.: Federated identity-management protocols. In: Security Protocols Workshop, pp. 153–174 (2003)
16. Morgan, R., Cantor, S., Carmody, S., Hoehn, W.: Federated security: The shibboleth approach. EDUCAUSE Quarterly 27(4) (2004)

Livelock and Deadlock Detection for PA Inter-organizational Business Processes

Damiano Falcioni, Andrea Polini, Alberto Polzonetti, and Barbara Re

Computer Science Division
School of Science and Technologies
University of Camerino
62032 – Camerino (MC), Italy
{damiano.falcioni,andrea.polini,alberto.polzonetti,barbara.re}@unicam.it

Abstract. The Public Administration domain is characterized by the dominance of inter-organizational Business Processes. These are a set of interrelated and sequential activities shared and executed by two or more Public Administration officies to achieve a business objective that is of value to citizens or companies in term of services. A Business Process results from the un-trivial integration of internal administration processes, so that structural problems such as livelock or deadlock may easily occur and in reality they are generally solved by involved civil servants. Nevertheless with the shift versus an electronic government this problem becomes particularly relevant. The paper presents a suitable approach for inter-organizational Business Process detection of livelock and deadlock situations. In particular, we introduce an approach to directly verify a Business Process modeled using the BPMN 2.0 semi-formal notation. The verification uses a state evaluation technique with an optimized unfolding algorithm considering specific BPMN 2.0 characteristics. A plug-in for the Eclipse platform has been also developed, which permits to have an integrated environment in which to design Business Process, using the Eclipse BPMN 2.0 Modeler, and to automatically verify it. The approach and the tool prototype have been successfully applied to real scenarios such as family reunion, grant citizenship and buoncer registration.

1 Introduction

Due to the maturity of the European Interoperability Framework [1] and its adoptions in European member states we realize that one of the main challenge in Public Administration (PA) is to cope with large collections of interconnected Business Processes (BPs). Technical and organizational interoperability should be embedded in the design of e-government information system. This is a problem both at national level, where different Public Administrations have to cooperate in order to provide a service, and at European level, where the development and improvement of cross-border e-government services have to become a reality according to the EU Ministerial Declaration on e-government [2] as well as to the

A. Kő et al. (Eds.): EGOVIS/EDEM 2012, LNCS 7452, pp. 125–139, 2012.

European Digital Agenda that, among the different objectives, aims at creating one single market in Europe [3].

According to the proposed motivational scenario, and mainly focusing on organization interoperability, we believe that Business Processes modeling and analysis gain more and more importance facing with the need of efficient and effective definition of inter-organizationals Business Processes. Conventional Business Process Management (BPM) research mainly dealt with intra-organization processes that in most of the cases are isolated. Even if value chains and boundary phenomenon have already been studied, collaboration in the context of BPM is still a topic under growing research and so far little research has examined the implication of boundary blurring BPs [4].

Now the challenge is to move toward an open environment [5] where large organizations, such as the Public Administration, have hundreds of BPs in place. Inter-organizationals BPs result from the un-trivial integration of internal organization processes, so that structural problems such as deadlock and livelock may occur. We believe that formal methods and in particular verification can find a interesting application field, in order to make PA more effective and efficient.

In this paper we present an approach for formal verification of PA inter-organizational BPs. The approach uses state evaluation techniques with an optimized unfolding algorithm based on BPMN 2.0 specific semantic. In this way after BP modelling using BPMN 2.0 the analyst can run our algorithm to check if the BP includes bad traces. In such a case he/she can re-engineer the BP in order to remove the bad traces so to have an improved BP.

A plug-in for the Eclipse platform has been developed. It permits to have an integrated environment in which to design Business Processes, using Eclipse BPMN 2.0 Modeler, and to automatically verify the process model via the proposed algorithm. The approach and the prototype have been successfully applied to real scenarios thanks to a close collaboration with local PA offices, with encouraging results. In particular, we report here the three cases studies: (i) family reunion, (ii) grant citizenship, and (iii) bouncer registration, which have been the subjects of our investigations.

The rest of the paper is organized as follows. The next Section presents background information, whereas Section 3 introduces the verification approach we propose. Section 4 presents the case studies and Section 5 describes the results obtained from the conducted experiments. Concluding remarks and opportunities for future developments are discussed at the end of the paper.

2 Background

2.1 Process Modelling

Technically public service related processes can be modelled and implemented using notations and tools based on the BP concept.

> "*A BP is a collection of related and structured activities undertaken by one or more organizations in order to pursue some particular goal.*

> *Within an organization a BP results in the provisioning of services or in the production of goods for internal or external stakeholders. Moreover BPs are often interrelated since the execution of a BP often results in the activation of related BPs within the same or other organizations*". [6]

In addition to the BP concept collaborative BP represents an issue in order to reach the suitable point of view able to represent the right abstraction level [7]. Recent works show that BP modelling has been identified as a fundamental phase in BPM. The quality of BPs resulting from the BP modelling phase is critical for the success of an organization. Its importance exponentially grows in order to support inter-organizational processes and related service delivery. Different classes of languages to express BPs have been investigated and defined. There are general purpose and standardized languages, such as the BPMN 2.0 [8] or the Event-Driven Process Chain [9] and many others. There are also more academic related languages, being the Yet Another Work-flow Language [10] the most prominent example.

In our work we refer to BPMN 2.0 [8] an Object Management Group (OMG) standard. This is certainly the most used language in practical contexts also given its intuitive graphical notation. We mainly use collaboration and conversation diagrams in order to have a complete representation both of internal process as well as of the message exchange.

2.2 Formal Verification

In the context of software systems, formal verification is the act of proving or disproving the correctness of a system with respect to a given formal specification or properties, using methods based on sound mathematical tools. Many different formal approaches can be applied to systems verification. Some studies have been reported on the application of formal methods in e-government [11] in order to analyse Business Processes. Standard approaches mainly refer to two main categories referring model checker for petri nets and process algebra, so there is the case that dedicate mapping has to be implemented in order to make formal verification accessible to the wide audience and integrated in the whole BPM life-cycle. The mapping mainly results with constraints on the process model and expressibility that can be represented during the modelling phase can be reduced due to the semantic of the target language. For instance, using BPMN 2.0 as modelling language if we consider petri-net as target language could happen that information about pools are lost. On the other side if we use process algebra as target language syncronization is a must also in the case it is not strictly needed, in fact using sequential step instead of synchronization inside a process we cannot map cycles. Common problem is state explosion [12].

In our work we propose a BP verification technique based on an optimized unfolding algorithm taking advantage of the specific BPMN2.0 semantic. In such a way we avoid problems resulting from the application of a mapping to a formal language. In order to avoid state explosion phenomenon the proposed optimization bound the branching with reference to exclusive gateway.

2.3 Unfolding

Unfolding is a technique of partial order reduction. It is widely applied to Petri Nets and Process Algebra in order to reduce state explosion problems during verification. Unfolding has proved to be very performant mainly on deadlock detection. It is based on the concept that some decidability problems can be reduced to reachability problems (proved to be decidable in many research works like [13]). In order to solve the problem, a prefix of the model is built with the objective to cover all the reachable states.

Unfolding of a model can in fact be infinite, but McMillan [14] identified the possibility of building a finite prefix of the net which could give us enough information to solve several problems. This is made ending the prefix in a specific point called "*cut-off*".

The concept of configuration is introduced, it is used to identify the current status of the model referred to a specific path, during the unfolding. So the key to terminate the unfolding is to identify configurations states acting as cut-off points. This must have the following property: any configuration containing a cut-off point must be equivalent (in terms of final state) to some configurations containing no cut-off points. From this definition, it follows that any successor of a cut-off point can be safely omitted in the unfolded model, without sacrificing any reachable state of the original model. This means that a cut-off point is reached in a configuration only when the current final state of the configuration is already present in the same configuration as previous state. So this current final state is our cut-off point. If we do not stop the prefix of the unfolded model in this cut-off point, we are sure that this state will infinitely happen again in the future because it has already happened once in the past.

Once the prefix has been constructed, the deadlock detection problem is reduced to a graph problem. This problem is NP-complete as shown by [14]. However this problem is readily solved in practice even for very large unfoldings. Problems, such as liveness and deadlock-freeness, in fact, are recursively equivalent to reachability, so that they are also decidable [15]. Approaches are also proposed in literature to verify temporal logics through unfolding [16].

There are several facts that are worth mentioning about the unfolding. The first is that the unfolding is an acyclic graph, defining a partial order on its nodes. Second, branching occur naturally in the structure where actual choice occurs (total order perform unneeded choice on unrelated transitions). The advantage is that we can explore the state space of concurrent systems without considering all possible interleaving of concurrent events. This became particularly significant if in the model there is a cycle.

In this work we base our verification approach on an optimized unfolding algorithm that exploits advantages provided by the use of BPMN 2.0. In particular, we reduce the state explosion problem reducing the interleaving between BPMN 2.0 elements, in a way that:

– Synchronizations happen only on parallel gateway in a pool and messages exchange between pools;
– Branching in the configuration tree happens only with reference to exclusive gateway.

The following section provides further details on the approach.

3 Proposed Approach

The approach we have defined supports Java oriented verification on BPMN 2.0 collaboration models. Starting from the results of a BP design phase we explore the model and we identify paths from BPMN 2.0 start events reaching a termination condition. Path definitions rely on synchronization and branching rules that are affected by the semi-formal semantic of the following BPMN 2.0 elements: pool, sending and receiving tasks, and parallel and exclusive gateways.

As already mentioned, in the collaboration diagram each pool encapsulates all the private process elements and a pool can interact via message exchanges with other participants. The approach we propose uses such encapsulation in order to eliminate interleaving among the elements in different pools that do not require synchronization. Synchronization is needed just for those tasks and events receiving or sending a message. Moreover, synchronization is observed in a pool for parallel gateways with references to input flows. Exploring the BP model, branching occurs only with reference to exclusive gateway. This give us the possibility to explore alternative paths. The specific characteristics of BPMN 2.0 elements suggests to conceive an optimization of the McMillan unfolding algorithm [14] specifically adapted to work on BPMN 2.0. In order to do that, we reviewed keys concepts such as configuration and cut-off points in a BPMN 2.0 context.

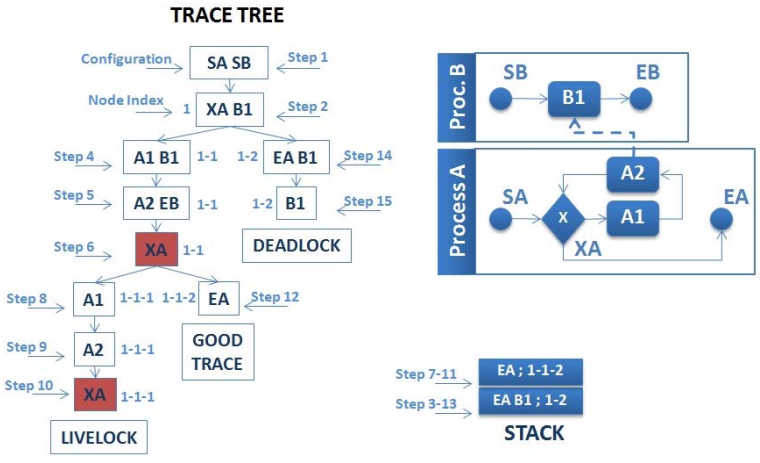

Fig. 1. Running Example

In Figure 1 we report a simple BPMN 2.0 collaboration model in order to make clear to the reader relevant aspects of the approach we propose. The BP is composed by two participants (pools) that exchange a message, the participant A internally decides how to behave according to the evaluation of the choice statement.

3.1 Configuration Definition

A configuration represents a possible partial run of the BP model under study. It is used to identify its current status during the execution of the unfolding algorithm. In Petri Nets the configuration contains the marked transitions. With reference to our approach a configuration refers to a specific path in the BP model. It differs from Petri Nets because in our case configuration contains all the activated BPMN 2.0 elements included in the collaboration diagram and their status.

In our approach all the configurations are stored in a tree structure. This is inspired from the coverability tree for Petri Nets introduced by Karp and Miller [17]. The coverability tree is an abstraction of the reachability tree which is precise enough to decide some important problems like coverability, boundedness and place boundedness problems for Petri Nets, and that were shown to be decidable [17]. Each node of the tree contains the BPMN 2.0 elements in the collaboration diagram that are currently active in term of diagram exploration.

Moreover, the application of unfolding algorithm in BPMN 2.0 satisfies the following conditions:

- If an element is in the configuration, then all of its ancestors are in the configuration too (a configuration is downward closed);
- A configuration can not contains two BPMN 2.0 elements in conflict, meaning that both are inputs from the same exclusive gateway.

The status of the BPMN 2.0 element is mainly relevant for what concerns those tasks sending and receiving messages. In particular, we accept as valid only those messages coming from tasks sending or receiving messages from an ancestor node in the configuration. We choose to evaluate such status at run-time instead of saving it in the configuration tree, in order to reduce memory consumption. As an example we refer to the steps 9 and 15 of the BPMN 2.0 exploration in Figure 1. During step 9 a message is sent from A2 task to B1 task, but it is never consumed because the task B1 has been already executed. As an effect during the backtracking (in step 13) B1 has a message that could be consumed but such messages do not come from an ancestor node of the current execution status so that such message is invalid and the B1 task remains blocked.

In order to correctly do the backtracking activities and complete the exploration of the tree we use a stack. It contains the tree nodes that have to be reloaded during backtracking and the index of the tree structure referring to the position in the tree of such nodes. The index is in the form *1-n-n-…-f*, parsed from left to right, where:

- *1* represents the root node and all the following nodes that do not split the tree;
- - separates between splitting nodes;
- n is a number representing the following node chosen from the current one and it includes all the following nodes after that choice till the next one;
- f represents the last branching node index and it is the same for all the following node until the path is ended.

This index structure makes easy the run-time evaluation regarding messages synchronization is particularly useful when there are messages sent from a task in an ancestor node of the configuration.

3.2 Livelock Identification (Cutoff Points)

The approach we propose exploits the configuration tree in order to find out cut-off points to identify livelock situations. A path is in livelock iff the current node is already observed during the exploration phase in one ancestor node of the configuration tree. In the case there are not cycles in the BP model then it is obvious that cutoff points can not be observed. In the configuration tree in Figure 1 the node referring step 10 is an example of cutoff point. As matter of fact the node involves the element XA and it is already observed in the ancestor node with reference to step 6.

3.3 Deadlock Identification

The approach follows the BPMN 2.0 termination paradigm in order to find out a deadlock. In BPMN 2.0 a BP terminates when end or termination events are reached during the process. The approach we propose adapts the unfolding algorithm in order to remove end events from the configuration each time they occur. The path results in deadklock iff in the current configuration there are only blocked elements (i.e. task or events waiting a message and parallel gateway waiting incoming flow that will never arrive). In the example in Figure 1 we observe a deadlock in step 13 when after backtracking, due to the gateway XA, the end event EA is reached and it is removed and the task B1 is blocked waiting for a message that will never arrive.

3.4 Good Trace Identification

The application of the approach returns with a good path when removing all the end events from the configuration then the tree node results to be empty. A node can be also emptied if a termination end event occurs. This means that the path is good and the process execution will stop correctly.

3.5 Prototype Implementation

The approach we propose is supported by a plug-in for the Eclipse platform permitting to have an integrated environment in which to design and verify BP models. The plug-in architecture is shown in Figure 2.

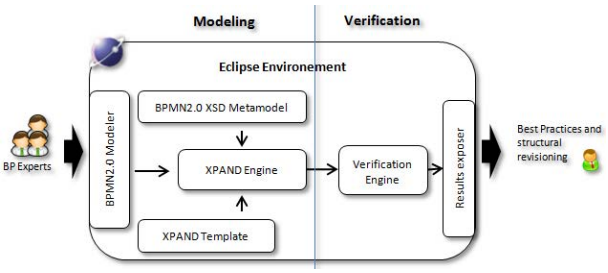

Fig. 2. Tool Architecture

The plug-in integrates the Eclipse BPMN 2.0 SOA Modeller[1] and is built over the BPMN 2.0 meta-model defined using the Eclipse Modeling Framework (EMF)[2], which has been defined respecting the official XSD schema for the standard.

The plug-in also integrates the XPAND[3] Eclipse engine. This is a language specialized for code generation which is based on EMF models and on the definition of transformation templates. This means that we are able to directly generate Java artefacts starting from a BPMN 2.0 model. The templates specifies what to do when a given graphical element of the BPMN 2.0 notation is found in defined BP model. Thanks to the XPAND engine the Java model of the Business Process is returned in output, so that it is possible to successively manage the model as Java objects. Verification runs on such a model implementing the algorithm. This is supported by the verification engine that gives back information about deadlocked, livelocked and good traces in textual way. Information about number of nodes checked, memory and time used are also shown. The engine has been built trying to minimize memory consumption and algorithm efficiency so that the Java Virtual Machine (JVM) interpretation process maximize performances.

The developed prototype can be downloaded from the repository hosted by Sourceforge[4].

4 Case Studies

The work we present refers to three real case studies concerning PA provided services. All of them are examples of inter-organizational BPs with several interactions between PAs. In particular, the considered services are:

– ***Family reunion*** – this is a service available for people legally residing in Italy which can apply on behalf of their relatives (spouse, depending parents,

[1] `http://www.eclipse.org/bpmn2-modeler/`
[2] `http://wiki.eclipse.org/MDT-BPMN2`
[3] `http://wiki.eclipse.org/Xpand`
[4] `https://sourceforge.net/projects/cowslip`

children less than 18 years old) for the purpose of family reunion and only after having provided evidence of their status with respect to "sufficient" incomes and a permanent address.

- ***Grant citizenship*** – this is a service used to ask for Italian citizenship by a foreigner or stateless person who has married to an Italian citizen or who is continuously residing in Italy for more then ten years.

- ***Bouncer registration*** – this is a service used to register bouncers in order to carry on their activity within public places.

The first and the second services require complex and inter-organizationals BPs and they are in place for several years now, therefore can be considered deeply tested. To give a quantitative indication in 2010 the Prefecture of Ancona (the capital city of Marche Region, in Italy) received 469 applications for family reunion and 760 applications for granting citizenship. For what concerns the bouncer registration service, even if it presents a simpler scenario, we choose it because its deployment is still on-going. We had the opportunity then to intervene and contribute to its development. In the following we provide a general description of each service, as they have been initially described by domain experts in the form of scenario specifications.

4.1 Family Reunion

The family reunion service is based on the principle of "family unity". In 1986 the first immigration law was promulgated in Italy as a result of the large number of applications submitted by foreigners in order to be reunite with their relatives. The Law went through several changes before the current version. The latest changes have been made by the legislative decree of 3 October 2008, n. 160 and then by Law 15 July 2009 n. 94 named "Measures for public safety".

Several participants are involved in the delivery of this service. The beneficiaries are both the foreigner, which applies for family reunion (or a patronage that acts on his/her behalf), and the family member to be reunited. The different PAs involved in the service delivery are following presented.

- The prefecture is the main driver of the process, on behalf of the Department for Civil Liberties and Immigration of the Ministry of Interior according to the geographical location of the applicant.
- The Police headquarters is in charge of public security controls and they give opinions on the feasibility of the application.
- The Italian authorities abroad (consulate or embassy) are responsible for verifying the subjective requirements.
- The Ministry of Foreign Affairs communicates the results of the procedure to the Italian authorities located in the state of the requesting beneficiary.
- The Ministry of Finance is in charge of releasing the fiscal code for the incoming relative.

To support the process the Department for Civil Liberties and Immigration of the Ministry of Interior desing and deployed a "one stop shop" service for immigration, named SPI. All the 106 Italian prefectures can access and use the system, which permits to the beneficiaries to electronically apply and verify the status of the requests, via a secured access.

The main steps of the BP supported by the SPI are as following descibed.

1. The BP starts with a reunion application done by beneficiaries living in Italy using a downloadable software client freely available after registration.
2. The application is managed by the SPI and assigned to a prefecture that asks, for public safety constraints, to the Police Headquarters and than invites the beneficiary to the Prefecture in order to check her/his status. Both the opinions from police and Prefecture may be cause of application rejection. Otherwise in case of acceptance the Ministry of Foreign Affairs provides the go-ahead ("nulla osta").
3. After the release of the "nulla-osta" the relative that has to be reunited goes to the Italian consulate or embassy in her/his country, and proving some specific requirements asks or VISA in order to be admitted in Italy.
4. Once in Italy the foreigner must go (within 8 days) to the Prefecture in order to register his/her arrival in Italy, to receive the fiscal code, thanks to the interaction with the Ministry of Finance, and to finally obtain the residence permit.

4.2 Grant Citizenship

Grant citizenship is a service to be used by foreigners and stateless persons to ask for Italian citizenship. The first regulation is the Law of 13 June 1912, n. 555 implementing the concept of family relationships assigning a position of absolute pre-eminence of the husband respect to his wife, at that time commonly recognized. After several law evolutions we can state as following. The primary mode of acquisition of citizenship is by birth. With the law n. 91 5/2/1992 is upheld the principle of "ius sanguinis". At the same time, taking into account the strong migration occurred in our country, people can obtain Italian citizenship for marriage or after long residence.

Several participants are involved in such service. The beneficiary is the foreigner which applies for Italian citizenship and the providers are the different Public Administrations involved in the service delivery as following.

- The Prefecture, on behalf of the Department for Civil Liberties and Immigration of the Ministry of Interior according to the geographical location of the request, is the main actor and drives the process, receiving the request, checking the requirements and giving the opinion.
- The Ministry of Interior receives electronically the request and the documentation, checks them, valuates the instance and took the final decision;
- The Municipality officiates to the new citizen sworn;
- The Ministry of Foreign Affair, Police headquarters, Ministry of Justice and public security offices such as Information Agency and External Security (AISE), Information Agency and Internal Security (AISI), give their opinions on the application.

In order to support the process the Department for Civil Liberties and Immigration of the Ministry of Interior decided to develop an electronic system, named SICITT. It is suitable to manage requests and documentations for granting citizenship. SICITT satisfies the needs of the Ministry of Interior to communicate with other offices involved in the process of grant citizenship mainly to obtain the opinions. It is in use in all the Prefectures and in almost every police-headquarters.

The main steps of the BP are described in the following.

1. The process starts with a request done by the foreigner by ordinary mail or delivered by hand to the Prefecture. The SICITT foresees that an employee uploads the request.
2. Document verification is the second step, and the following conditions could occur.
   a) The prefecture asks to complete the documentation in the case some documents are missing. Then the applicant has to produce and delivery the required documents to the Prefecture, otherwise the citizenship office begins the procedure for instance rejection.
   b) The prefecture notifies the begin of the rejected procedure if some requirements are not satisfied. In 30 days the applicant has to solve such condition otherwise the request will be classified as inadmissible.
3. On the other side when the documentation is complete and all the requirements are satisfied the following steps are completed.
   – The request inserted in SICITT becomes visible to the police-headquarters that checks the lack of impediments, and then expresses an opinion. If the Prefecture does not receive the police-headquarters opinion in 6 months, it solicits the office.
   – Only after receiving the opinion of the police-headquarters, the Prefecture sends its opinion to the Ministry of Interior. Contemporary to the receipt of the application to the Ministry of Interior, the SICITT automatically sends a request of information to other offices: AISE, AISI, Ministry of Justice (criminal record), MAE and to the department of the anticrime police.
   – Only after receiving all the opinions, the Ministry of Interior verifies the instance and it can decide to:
     a) Ask for an integration of the documents;
     b) Start the procedure for the rejection of the instance;
     c) Confirm grant citizenship.

     Any final decision is sent to the Prefecture that is in charge to notify the applicant about the decision.
   – In case of confirmation, the Prefecture asks to the municipality to call the applicant for the oath. Only after applicant sworn the process is closed.

4.3 Bouncer Registration

The bouncer is a person employed by a cinema, recreation ground, nightclub or similar establishment to prevent troublemakers from entering or to reject them

from the premises. In Italy, a national registry has been created according to the Ministry of Interior decree of 6 October 2009 and all the Italian bouncers have to satisfy specific requirements and then be registered in the registry.

Several participants are involved in the provisioning of such a service. The beneficiaries are the managers of public place or vigilance institute that do the request, and the bouncer who will be registered in the list. The providers are the different Public Administrations involved in the service delivery as following.

- Prefecture, on behalf of the Department of Public Security of the Ministry of Interior according to the geographical location of the place, has to receive the request and decides for granting or rejecting decree;
- The Police headquarters and several police departments such as Police anti-crime, General Investigation division and Special Operation (Italian acronym DIGOS) that give their opinions.

To guarantee the process the Department of Public Security of the Ministry of Interior is developing an application, named BTF, to electronically manage the requests of inscription in the bouncers registry. Up to now the BTF is going to be used by all the Prefectures and the police-headquarters, but it is expected that in a second phase it will support a fully interactive service.

1. The process starts with a request delivered by hand or by ordinary mail, from a manager of a public place or of a vigilance institute, to the Prefecture in charge to manage it. The request is successively uploaded into the BTF manually by the PA employee.
2. The Prefecture proceeds with the documents verification, it may happen that the documentation is incomplete. In this case it asks for integration to the applicant.
3. When the documentation is complete, the Prefecture analyzes it and then waits for the opinion from the police-headquarters that has to come within two weeks. If the Prefecture does not receive the opinion, it has to solicit the police-headquarters.
4. Before giving the opinion, the police-headquarters asks to other police offices, Police anti-crime and DIGOS, for receiving more information about the bouncer.
5. After receiving all the opinions from all the police-headquarters, the Prefecture decides the instance. If it is positive the inscription in the list of bouncers is authorized, otherwise the request is rejected.

4.4 Process Modeling

For each process we developed a BPMN 2.0 specification both conversation and collaboration diagrams. We do not report the diagrams here given their graphical complexity and consequently required space. Neverthless to give an idea of their complexity Table 1 reports the number of instances which are included in the different BPs for each different class of BPMN 2.0 constructs. It is easy to imagine that the high complexity of such BPs hinders their manual manipulation. Instead it is necessary to develop automatic techniques permitting to verify if unwanted situations (deadlock and livelock in our case) could emerge.

Table 1. Model Complexity and Experimental Results

Service	Pools	Activities	Message Flow	Execution Time (min)	Nodes in the Tree	Dead.	Live.	Good traces
Family reunion	8	131	36	30	253	40	8	0
Grant Citizen.	11	168	62	17	123	18	21	15
Buoncer Reg.	6	40	17	6	187	25	24	1

5 Experimentation

As for any approach using verification techniques it is important to check whether the state explosion phenomenon could hinder its applicability to real case studies. In our case we experimented with the three real processes discussed in the previous section. For all the considered processes relatively small state sets were generated. In particular, the experiments we have conducted using a desktop PC equipped with a Core 2 Duo 2,20GHz and 4GB RAM, have highlighted that defined BP can be checked with respect to the properties included in the framework in less than 30 minutes, for the most complex BP scenario. Moreover the most complex BP generated a state space of around 253 nodes in the tree for a total of around possible 48 executions paths explored. This data seems to support the idea that in the current status (i.e., complexity of BP in the e-government domain, mapping we have defined and quality properties to be checked) the approach is applicable in real scenarios and can be a useful support for BP designers. In Table 1 we report also the data resulting from the conducted experiments.

The application of our approach and has been really useful to avoid design error resulting from the complexity of the considered PA scenarios. In particular we were able to highlight several issues with the defined BP with respect to messages exchange.

As could be expected the main issues are hidden within exceptional behaviours. An interesting result refers to the fact that similar "bad traces" could be observed within different BP specifications. This could lead to the identification of a list of "risky" interactions so to provide indications for improving future BP modeling. In particular, in all the different BP we could detect livelock conditions when a document is required and it is not properly compiled, so to need further integrations. This was the case in the Bouncer Registration service. An example of deadlock occurs when there is an exclusive gateway in which at least two of its output flow will converge, after several steps, into a parallel gateway. This means that the parallel gateway does not start until all its input flows are consumed. This can never happen so a deadlock occurs. This was the case in the grant citizenship process model with reference to the request of the nulla osta from the prefecture.

With reference to specific cases we can refer to the following scenarios. In the Bouncer Registration process model a deadlock occur during the first step involving the PA manager. In fact it can happen that the PA manager waits

for a document from the prefecture that will never arrive since the prefecture already has a version of the document and it proceeds without considering the PA Manager. This deadlock does not have a huge impact within a human driven scenario where the civil servant will adapt to the situation. Obviously different is the case of a scenario driven and supported by IT systems. In most of the cases the PA Manager has to provide automatically the document and the BP results in resource starvation. In the grant citizenship process model an example of deadlock occurs when livelock is observed in one of the involved pools. It happens in the last step when the municipality waits for a call from the prefecture. In this case if the request is not approved, due to document mismatching, it happens a livelock that also results in the deadlock of the municipality that still waits for the prefecture call.

6 Conclusions and Future Work

Public Administration Business Processes are highly complex and typically foresee the interaction of many different stakeholders. Given the continuous shift from human driven processes to mainly electronic driven processes, we are in urgent need of techniques for modeling and analyzing PA BPs. In this paper we presented an approach for checking deadlock and livelock of complex BP modeled using BPMN 2.0. The approach has been experimented with three complex scenario with interesting results. In particular, it is evident that just the effort of graphically modeling a business process can help domain experts to identify unwanted interactions. Nevertheless BPs enacted within the PA are so complex that their manual manipulation is not a suitable option. The verification algorithm we derived helped in identifying many dangerous traces.

In the future we intend to apply the approach to many other BP and to consider data set during the verification phase. At the same time we intend to explore if commonalities are available among the various BPs leading to similar unwanted traces. In this way we could derive a list of BP "anti-pattern" which can help the developer of BPs for PA.

References

1. European Commission: European Interoperability Framework (EIF) Towards Interoperability for European Public Services (2011)
2. Commission: 5th ministerial egovernment conference. Ministerial Declaration on eGovernment (2009)
3. Commission, E.: Communication from the commission to the european parliament, the council, the european economic and social committee of the region. a digital agenda for europe. Technical Report COM (2010) 245 final, European Union, Brussels (2010)
4. Niehaves, B., Plattfaut, R.: Collaborative business process management: status quo and quo vadis. Business Process Management Journal 17(3), 384–402 (2011)

5. Houy, C., Fettke, P., Loos, P., van der Aalst, W.M.P., Krogstie, J.: BPM-in-the-Large – Towards a Higher Level of Abstraction in Business Process Management. In: Janssen, M., Lamersdorf, W., Pries-Heje, J., Rosemann, M. (eds.) EGES/GISP 2010. IFIP AICT, vol. 334, pp. 233–244. Springer, Heidelberg (2010)
6. Lindsay, A., Downs, D., Lunn, K.: Business process – attempts to find a definition. Information and Software Technology 45, 1015–1019 (2003)
7. Roser, S., Bauer, B.: A categorization of collaborative business process modeling techniques. In: Seventh IEEE International Conference on E-Commerce Technology Workshops, pp. 43–51. IEEE, Los Alamitos (2005)
8. Object Management Group: Business Process Model And Notation (BPMN) Version 2.0 (2011)
9. Mendling, J.: Metrics for process models: empirical foundations of verification, error prediction, and guidelines for correctness. Springer (2008)
10. van der Aalst, W.M.P., ter Hofstede, A.H.M.: YAWL: yet another workflow language. Information Systems 30(4), 245–275 (2005)
11. Davies, J., Janowski, T., Ojo, A.K., Shukla, A.: Technological foundations of electronic governance. In: Janowski, T., Pardo, T.A. (eds.) ICEGOV. ACM International Conference Proceeding Series, vol. 232, pp. 5–11. ACM (2007)
12. Clarke, E.M., Grumberg, O., Peled, D.A.: Model Checking. Hardcover (2000)
13. Leroux, J.: Vector Addition System Reachability Problem: A Short Self-contained Proof. In: Dediu, A.-H., Inenaga, S., Martín-Vide, C. (eds.) LATA 2011. LNCS, vol. 6638, pp. 41–64. Springer, Heidelberg (2011)
14. McMillan, K.: Symbolic model checking: an approach to the state explosion problem. Technical report, DTIC Document (1992)
15. Hack, M.: Decidability questions for Petri nets. Garland Publishing, New York (1975)
16. Esparza, J., Heljanko, K.: Unfoldings: a partial-order approach to model checking. Springer, New York (2008)
17. Karp, R., Miller, R.: Parallel program schemata. Journal of Computer and System Sciences 3(2), 147–195 (1969)

A Service-Oriented Integration Platform to Support a Joined-Up E-Government Approach: The Uruguayan Experience

Laura González[1], Raúl Ruggia[1], Jorge Abin[2], Guzmán Llambías[1,2], Raquel Sosa[1], Bruno Rienzi[1], Diamela Bello[2], and Fabricio Álvarez[1,2]

[1] Instituto de Computación, Facultad de Ingeniería, Universidad de la República, Uruguay
{lauragon,ruggia,gllambi,raquels,brienzi,falvarez}@fing.edu.uy
[2] Agencia de Gobierno Electrónico y Sociedad de la Información, Uruguay
{jorge.abin,guzman.llambias,diamela.bello,
fabricio.alvarez}@agesic.gub.uy

Abstract. E-Government Platforms have become a key tool to support the development of e-government in many countries. They usually provide infrastructure and services that facilitate the interconnection between the information systems of public agencies, provide common services that generate economy of scale, and encourage the implementation of multi-agency services. In particular, the Uruguayan E-Government Platform has the general goal of enabling and promoting the development of e-government services in Uruguay. The platform, which follows a joined-up approach, consists of an Interoperability Platform and a set of Crosscutting Services. It implements a service-oriented architecture, leveraging the Web Services technology, to expose, use and combine government functionality implemented by public agencies. This paper presents the Uruguayan E-Government Platform focusing on two components of the Interoperability Platform: the Middleware Infrastructure and the Security System. It also evaluates its first years of operation which have shown that, although there are still many challenges to be addressed, the platform is a key enabler for developing a joined-up e-government approach in Uruguay.

Keywords: e-government, soa, interoperability, security, web services, middleware.

1 Introduction

During the last decades, Latin American countries have progressively been driving e-government initiatives. More precisely in Uruguay, the Electronic Government and Information Society Agency (AGESIC[1], Agencia de Gobierno Electrónico y Sociedad de la Información), which has the mission to lead the e-government strategy in Uruguay, aims to improve the services provided to Uruguayan citizens, leveraging the capabilities of Information and Communication Technologies (ICT). It also aims to

[1] http://www.agesic.gub.uy/

A. Kő et al. (Eds.): EGOVIS/EDEM 2012, LNCS 7452, pp. 140–154, 2012.

leverage, as far as possible, the existing available services in public agencies, which requires the integration of the information systems that implement them.

Similar to other regions, E-Government Platforms in Latin America have shown to be one of the key tools to support this kind of integration [1]. They usually provide infrastructure and services that facilitate the interconnection between the information systems of public agencies, provide common services that generate economy of scale, and encourage the implementation of multi-agency services.

In particular AGESIC has designed, built and made available the Uruguayan E-Government Platform [2]. This platform has the general goal of enabling and promoting the development of e-government services in Uruguay following a joined-up approach. The platform consists of an Interoperability Platform and a set of Crosscutting Services. The Interoperability Platform, which comprises a hardware and software infrastructure along with legal and technical frameworks, aims to facilitate the implementation of e-government services and their access. It also provides the support to implement a service-oriented architecture (SOA), where public agencies provide its government functionality through software services which are described, invoked and combined in a platform independent way.

This paper presents the Uruguayan E-Government Platform (EGP.uy), focusing on two of the components that support the Interoperability Platform: the Middleware Infrastructure and the Security System. The Middleware Infrastructure provides mechanisms to solve interoperability issues and to simplify the development, deployment and integration of services and applications within the platform. The Security System provides security services to the rest of the components and is the element in charge of the authorization, authentication and accounting (AAA) tasks in the platform. The paper also presents an evaluation of the first years of operation of the platform, describing its current situation and perspectives.

The rest of the paper is organized as follows. Section 2 provides background on e-government platforms and the Uruguayan e-government strategy. Section 3 presents a general overview of the EGP.uy. Section 4 describes the Interoperability Platform, in particular its Middleware Infrastructure and Security System. Section 5 presents the current situation and an overall evaluation of the EGP.uy. Finally, Section 6 presents conclusions and future work.

2 Background

This section presents background on the Uruguayan E-Government Strategy and related work on E-Government Platforms.

2.1 Uruguayan E-Government Strategy

In Uruguay, the e-government strategy has followed a joined-up approach based on an E-Government Platform (EGP).

The underlying context is characterized by a very heterogeneous application of IT in public services. While some public e-services have been developed since the year 2000, providing Web-based mechanisms to access information and/or to perform transactions, a large portion of public administration remains underdeveloped even for

internal operations. Concerning the usage of Internet in households, Uruguay has very high rates. Furthermore, the IT industry is well developed and local professionals implement large-size systems using cutting-edge technologies like Web Services.

Based on this context, the main goals of the e-government strategy, which was developed in 2006, were to improve the quality of citizen services and the efficiency of public administration by promoting the implementation of IT-based services. More specifically, the e-government strategy aimed at facilitating public agencies to publish e-services, by providing them technical guidance and a large-scale infrastructure. While the technical guidance consists of defining IT standards and promoting a SOA application, the large-scale infrastructure consists of a high-quality communication network, a PKI system, and an Authentication System. The strategy also aimed at improving quality of service by involving private partners and by enhancing the efficiency of composed public-private services. The EGP constitutes, in this way, the key enabler of this nation-wide integration strategy. The extensibility of the approach is based on applying a standards-based modular approach to services, which enables new services to be added or changed with low impact. Finally, another objective of the e-government strategy has been to support the Open Data Government policy by offering a single access point through the portal services and several artifacts. This approach facilitates the implementation of this policy to all public agencies.

In summary, the strategy aimed at developing a joined-up approach by enabling the composition of services provided by public or private institutions, and therefore leveraging existing capabilities.

The adopted approach to carry out this strategy was mainly based on the implementation of an operational EGP, which is the cornerstone of the joined-up approach carried out in Uruguay. In order to strengthen the service integration and composition capabilities as well as the implementation of a SOA-based e-government, interoperability technologies are provided in all the EGP layers (e.g. business services through Web Services, user interaction through WSRP portals). To facilitate and speed up the implementation of such composed services, while atomic services execute on the agencies' servers, the core of the EGP was built using an advanced integration middleware. More concretely, an Enterprise Services Bus infrastructure was selected to provide these integration functionalities. Besides the e-government platform, technical specifications and standards were developed to provide guidance to agencies.

It is important to point out that the e-government strategy and the development of the EGP is part of a wider government policy (the Uruguayan Digital Agenda)[3].

2.2 Related Work on E-Government Platforms

In order to facilitate the execution of governmental processes and the interaction between the citizens and the governmental organizations, several countries all over the world initiate and conduct e-government initiatives [4].

To support them, countries follow different approaches, potentially complementary. Some approaches focus on defining frameworks which specify how to build e-government applications, but without providing an execution environment [5]. Others focus on providing EGPs [1][4][6][7], which usually comprises a technological infrastructure and services that supports the interconnection between Government Services. These platforms are usually based on standards to allow the integration between public agencies that may have different technological environments. Beyond

their particular characteristics, EGPs usually provide a set of basic capabilities which include, among others, security, interoperability, connectivity and communication.

The distinct characteristic of the EGP.uy is that it focuses on building an open platform to promote the reuse of existing services running in public agencies. The main advantages of this approach are the intrinsic openness and extensibility of the platform, as well as the economy by promoting the reusability of existing solutions.

3 The Uruguayan E-Government Platform

The Uruguayan E-Government Platform (EGP.uy) has the general goal of facilitating and promoting the implementation of e-government services in Uruguay. To this end, the platform provides mechanisms which aim to simplify the integration between public agencies, to guarantee secure interactions within the platform and to allow the communication with citizens. This section provides a general overview of the platform, describing its main components, capabilities and actors.

3.1 General Description

The EGP.uy consists of an Interoperability Platform and a set of Crosscutting Services. The Interoperability Platform, which comprises a hardware and software infrastructure along with legal and technical frameworks, facilitates to public agencies the implementation of e-government services and their access. On the other side, the Crosscutting Services provides specific utilities to citizen and/or public agencies.

The technological support for the Interoperability Platform and the Crosscutting Services is given by various components which aim to simplify the integration between public agencies, assure that all interactions within the platform are performed in a secure environment and allow the communication with citizens. Fig. 1 presents these components, along with the main actors involved with the platform.

The components which support the Interoperability Platform are the Security System, the Metadata Management System and the Middleware Infrastructure. The Crosscutting Services are, at this time, the E-Government Portal, the Government Search Engine, the Electronic Record System and the Geographic Information Portal. Sections 3.2 and 3.3 present in more detail these components and services.

On the other side, the actors involved with the platform are the general public, public agencies and platform administrators. The general public (i.e. Uruguayan citizens, foreign people and private companies) accesses e-government services through the internet using, for example, the E-Government Portal or Web Services exposed at the EGP.uy. Public agencies leverage the connectivity provided by REDuy, a high-speed network infrastructure, to access and provide services and components in the EGP.uy. Finally, platform administrators deal with all the tasks concerned with the administration and operation of the platform.

REDuy [8] is a high-speed wide-area network which provides the required connectivity infrastructure to allow public agencies to access the EGP.uy and other agencies. REDuy is implemented over the MPLS (Multi Protocol Label Switching) network of ANTEL, the public telecommunications company of Uruguay, and it supports speeds from 10 Mbps to 100 Mbps. REDuy is protected by firewalls which control the network traffic, from and to the network.

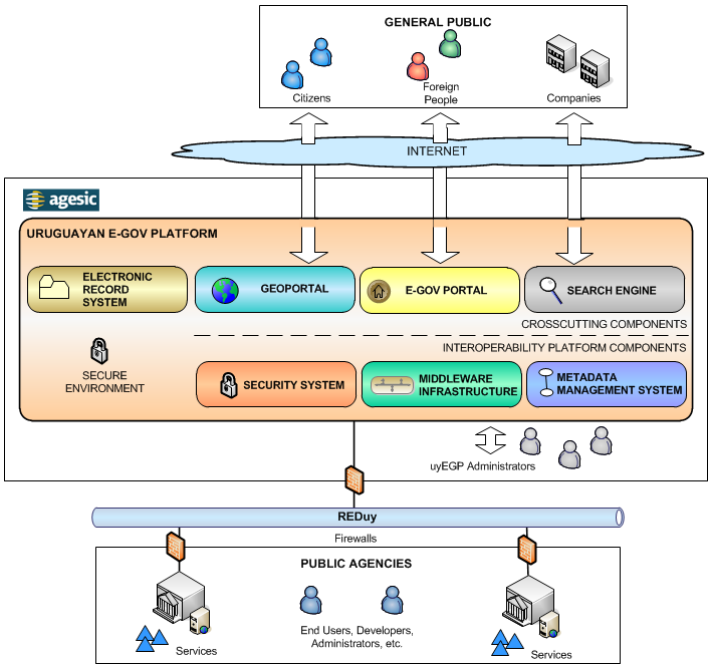

Fig. 1. Main Components and Actors of the EGP.uy [2]

The EGP.uy implements a SOA, leveraging the Web Services technology. In this way public agencies provide its government functionality through software services which are described, invoked and combined in a platform independent way. This aims to simplify the integration between public agencies, and to promote the reuse and exploitation of government assets. Additionally, it contributes to be able to respond in a more agile way to changes in requirements or regulations [9][10]. Software services provided by public agencies are usually hosted in servers located at the agencies. These services can be built from scratch or they can expose government functionality implemented in existing systems, leveraging in this way assets that the government already has. Additionally, if services have some special requirement that cannot be satisfied at the agencies, they can also be hosted at the EGP.uy.

It is important to remark that in order to support the use of the EGP.uy, now and for the future, a legal infrastructure had to be developed. This infrastructure comprises supporting laws and regulations regarding personal data protection, electronic signature (including advanced signatures), interoperability between public agencies and access to public information. There are currently other laws and regulations in process to be approved. It was also necessary to guide the adoption of several technological standards through guidelines and best practices. In order to use and publish services at the platform, public agencies must use this normative. This set of laws, regulations and technical recommendations are also part of the EGP.uy [11][12].

3.2 Crosscutting Services

At this time the Crosscutting Services are the E-Government Portal, the Government Search Engine, the Geographic Information Portal and the Electronic Record System.

The E-Government Portal[2] is the entry point to the Uruguayan government content and procedures available in the Internet [13]. The information included in the portal consists of headlines that are taken from different Uruguayan websites (mostly public agencies websites). Also, a link to the source website is included in each headline, so that citizens can access the complete content. This strategy contributes to improve the quality of information at the source, which is produced and managed by the public agencies themselves. The portal organizes and categorizes information, according to user profiles (e.g. women, students) and thematic areas (e.g. health, education).

From a technical point of view, the information from the source websites is integrated in the portal via RSS feeds hosted in the sites. If a website does not provide information in this format, screen-scrapping techniques are used to integrate the information in the portal. The implementation of the portal is mostly based on IBM WebSphere Portal and Lotus Web Content Management. The portal supports industry standards, like the Java Portlets specifications and Web Services for Remote Portlets (WSRP). Also, it complies with well-known web content accessibility guidelines.

The Government Search Engine[3] has the main goal of implementing a search engine oriented to the specific needs of the Uruguayan government. The main benefit, compared to using other general search engines like Google, is that it is optimized to search Uruguayan government content. The implementation of the search engine is based on Google Search Appliance (GSA) and SmartLogic Semaphore.

The GeoPortal[4] is a geographic information portal which allows querying and analyzing, through the Internet, the geographic information coming from public agencies. The Geoportal is one of the services in the Spatial Data Infrastructure project (IDE) which has the main goal of creating a network service to access and share geographic information across the Uruguayan public agencies. IDE services are compliant with the Open Geospatial Consortium standards[5].

The Electronic Record System has the goal of handling government records and simplifying their interoperability across public agencies. The main component of the system is an electronic record management application. This application can be used with a Software as a Service (SaaS) approach or can be installed in the public agencies themselves. Additionally, it will provide citizens with a Web interface which will allow them to trace records through the Internet.

3.3 Components of the Interoperability Platform

The Interoperability Platform facilitates the implementation of e-government services and their access. The components which support this platform are: the Metadata Management System, the Middleware Infrastructure and the Security System. The Metadata Management System provides a high level specification of the concepts related

[2] http://portal.gub.uy/
[3] http://buscador.gub.uy/
[4] http://idevisualizador.agesic.gub.uy/
[5] http://www.opengeospatial.org/

with public services in order to avoid, or even solve, ambiguities when public agencies use these concepts. The knowledge in this system is handled through ontologies specified via OWL (Web Ontology Language), using Protégé as the modeling tool. This system also exposes interfaces, through the Web Services technology, so that other systems can interact with it. The Middleware Infrastructure and the Security System are described in Section 4.1 and Section 4.2, respectively.

4 The Interoperability Platform

This section presents the main features provided by the Interoperability Platform, focusing on the Middleware Infrastructure and the Security System.

4.1 Middleware Infrastructure

The Middleware Infrastructure has the goal of promoting the interoperability between the different public agencies, providing the required mechanisms to facilitate the development, deployment and integration of application and services. These mechanisms are also the foundation to implement a SOA. The Middleware Infrastructure consists of three main blocks: execution environments, a Service Registry and ESB products.

Execution Environments. Even though applications and services provided by public agencies can be usually hosted at the agencies themselves, the Middleware Infrastructure provides execution environments to host them. These environments are based on commonly used middleware technologies, like application servers and ESBs.

Public agencies can leverage these environments to host applications and services which require advanced hardware and/or software infrastructure which, in some cases, is not available at the agencies. This infrastructure can be required to guarantee certain quality of service level regarding, for example, response time or availability.

Execution environments are also used to host application or services which provide general purpose functionalities or utilities. For example, there is a Timestamp service, provided by AGESIC, which returns the current date and time.

The Middleware Infrastructure provides execution environments for two of the main enterprise application platforms: Microsoft .Net Framework and Java Enterprise Edition (Java EE). The latter is provided through the JBoss Enterprise SOA Platform. This dual platform intends to face interoperability issues and provide technological independence in new acquisitions or developments. Moreover, the platform includes other advanced components, for example, WS-BPEL engines.

Service Registry. The Service Registry provides functionalities which allow publishing, describing, searching and discovering e-government services within the EGP.uy. In particular, the Service Registry provides all the required information, specified using the WSDL standard, to allow public agencies to invoke services. Besides this technical specification, when a public agency publishes a service in the EGP.uy, it has to specify additional information regarding quality of service (e.g. availability, response time and maximum throughput), security requirements (e.g. authorization mechanism), general documentation (e.g. description of operations and parameters,

input and output examples), operational information (e.g. implementation language) and technical support information, among others. This information has to be specified in a service publication request form [14].

Although the Service Registry is currently an internal component within the EGP.uy (i.e. only AGESIC administrators can update it), AGESIC plans to provide a public Service Registry (e.g. an UDDI compliant registry) so public agencies can discover services by themselves.

Enterprise Service Bus Products. An Enterprise Service Bus (ESB) is a standards-based integration platform which includes different middleware technologies (e.g. message-oriented middleware and Web Services) and provides mediation capabilities (e.g. data transformation and intelligent routing) to reliably connect and coordinate the interaction of diverse applications in an heterogeneous environment [15]. When using an ESB, applications and services communicate by sending messages through the ESB. The Middleware Infrastructure includes two ESB products: JBoss ESB and Microsoft Biztalk Server (plus Biztalk ESB Toolkit). Some of the ESB features that are leveraged within the Interoperability Platform are location transparency, asynchronous messaging, message transformation and content-based routing.

Location transparency means that client applications are not aware of the real network address of the services they want to invoke. In order to invoke a service they have to specify a logical address which identifies services within the platform. The mapping between logical and real addresses is managed at ESB products. In this way, if a service changes its real address there is not any impact in client applications, given that the mapping can be adjusted at ESB products. Additionally, service providers (i.e. public agencies) do not need to make public the location of their servers, which contributes to achieve a higher security level for them. In the context of an invocation, the logical address of services is specified leveraging the WS-Addressing standard.

The Asynchronous Messaging capabilities allow supporting different messaging models. In particular, a publish-and-subscribe service was implemented to provide a broadcast-like communication mechanism where a producer notifies certain information to interested parties. The mechanism has two subscription modes: push and pull. Using the push mode, subscribers receive notifications in a specific service previously specified by them. Using the pull mode subscribers must communicate with the platform periodically to check if there is any new notification. The advantage of the push mode is a real time notification mechanism but requires a high availability infrastructure. On the other side, the pull mode has the disadvantage of receiving notifications on demand. Leveraging this publish-and-subscribe mechanism, a service which notifies changes in citizen's data (e.g. marital status) was implemented.

The Message Transformation capabilities allow transforming messages passing through the ESB according to a given transformation logic specified, for example, using XSLT. In the context of the Interoperability Platform, this capability has been used to solve different interoperability problems, given that although the interactions between public agencies are based on Web Services standards, this is not always enough to guarantee end-to-end interoperability [16]. Transformations can also be used to reduce the impact in client applications when a service contract changes [17].

The Content Based Routing capability routes ESB messages according to the messages content. It is used within the platform to route messages to the real address of services: it obtains the logical address of the service from the WS-Addressing header, gets the real address from a mapping table and routes the message to this address.

4.2 Security System

The Security System provides the mechanisms to enforce AAA policies according to the security requirements of the applications, services or components in the EGP.uy. Public agencies can delegate the compliance with Web Services' security requirements to this component. The Security System can be divided in three main blocks: the Audit System, Peripheral Security Services and the Access Control System.

Audit System. The Audit System provides the required tools to perform security audits in the EGP.uy. The system gathers information and performs audit analysis and reports that can answer questions such as, among others, who consumed this service?, and at what time?. The Audit System is based on Tivoli Compliance Insight Manager.

Peripheral Security Services. The Peripheral Security Services have the main goal of facilitating the secure access of public agencies to the EGP.uy and comprise two main services: a Certification Authority and a Directory Service.

The Certification Autority (CA) has the goal of issuing and managing the general purpose digital certificates that are used within the platform. For example, the CA issues the certificates which are used by the servers to establish secure connections with the EGP.uy. The implementation of the CA is based on Windows Server 2003.

The Directory Service provides directory services through the LDAP protocol and has four main functions [2]: i) replicate, in an automatic way, the directory structures of the public agencies that have a directory service, ii) provide directory services for applications deployed within the EGP.uy, iii) provide directory services to public agencies which do not have one, and iv) provide a unified view of the government directory structures. The Directory Service is mainly implemented with IBM Directory Server, Tivoli Identity Manager and Tivoli Directory Integrator.

Access Control System. The goal of the Access Control System is to provide mechanisms that allow applying access control policies over application and services available within the EGP.uy. These mechanisms follow a Role Based Access Control (RBAC) schema. The Access Control System has three components: the Security Token Service, the Security Policy Manager and the XML Firewall.

The Security Token Service (STS) has the responsibility to issue the required security tokens to allow client applications to invoke services published in the EGP.uy. This component is compliant with the WS-Trust v1.3 standard and it is based on Tivoli Federated Identity Manager. The STS trusts the authentications performed at the public agencies to issue security tokens. In particular, it verifies the authenticity of the requests through digital signature mechanisms.

When an application running in a public agency wants to invoke a service in the EGP.uy, it first has to request a security token to the STS. This request is performed using the WS-Trust standard and includes a security token, specifying the user role invoking the service. The security token is specified using SAML (v1.1 or v2.0) and it

is digitally signed by the public agency. When the EGP.uy receives a security token request, it verifies the digital signature of the token included in the request. It also verifies that the user role specified in the security token is in the LDAP directory. If all the verifications succeed, the STS issues a security token, including the user role, which is specified using SAML v1.1 and is digitally signed by the EGP.uy. The communication between public agencies and the STS is performed over HTTPS.

The Security Policy Manager acts as a Policy Decision Point (PDP), given that it is in charge of authorizing the requests for invoking services in the EGP.uy. To this end, it stores information about which roles have access to which operations of the published services. When the EGP.uy receives a request (i.e. a SOAP message) to invoke an operation of a given service, it obtains from the WS-Addressing headers the logical address of the service and the operation to be invoked. It also gets the user role from the security token which is included in the message following the WS-Security standard. In this way, it has all the required information (service, operation and role) to be able to authorize, or not, a given invocation request. The Security Policy Manager is implemented with Tivoli Security Policy Manager.

The XML Firewall acts as Policy Enforcement Point (PEP) leveraging the decisions taken by the Security Policy Manager. For each service published in the EGP.uy, a proxy service is deployed in the firewall. When a client application wants to invoke a service, the invocation has to be done through its proxy service. In case the firewall authorizes the invocation, it routes the request to the Middleware Infrastructure which finally sends the request to the service. Otherwise, an error message is returned to the client application. These interactions are also performed over HTTPS. The XML Firewall is implemented with IBM Websphere Datapower Xi50.

4.3 Steps in a Service Invocation

Fig. 2 presents a summary of the required steps to perform a service invocation within the EGP.uy, focusing on the processing at the Interoperability Platform.

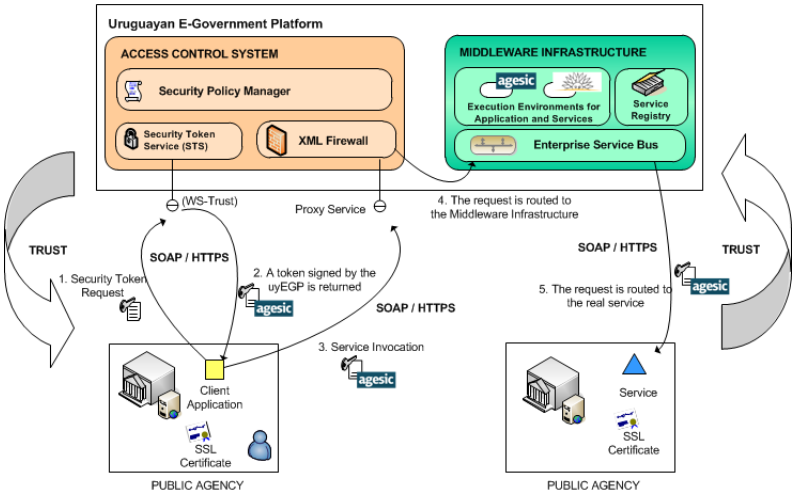

Fig. 2. Service Invocation [2]

4.4 Summary of Features Provided by the Interoperability Platform

As presented in previous sections, the Interoperability Platform provides different features that public agencies can leverage. The implementation of these features at the Interoperability Platform generates economy of scale, given that with a single effort various agencies can be benefited.

Additionally, the capabilities provided by the Interoperability Platform allow implementing other mechanisms to deal with specific requirements that public agencies might have. In particular, some mechanisms were implemented in the platform to control the number of invocations of a service according to different factors.

The load control mechanism limits the number of invocations per second a given service can have. In turn, the time control mechanism restricts the times of the day in which a service can be invoked and, in these periods of time, it also limits the number of service invocations per client. Finally, the date control mechanism controls that services can be invoked in specific dates.

As a summary, the Interoperability Platform offers these main features to public agencies: i) execution environments, ii) synchronic service invocation, iii) publish and subscribe service, iv) access control mechanisms, v) directory service (LDAP), vi) security audit services, and vii) load, time and date control for service invocations.

5 Current Situation and Evaluation

Since its start-up in 2009, public agencies have been progressively joining the EGP.uy. This section describes its current situation and presents a general evaluation.

5.1 Current Situation

About 150 nodes, belonging to different agencies, are currently connected to the RED.uy and other 20 are expected to join it in the short term. In addition, several services and applications, like Web Services, Portal and government business applications, are already accessible through the REDuy. The Interoperability Platform currently publishes twenty three services; ten of them implement public administrative procedures while the others correspond to internal interactions between public agencies. One example of implemented administrative procedures is the Electronic Certificate of Decease, which enables authorized users to access the certificates issued in a given period of time. Another example is the Basic Identification Service, which enables to obtain personal data of a citizen (e.g. names, sex and birthday) given the national identification number. These services are currently used by nine different agencies. For example, the Social Development Ministry, which administers social programmes to assist low income population, uses the Basic Identification Service to validate the identity of the beneficiaries of the programmes. Currently, there are also more than twenty services in testing phase.

Concerning the performance of the published services, monitoring have shown that invoking a service through the platform (i.e. the steps in Fig. 2) has an overhead of, at most, one second more than point-to-point invocations between agencies.

5.2 Main Benefits

While the most evident benefit of the EGP.uy is to provide a legal and technical framework that can be used by public agencies to collaborate and reuse existing information and services, there are other economic, administrative and development ones. The EGP.uy design (a broker between all the agencies using standardized protocols) enables to reduce point-to-point agreements between agencies as well as their associated burden (e.g. definition of exchange protocols and formats). This has also enabled to reduce costs and software development workload as well as reducing barriers for incorporating advanced integration technologies. Furthermore, the standards and good practices promoted by the EGP.uy helped agencies to achieve higher quality implementations than former ones based on legacy technologies.

From a legal point of view, the EGP.uy enables to ensure that information exchanges comply with Uruguayan laws and regulations (e.g. personal data protection). From an economic point of view, the EGP.uy aims at promoting economy of scale by providing applications and services that can be reused by several agencies. From an administrative point of view, the EGP.uy provides a centralized Service Registry which constitutes the basis of the e-Government SOA Governance. This Registry provides rich information for each service including documentation, QoS information (response time and max throughput), technical and business contacts and technical issues support. AGESIC also provides assistance to agencies that do not find services matching their requirements.

Concerning application development using the platform, AGESIC provides a first level of technical support. Developers do not interact with products' support services but with AGESIC support team, which assist them on dealing with integration requirements (SSL, Certificates, Web Services, etc).

Finally, the design of the EGP.uy, based on an open service approach in which any agency can publish and consume services, promotes the development of new services by composing existing ones.

5.3 Main Challenges

Public agencies joining the EGP.uy generally face technical and cultural challenges. While technical problems (e.g. interoperability issues, inadequate hardware or software infrastructures, etc) are usually solved in the first phase of the integration process, cultural ones are harder to address and they can have a negative impact in the success of the integration [18]. In particular, the resistance to use EGP.uy because it is external to agencies and the seizure of information have been the most common cultural problems. Furthermore, the lack of confidence in the platform, for example regarding security, performance and availability, were also important barriers. The first generation of services, although very basic and with limited business value and reuse, enabled agencies to better understand the EGP.uy. After this initial phase, new generations of more valuable and sophisticated services have been implemented.

Finally, it took time to public agencies to "take possession" of the EGP.uy and consider it as part of their IT commodities.

All this difficulties are being addressed through different initiatives like workshops focusing on the usage of the platform, guides and tutorials, software components that simplify the integration with the EGP.uy and training courses along the year. These initiatives have been well received by agencies and have apparently paid off, as the number of new services in the first quarter of 2012 is the same than the number of new services throughout 2011.

5.4 Lessons Learned

The three years process of development and operation of the EGP.uy enable to summarize some main lessons: i) training IT staffs in agencies, providing technical support and assistance, and developing adapters and libraries that simplify the integration to the platform had a key impact in reducing the technological gap between agencies and the EGP.uy, ii) in order to use the platform, public agencies have had to understand the benefits of the EGP.uy; developing an effective communication and joined work with the agencies enabled to generate this knowledge and trust, iii) when agencies received additional benefits for publishing/consuming services they were much more motivated to use the platform, iv) involving operational IT staff from the beginning promoted the appropriation of the EGP.uy and made them to feel that is part of their IT infrastructure, and v) developing new common solutions based on agencies' requirements have been a key type of activity to address complex applications.

6 Conclusions and Future Work

This paper presented the design, architecture and implementation of a joined-up e-government approach based on an advanced middleware platform.

This experience has shown the feasibility of implementing an EGP using state of the art technologies, especially middleware and security, and the potential of a middleware-based integration platform to support a large variety of value-added services. The E-Government program also enabled improving the overall AGESIC technological services (e.g. the National Root PKI, Network Time Services). Finally, the current increased demand for services shows that this is a midterm investment. On the other side, technical and cultural challenges still remain, which can constitute barriers for a successful integration with the platform.

The main contributions of the paper are the technical description and evaluation of the approach followed in Uruguay, which is based on an integration platform promoting reuse and composition of services running in public agencies. Furthermore, the paper explains the key role of the ESB as integration middleware. Finally, the paper could enable to evaluate the followed approach to implement an e-Government strategy centered on reusing and composing existing services.

Future work involves three groups of initiatives: new services for citizens and public agencies, enhancement of the EGP.uy and enhancement of some platform services. The initiatives in the first group are to: i) frameworks to support online transactions through reusable components (e.g. electronic forms), ii) Government Resource Planning services, and iii) e-health services (e.g. medical terminology services, HL7 broker, telehealth services). The initiatives in the second group are Integrating

Geographic Services with the Interoperability Platform [19], developing adaptive ESB mechanisms to deal with quality of service [20][21], and perform automatic regulatory compliance validations (e.g. regarding Personal Data Protection). Finally, the initiatives in the third group are supporting file exchange over the EGP.uy, enhancement some security topics like citizen authentication (end-to-end security), enforce security at the message level (e.g. integrity) and supporting multi-agency service compositions.

References

1. Items International, Moreno Escobar, H.: CEPAL - e-Government architectures, technical and political situation in Latin America, http://www.eclac.org/ddpe/publicaciones/xml/7/28647/W129.pdf
2. AGESIC - Guía de uso de la Plataforma de GE del Estado uruguayo, http://www.agesic.gub.uy/innovaportal/v/1454/1/agesic/guia_de_uso_de_la_plataforma_de_ge_del_estado_uruguayo.html
3. AGESIC - Agenda Digital Uruguay 2011 - 2015, http://www.agesic.gub.uy/innovaportal/file/1443/1/agesic_agendadigital_2011_2015.pdf
4. Helali, R., Achour, I., Labed Jilani, L., Ben Ghezala, H.: A Study of E-Government Architectures. In: Babin, G., Stanoevska-Slabeva, K., Kropf, P. (eds.) MCETECH 2011. LNBIP, vol. 78, pp. 158–172. Springer, Heidelberg (2011)
5. Interoperability Solutions for European Public Administrations - ISA - European Commission, http://ec.europa.eu/isa/index_en.html
6. Batini, C., Cappadozzi, E., Mecella, M., Talamo, M.: Cooperative Architectures - The Italian Way Along e-Government (2002)
7. Sudoh, O., Kinoshita, Y.: Transformative and Innovative E-Gov for the Next Generation: Linkages of Back Offices for One-Stop Portal. In: Janssen, M., Lamersdorf, W., Pries-Heje, J., Rosemann, M. (eds.) EGES/GISP 2010. IFIP, vol. 334, pp. 111–124. Springer, Heidelberg (2010)
8. AGESIC - REDuy, http://www.agesic.gub.uy/innovaportal/v/759/1/agesic/REDuy.html
9. Practical Guide to Federal Service Oriented Architecture | The White House, http://www.whitehouse.gov/omb/E-Gov/pgfsoa
10. Papazoglou, M.P., Traverso, P., Dustdar, S., Leymann, F.: Service-Oriented Computing: State of the Art and Research Challenges. Computer 40, 38–45 (2007)
11. AGESIC - Marco legal, http://www.agesic.gub.uy/innovaportal/v/42/1/agesic/marco_legal.html
12. AGESIC - Normas Técnicas, http://www.agesic.gub.uy/innovaportal/v/114/1/agesic/normas_tecnicas.html
13. AGESIC - Portal y Buscador del Estado, http://www.agesic.gub.uy/innovaportal/v/1067/1/agesic/portal_y_buscador_del_estado.html
14. AGESIC - Formulario de Solicitud de Publicación de Servicio en la PGE, http://www.agesic.gub.uy/innovaportal/file/1929/1/formulario_solicitud_publicacion_servicios_pge_v2.4.odt

15. Chappell, D.: Enterprise Service Bus: Theory in Practice. O'Reilly Media (2004)
16. Lewis, G.A., Morris, E., Simanta, S., Wrage, L.: Why Standards Are Not Enough to Guarantee End-to-End Interoperability. In: Seventh International Conference on Composition-Based Software Systems (ICCBSS 2008), Madrid, Spain, pp. 164–173 (2008)
17. González, L., Ruggia, R.: Addressing the Dynamics of Services Contracts through an Adaptive ESB Infrastructure. Presented at the 1st International Workshop on Adaptive Services for the Future Internet
18. Jimenez, C.E., Criado, J.I., Gasco, M.: Technological e-Government Interoperability. An Analysis of IberoAmerican Countries. IEEE Latin America Transactions (Revista IEEE America Latina) 9, 1112–1117 (2011)
19. Sosa, R.: Integración de Servicios Geográficos en Plataformas de Gobierno Electrónico (2011)
20. González, L.: Plataforma ESB Adaptativa para Sistemas Basados en Servicios (2011)
21. González, L., Ruggia, R.: Addressing QoS issues in service based systems through an adaptive ESB infrastructure. In: Proceedings of the 6th Workshop on Middleware for Service Oriented Computing - MW4SOC 2011, Lisbon, Portugal, pp. 1–7 (2011)

Modeling Administrative Procedures to Improve Information to the Public*

José Félix Muñoz[1,2], Carlos Bobed[2], and Francisco Serón[2]

[1] Aragonese Foundation for Research & Development (ARAID)
[2] University of Zaragoza, Walqa Technological Park, E-22197 Huesca, Spain
{jfm,cbobed,seron}@unizar.es

Abstract. This paper deals with the theoretical foundations, standards used and experience gained in the design, development and deployment of a human-shaped intermediary agent on the website of a public administration, whose purpose is to inform citizens about files that are being processed there. This agent exploits different knowledge sources under a unified model, which allows it to integrate factual knowledge about what has already been done, provided by the workflow tool, and theoretical knowledge about the procedural steps that still need to be taken before finalizing it.

The knowledge model the agent uses is implemented by using XPDL. The benefits of using this model language along with the defined equivalences are explained. Finally, we indicate the main problems encountered in the deployment of the agent on the websites of two Spanish councils, emphasizing the lack of availability of knowledge in the system that would be important in order to give information to the public, especially regarding access permissions.

Keywords: e-government, open government, administrative procedures, intelligent agents, semantic web, ontologies, XPDL.

1 Introduction

1.1 Background

In recent years, Spanish public administrations have made a major effort to systemize and model their procedures. One very important factor was the 11/2007 Act on electronic access to public services for citizens, which obliges public administrations to use the Internet in its communications with the public (a concept that includes both individuals and businesses), that is, in their front-office. One of the elements that all administrations must prepare in accordance with the 11/2007 Act is the "catalogue of

* Work partially financed by the spanish government and co-financed by the ERDF (European Regional Development Fund) through the projects "Intelligent Agent for Assisting Users of the Electronic Municipal Administration" (AIAM), TSI-020100-2010-455, of the Avanza Plan; "Legal Guarantees Applicable to Electronic Documents", DER2009-09744; and "Replikants: Towards a New Generation of Humanalike Agents", TIN2011-24660, of the Spanish National RDI Plan.

A. Kő et al. (Eds.): EGOVIS/EDEM 2012, LNCS 7452, pp. 155–169, 2012.

procedures". Here, it is essential to make a distinction between two meanings of the word "procedures": on one hand, it is used to refer to each of the administrative actions that members of the public may initiate in an administration in order to achieve a given objective (renovating their home or appealing against a traffic penalty for example), and, on the other hand, it is used to refer to the process that is followed in the administration in order to reach a decision on these actions. The law refers to the expression "catalogue of procedures" in terms of the first meaning (for which we shall use the word "procedures" in this article). Consequently, the "catalogue of procedures" does not include procedural knowledge (about the processes), but is a document that contains a list of all the procedures that citizens can follow before a certain public administration.

As well as providing the means so that members of the public can communicate with them via the Internet, many administrations are also computerizing their back-offices through the implementation of workflow tools for the processing of procedures (the term "processing platform" is generally used to refer to them), and the gradual replacement of paper documents by their electronic equivalents. When carrying out this work, it should be remembered that the 11/2007 Act specifies that the automation of procedures must be preceded by analysis regarding their functional redesign and simplification. Regarding the tools to be used for this purpose, one is BPMN [4] (Business Process Modeling Notation), a process modeling language that was developed for the modeling and optimization of business processes in private companies, but it is also suitable for modeling administrative procedures [15]. Some public administrations in Spain have already started to use the BPMN language [3].

1.2 Three Information Sources

The information that is currently provided to the public on the websites of public administrations is mainly that relating to the "catalogue of procedures". This is public access information and basically includes the purpose of each procedure, the available channels —in person, via the Internet (with or without an electronic certificate), by post or by telephone— and the basic requirements for their initiation (documentation to be provided, for example). The second source of information is the one regarding files being processed (not finished). Access is restricted to interested parties and includes the procedural steps already taken and access to documents associated with them.

Finally, there is a third type of information available in the administration's information system, which is that regarding the processes and which is currently not included in the information that public administrations provide to the public on their websites. Therefore, at the end of 2010 our group, together with the company iASoft/Oesia, created the project "Intelligent Agent for Assisting Users of the Electronic Municipal Administration" (AIAM, for its acronym in Spanish), with the aim to develop an intelligent agent [16] that will serve as an interface for communication with members of the public and be capable of integrating these three information sources. This paper focuses on the model that allows the agent to integrate and exploit these three sources of information.

The rest of the paper is structured as follows. In Section 2, the nature of the different knowledge sources that the agent has to deal with is analyzed. Then, in Section 3, the actual model that the agent handles and the different design decisions

are explained. In Section 4, the scenarios where the agent has been deployed are presented, as well as some important experiences gained from the deployment. Finally, in Section 5, conclusions and future work are presented.

2 The Knowledge Used by the Agent

2.1 Substantive vs. Procedural Law

In the science of the law, a distinction is made between two types of law: *substantive law* and *procedural law*. In brief, we can say that substantive law establishes rights and that procedural law deals with the way in which actions are used to demand their effective enforcement before public bodies and with the course that established procedures follow in order to arrive at a decision. This distinction is also valid from the point of view of knowledge representation, as each one has very different characteristics. Substantive law refers to a large extent to elements of reality, whether moral (values) or physical. Therefore, ontologies [7] are usually used to model it, as they enable us to represent this reality by categorizing concepts and to establish relationships between them.

However, in procedural law both the agents responsible for executing the administrative actions and the procedures they use are creations of the law itself, that is, they do not have their own existence that is prior to and independent of the law. In this respect, procedures are abstract entities created by laws, which means that the inherent ambiguity of concepts that are used for their representation (or modeling) may be much less than the ambiguity that concepts used in the representation of substantive law. Although other types of knowledge might appear in the creation of procedures (for example in [8] distinctions are made between business activities, process workflow, social structure, knowledge created and used, and technology), the main object to be modeled regarding procedural knowledge is the process workflow itself. As a consequence of the above, instead of using an ontology to model the different objects that a procedure comprises, a more specialized modeling formalism should be considered in order to properly capture the semantics of the flow without duplicating modeling efforts.

Finally, a reflection about the scope of the model presented in this paper regarding access permissions has to be posed. The agent allows access to administrative files being processed and, in accordance with the law, each file can only be accessed by citizens who are interested parties. These include firstly the promoter, who is the person that initiates the action, but also include any people that have rights that could be affected by the proceedings. Therefore, while the allocation of access permissions to civil servants may be carried out based on formal knowledge, as permissions derive from their role in the entity [18], in the case of members of the public it is necessary to study their rights, both in order to permit access (a legitimate interest in the proceedings) and to deny it (e. g. a conflict with the right to privacy of other people). Consequently, the modeling of knowledge regarding access permissions would introduce all the inherent complexity of substantive law into the system and it would be necessary to develop a specialized agent, which does not fall within the scope of our project, but it could be considered as future work.

2.2 Theoretical and Factual Knowledge

Apart from the distinction made in the previous subsection, there are two types of knowledge that the agent uses: theoretical and factual. The first deals with procedures and has its origins in the law —legislation (laws) and subordinate legislation (bylaws) [9]. Within this type, as we have seen, it is necessary to differentiate between:

- Knowledge that describes the different administrative actions that the public can take. In Spain, normally, the information that is given to the public about this type of knowledge has been previously compiled in the "catalogue of procedures", has been entered into a database and is provided to the public in text form via dynamic web pages.
- Knowledge that defines the processes that are followed to resolve the administrative actions. This one is being computerized to a much lesser degree because the work for the modeling of the processes was not included within the obligations imposed by the 11/2007 Act, and therefore depends on the policy of each administration, which carry them out as necessary for administrative simplification or for the automation of the back-office. Another reason is that, even when the systematization work is carried out, the use of specific modeling tools is not spread and in many cases the procedural flows are described only in text form.

As a matter of fact, there is a direct dependence between the theoretical and factual types of knowledge, as theoretical knowledge acts as a metamodel for factual knowledge. The theoretical knowledge provides the different processes, i. e. instances of *process*, that represent the different classes of *files* that can be used when dealing with factual knowledge. That is, the instances at the theoretical level are the classes at the factual one. In the functioning of the agent, when members of the public request information, the agent firstly finds their *files*. Then, for each *file*, an entity is selected from the model above (*processes*) that matches it —that is, the entity that is being used for its processing. After that, an instance from the procedural entity is created for each *file* and the part of the instance that relates to the part of the process already carried out is completed using the data from the "processing platform".

In the following subsection, we will present the details of the modeling of processes that supports the agent below: the conceptual model, the modeling language used, how to map the elements of procedures onto it and the extension possibilities that the model has.

3 The Modeling of Procedures

3.1 Modeling of *Procedures* and *Files*

As we have seen, the agent is able to work using procedural knowledge on two levels: theoretical and factual. Theoretical knowledge allows the agent to be aware of the flow that a certain file has to follow and factual knowledge is the information about the real progress of proceedings. Figure 1 shows the model of theoretical level types in detail, together with the relationship between the two main types from both levels. The theoretical model acts as a metamodel for the factual model, as instances regarding different procedures are in turn instantiated for each file. The factual model

is not depicted completely in the figure because we focus on the classes that have deep conceptual differences between knowledge levels. The rest of the model is quite similar to the theoretical one.

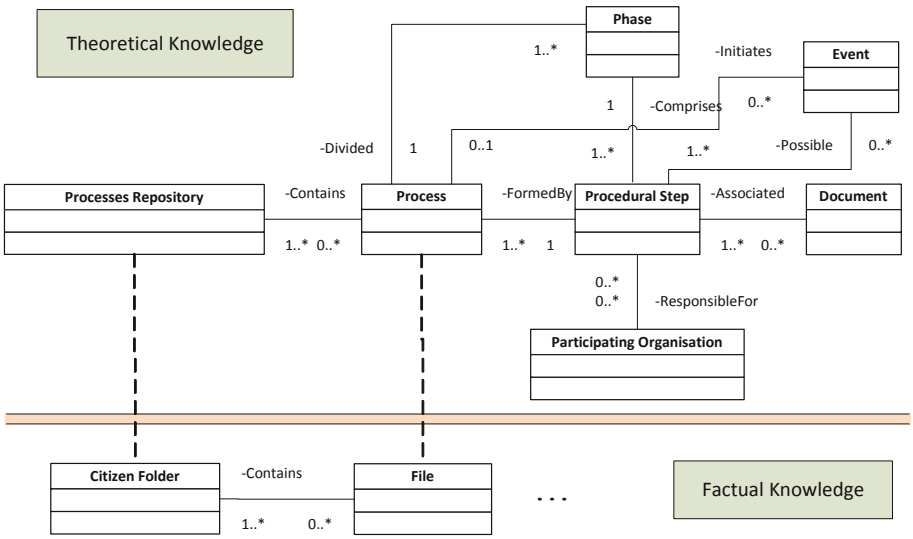

Fig. 1. Relationships between the different elements of the models

The model above (theoretical knowledge) represents the different processes that may occur and is made up of the following elements:

- *Process*. This is the workflow model of a process used in public administrations. These constitute the procedural knowledge and are stored in the *processes repository*. These are divided into *phases*, and are composed of *procedural steps*. For each *file* opened in the Administration a *process* is instantiated, depending on the procedure.
- *Procedural Step*. This is each of the steps that comprise the *process*. They are grouped together into *phases*, which give a logical unity to a group of *procedural steps*.
- *Event*. This is any external fact that affects the *process*. These are not considered in the execution flow, but it is specified in the theoretical model which *events* may occur in a certain *procedural step*. These may initiate other *processes* and are always associated with the *procedural step* in which they occurred.
- *Document.* This is the type(s) of documents that are required in each *procedural step*.
- *Participating Organization*. This is the body in charge of carrying out a certain *procedural step*.

This theoretical model is instantiated for each file, leading to the factual knowledge model:

- *File*. This is an instance regarding a procedure that is completed using the factual information from a *file* being processed. These are grouped together in the *citizen folder.*
- *Citizen Folder*. This is the group of all the *files* being processed in which a user is interested part. To the extent that this is a repository for instances regarding *processes* (*files*), it can be considered as the counterpart to the *processes repository*, although it should be remembered that the criteria used for the groups are entirely different, in one case *processes*' families are grouped, in the other the *files* related to a particular citizen are grouped.

The other entities (*events*, *documents* and *procedural steps*) become instances of the classes defined in the theoretical model. In the factual model, instances represent real objects with real occurrences, while in the theoretical model the classes to which they could belong are considered.

3.2 Why XPDL? An Overview

In general, when we talk about modeling knowledge the use of ontologies springs to mind. However, the characteristics of the information that the agent has to process (procedural knowledge) imply that the most suitable option would be the adoption of modeling languages whose specific purpose will be the processes. This way, efforts to define the execution semantics of the processes are avoided, as they are given to us by the language used in the adopted model itself.

The modeling language chosen was XPDL [17], a process modeling language that was specifically designed to represent BPMN (Business Process Modeling Notation) models. XPDL, standardized by the Workflow Management Coalition (WfMC), allows us to specify the recitals of a process and provides us with three important characteristics in accordance with the specifications established for the AIAM project:

- It is an open standard.
- It allows us to model the processes that the agent has to interpret.
- It offers flexibility for the extension of specific added information from the project.

Figure 2 shows a view of the main elements that XPDL provides. Only the most important ones are mentioned. For more details please see [17]:

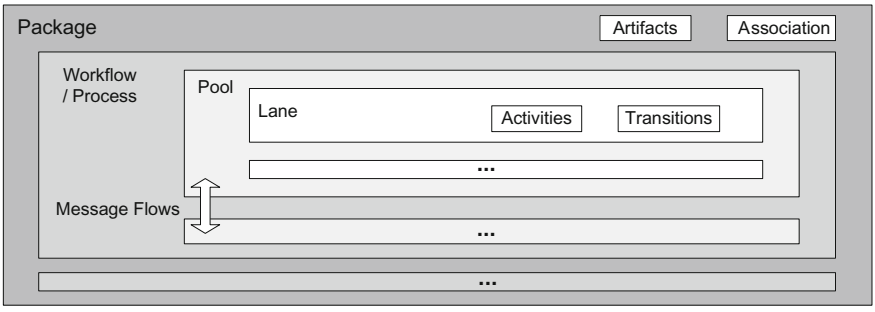

Fig. 2. Inner organisation of the XPDL elements

- *Package:* It is a container that groups together different *processes*/*workflows* and stores characteristics that are common to all of them (author, version, status etc.).The *processes* included in a package inherit the same characteristics, except those that might be redefined at the process level.
- *Process/Workflow:* It contains the definition of the process (workflows, activities, etc.) and information associated with its administration and execution.
- *Swimlane:* They are groupings that facilitate the distribution and viewing of a collection of *processes* and the activities that they contain. There are two types: *pool* and *lanes*. A *pool* contains one or more *lanes*. It groups a set of activities and transitions between them. Activities from different *lanes* in a same *pool* can be connected by transitions; however, transitions cannot be established between activities from different *pools*. *Lanes* subdivide *pools*. They are normally used to specify different roles in the *process* (the activities included in a *lane* inherit said roles, such as *participant* or *performer*).
- *Activity:* They are each of the stages of a *process*. Table 1 shows the different types that exist.

Table 1. Types of Activities that XPDL offers

Type	Description
No Implementation	It does not have any associated execution method (there is no application or service to be called in order to execute this activity).
Block	It groups a set of subactivities, but there is no communication channels (neither input nor output parameters).
Sub-Flow	It represents a call to another *process*, with communication of input/output parameters. It permits the reuse of other models by including them as activities in our *process*.
Route	It does not entail a workload, but a decision about which direction the execution flow should follow.
Event	These are facts that occur during the execution of the *process* and can affect several of its phases.

- *Transition:* It represents movement from one *activity* to another. They may have logical conditions which activate them to be followed or not, depending on their evaluation during the execution of the *process*.
- *Participant*: It represents the various agents that may participate in a *process*. It enables them to be represented at different levels: individuals, administrative roles, organizations etc.
- *Artifact*: They are necessary elements for the complete description of the process. However, they do not affect the flow of the *process*. There are three main types: *Text annotation, DataObject* and *Group*.
- *Association*: An entity that is used to associate the defined *artifacts* with its associated elements.

- *Vendor/User Specific Extensions*: One of the most important characteristics for the adoption of XPDL in the development of the agent: its extension mechanism. Nearly all of the XPDL entities admit the definition of *extended attributes*. Represented by pairs (key, value), they allow the XPDL to be extended using external information that must be interpreted by its corresponding editor (in our case, the intelligent agent).
- *Others:* XPDL is a language focused on the modeling of processes for their later deployment and execution in a workflow engine. This makes it an extensive and expressive language. The AIAM project is not interested in the execution, but in the interpretation of the status of the workflow. Therefore there are XPDL elements that we do not describe as they are not useful for the agent.

3.3 Elements of the Procedures and Mapping to XPDL

Now that we have seen why XPDL is a suitable modeling language for the project, we will explain how the modeling forms part of the processes followed in public administrations using XPDL elements. As we have seen earlier, the agent interprets both formal and factual knowledge based on XPDL models. Therefore, the principal mappings established between the elements of our data model and the elements described by the XPDL standard are as follows:

- *Processes Repository – XPDL: Package*

It contains the generic *processes* to be instantiated. It is a *package* that contains the generic workflows that are associated with each *process*. The agent needs to access it to obtain the process model that is to be instantiated in order to generate a *file* that will then be included in the *citizen folder*.

- *Citizen Folder – XPDL: Package*

It contains citizen's *files*. It stores *workflows* that are completed using the information about the status of the *file*. This information is obtained by accessing the underlying processing platforms.

- *Process – XPDL: Workflow*

It represents the process in a generic way. It provides the workflow that a *file* needs to follow and information regarding *participants, procedural steps* and *documentation* that must later be requested for each specific *file*.

- *File – XPDL: Workflow*

It represents the status of a *file*. It is comprised of a workflow that includes the information about the status of a *file*: *procedural steps* and *phases* already finished, responsible bodies and generated documentation.

- *Procedural Step– XPDL: Activity*

They directly map the various *procedural steps* that make up a *process*. Three XPDL activity types are used:

- Normal procedural steps: They are represented as No Implementation activities as the agent has only to interpret them, not to execute them.
- Decision making/forks: They are naturally mapped to Route activities.
- Common processing blocks (CPB)[13]: A common processing block is a common workflow that appears in different procedures. They are modeled as Subflows as the agent might need information about the current status of the file to interpret them properly, and therefore there is a need of a communication channel in the model (XPDL Blocks do not offer it).

- *Phase – XPDL: Extended Attribute*

The *phase* which each procedural step belongs to is represented as an *extended attribute* of the *procedural step* in question. This figure does not exist in XPDL and therefore we have added it through the *Extended Attribute* mechanism that the standard provides.

- *Body – XPDL: Participant (Organizational Unit)*

It represents the bodies that may be associated with each *process* due to being responsible for its processing.

- *Event – XPDL: Artifact (TextAnnotation)*

It represents the various events that could occur during the lifetime of the *process*. Despite the fact that XPDL offers *events* in its model, there is a major difference between their meanings. The XPDL events are connected to the workflow execution (event-oriented execution), while those of the AIAM model refer to any external occurrence that could affect the process, but which is not included in its workflow (e.g. the death of the requesting party). In view of the difference in meaning between the *Event* elements defined in XPDL and those used in our model, we use a text annotation for each event that occurs, which refers to an external description of the occurrence.

- *Document – XPDL: Artifact (DataObject)*

It represents the documents that are generated during the *process* and associated with the *file*. It is associated with the *procedural step* in which they were added in the *process*.

3.4 Modularity of Our Model

A major concern while designing our model was to keep it extensible and modular. The knowledge modeling must follow a modular approach (as must the software development), as this facilitates the various tasks that take place during the lifecycle of the model (maintenance, revision, reuse etc.) [6], as well as their understanding and adoption by third parties.

In our case, the modularity achieved in the design of the AIAM project provides it with a great deal of flexibility. Indeed, although in this section we have focused on the information modeling of processes, the AIAM agent is not limited to handling procedural knowledge. It also obtains and handles information from other knowledge sources that have been modeled and integrated for their interpretation by the agent. In Figure 3 we can see the organization of the different models that the agent uses. This information includes

the different types of documents that may be associated with procedural steps. The AIAM includes a taxonomy of them and of their associated metadata and also, based on the latter, manages the rights to access in the form of logical rules.

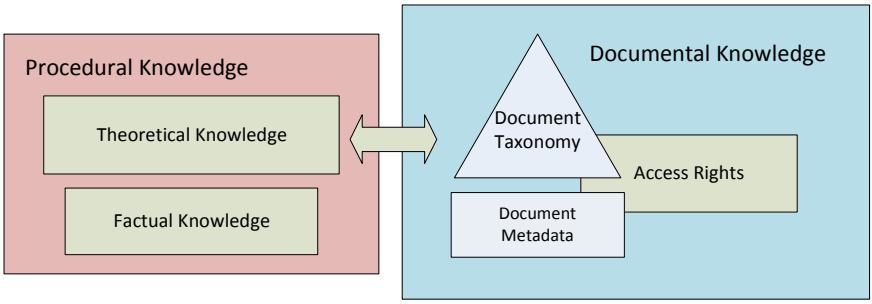

Fig. 3. Knowledge modules of the AIAM

4 The Deployment of the Agent in Municipal Administrations

4.1 The Environments for the Integration of the Agent

In recent years, two workflow tools for the processing of files by Spanish public municipal administrations have been developed. Both are distributed as free software. The first is SIGEM [12], developed through a Spanish Government initiative and the second is W@nda, by the Regional Government of Andalusia. Both tools have their own module for the definition of processes, but the most comprehensive is Model@, which is part of the second initiative and enables diagrams that define processes to be graphically created, managed and maintained, through the XPDL standard [14].

Our agent is developed in partnership with the councils of two cities — Huesca and Zaragoza – and its ultimate objective is its integration into the websites of these two public administrations. Huesca City Council is installing SIGEM for the management of its *files*, although there are still other platforms and the unification of all departments under SIGEM has not been proposed yet. For its part, Zaragoza City Council has been developing an ambitious project over the last three years so that all of its *files* will be processed using W@nda. Regarding the "catalogues of procedures", the contents of both organizations are on a database, with the objective of constructing their websites dynamically with information for the general public.

Also, given that the agent will give access to restricted information, it is essential that users are identified before using it. Therefore, within the websites of public administrations, the agent will be located in what is called the "citizen folder". Although in our model we have used this name to refer to the group of *files* of a citizen, its usual meaning is an area of websites of public administrations where access can be gained after logging in by members of the public and where all the information regarding their relationship with the organization can be found. The use of a recognized electronic certificate is required in practically all Spanish councils for access to the "citizen folder" [5]. Consequently, AIAM does not include mechanisms for identification, as it receives the user's identity of the environment.

4.2 Architecture and Interface with Users

One of the main requirements in the design of our agent was that it could be integrated into the websites of different administrations minimizing the deployment efforts. The adoption of a shared model and the integration of the available information using XPDL allowed us to develop our agent in a *black box* way, as it only communicates with the underlying information system to obtain that file. Consequently, each organization interested in the deployment of the AIAM agent on its website must develop a service, needed to construct a well-formed XPDL file, in accordance with the definition that has been developed during the project and whose main characteristics were described in Section 3 (see Fig. 4).

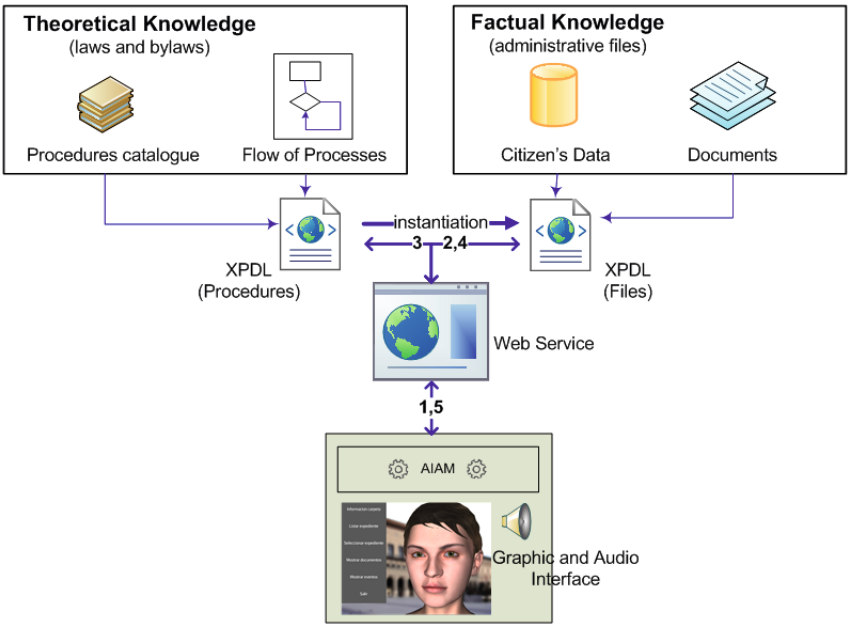

Fig. 4. Architecture of the AIAM agent

When a citizen logins, the AIAM agent invokes the appropriate Web Service deployed by the administration (Fig. 4, step 1) to retrieve the XPDL file containing the corresponding c*itizen folder*. This service consults the *files* currently being processed related to the citizen (Fig. 4, step 2) and then, retrieves the associated *procedures* (their theoretical definitions) to use them to build the final c*itizen folder* (Fig. 4, step 3). With the information available in the underlying system (the administration's *back-office* system) about the citizen and the different aspects of the *files*, the agent builds an XPDL containing all the relevant data (Fig. 4, step 4). Finally, once the XPDL file is created, the agent interprets and explains it to the citizen by means of a graphical and audio-enabled interface (Fig. 4, step 5).

As we discussed in Section 2, and as is reflected in the Figure 4, the knowledge that the AIAM agent handles is based on both theoretical and factual knowledge.

The XPDL *procedures* act as the classes of procedures that are instantiated to build the XPDL *files* file. However, although in this section we have focused on the procedure interpretation, we want to remark (recalling Section 3. 4) that the information that the AIAM agent manages is not restricted only to the content of the XPDL file, as the model has been designed to be extensible through the use of external URIs (following the principles of Linked Data [2]).

4.3 Experiences Learned

4.3.1 The Lack of Information Available for the Public

Apart from usability, the most important question when it comes to evaluating the functionality of the agent is the quality and quantity of information provided by it. However, this obviously depends on the existence of knowledge about the *files* in the information system of the council and on the way this knowledge is organized. We have seen that there are three information sources used by the agent. The first is the "catalogue of procedures", used for members of the public when they have a need and are searching for the appropriate procedure for their request and which is normally the most developed source in organizations. As future work, the possibility of extending the functionality of the agent to this phase prior to the initiation of *files* has been proposed, but at the moment, the agent focuses on procedural knowledge and uses information from the catalogue only as an accessory to describe some characteristics of the procedure followed in each file.

The second type of information is the one about files. Metadata are its main source, both about the file and the documents associated with it. Although very comprehensive sets of metadata are defined in the consulting phase prior to the development of the processing platforms, the ones that were really included in the development were the essential set for the management of *files*, and even then many lacked content. The result is that the information that may be provided to users is quite bare. Despite the above, there are interesting possibilities such as adding geographical information associated with files [1]. In our case, Zaragoza City Council has a very comprehensive geographical referencing system, named iDEZar [11], and the metadata from this type of information are completed in the majority of files. This has made it possible for the agent to connect to the geographical information of the organization, placing the *file* on a map when it is associated with a spatial reference. The encoding used for the exchange of this information is UTM30N, as this is what is used in IDEZar.

Finally, the third type of information is that regarding the procedural flow, including the various steps to be taken, bodies responsible for them and the specified periods for their execution. In this case there is also a lack of available information as the organizations chose to define a generic process model for the setting up of the processing platforms. This model is used for all procedures and council workers adapt each *file* process through the options to add new steps, which includes the workflow tool. Therefore, currently the AIAM can only report on common processes, which in many cases do not match the process that the file ultimately follows. However, the perspective is that this situation will improve as councils plan to model new processes, with Zaragoza City Council preparing to model the processes corresponding to town planning procedures, which is one of the largest areas of the

council. This work is carried out in order to incorporate the procedural flow into the processing platform. However, it can be re-used immediately to improve public information, without requiring additional work.

4.3.2 The Need of Metadata about Access Permissions

One especially serious consequence of the lack of definition and completion of the metadata is that there are many people who have the right to access *files* and cannot do so. The reason is the lack of metadata regarding the interested parties in *files*, which would be the means that the agent would have to decide who is authorized to access them and who is not. In the two councils where the agent is being installed, the only information from files regarding access permissions for members of the public is the identity of the promoter, who is the person that initiates the *file*. Consequently, even when the promoter acts as the representative of a person it is not possible to give file access to this person, as there is only information in the system about the representative.

There should also be metadata about permissions in documents, indicating, for example, whether they contain protected personal data or not. Also in this case, it should be remembered that, once files are finalized, some documents should be added to repositories accessible to the public as the law specifies free access to the documentation of finalized files. This legal provision was not complied with to a large extent when documents were on paper, but electronic management would enable automation and consequently would make the exercise of this right truly effective. Consequently, documents must include metadata regarding the existence or not of limitations to public access in each specified document from the time of their creation [10]. However, experience tells us that it is not enough to include metadata in the structure of documents, but that they should be assigned a content by default when preparing the templates of administrative documents, to ensure that document's metadata are not left empty. This is possible because in many cases it is possible to forecast, by being aware of the document's content type, if it will or will not be affected by these restrictions. Therefore the right to free access to the information of public administrations would be guaranteed, along with any rights that might be affected by access, because if access is allowed on template by default and there is an exception, a council worker would always be able to change the appropriate metadata in the corresponding instance of the document.

5 Conclusions

In this paper, we have proposed a model for both the theoretical and factual dimensions of the procedures that are part of the relationship between public administration and public. This model allows representing this information to be exploited to make it more accessible to the citizens. Regarding this, the AIAM project is defined as a line of research of our group dedicated to Open Government, whose objectives are the study and development of legal and technical mechanisms that enable the right of citizens to free access to information from the public sector to be supported as far as possible.

The experience gained through the AIAM project has enabled us to conclude that XPDL, which is a standard designed to automate the processing of procedures through workflow tools, can also be used as a basis for an agent that informs members of the public about the status of their *files*, by integrating the information about procedural steps already taken in their processing with that relating to what still needs to be done. Also, using the strategy followed in the project, this can be done by using the work carried out for the automation of the back-office of public administrations, which is thereby reused in order to inform citizens in the front-office. This agent, which integrates theoretical and factual knowledge, can also be applied in order to help civil servants in the processing of files, which is seen as one of the future lines for the wider application of the results of the project.

Finally, within this line of research, we have seen in several projects that it is important that requirements regarding public access to information are incorporated right from the initial developmental phases of electronic administration systems. Usually, only requirements proposed by the civil servants responsible for procedures are specified, but they do not prioritize the exercise of these rights and usually interpret them in a restrictive way. The result is that computer programs are constructed in such a way that it is not easy, and in many cases not even possible, to comply adequately with the rights of the citizens in this regard.

References

1. Lacerda, Y.A., de Figueirêdo, H.F., Feitosa, R.G.F., Falcão, A.G.R., de Souza Baptista, C.: Visual Modeling of Workflow with Support to Multimedia and Spatiotemporal Indexing. In: Andersen, K.N., Francesconi, E., Grönlund, Å., van Engers, T.M. (eds.) EGOVIS 2011. LNCS, vol. 6866, pp. 184–196. Springer, Heidelberg (2011)
2. Bizer, C., Heath, T., Berners-Lee, T.: Linked Data-The Story So Far. International Journal on Semantic Web and Information Systems (IJSWIS) 5(3), 1–22 (2009)
3. Burgos, P., Simino, M.T., Rodelgo, M.A., Ranz, A.: Gestor de Expedientes Normalizado GEN. In: Tecnimap 2010, Zaragoza (2010)
4. Business Process Model and Notation (BPMN), `http://www.omg.org/spec/BPMN/`
5. Directive 1999/93/EC of the European Parliament and of the Council of 13 December 1999 on a Community framework for electronic signatures, article 6
6. Gómez-Pérez, A., Fernández, M., Corcho, O.: Ontological Engineering. Springer, London (2004)
7. Gruber, T.R.: Towards Principles for the Design of Ontologies Used for Knowledge Sharing. In: Guarino, N., Poli, R. (eds.) Formal Ontology in Conceptual Analysis and Knowledge Representation. Kluwer (1993)
8. Hawryszkiewycz, I.T.: Process Modeling Semantics for Complex Business Environments. In: Janssen, M., Lamersdorf, W., Pries-Heje, J., Rosemann, M. (eds.) EGES/GISP 2010. IFIP AICT, vol. 334, pp. 155–166. Springer, Heidelberg (2010)
9. Nešković, S., Paunović, O., Babarogić, S.: Using Protocols and Domain Specific Languages to Achieve Compliance of Administrative Processes with Legislation. In: Andersen, K.N., Francesconi, E., Grönlund, Å., van Engers, T.M. (eds.) EGOVIS 2011. LNCS, vol. 6866, pp. 284–298. Springer, Heidelberg (2011)

10. Oliver-Lalana, A.D., Muñoz, J.F.: Collisions Between Data Protection, Transparency and Efficiency. In: Galindo, F., Traunmüller, R. (eds.) E-Government: Legal, Technical and Pedagogical Aspects, pp. 349–364. Universidad de Zaragoza, Zaragoza (2003)
11. Portolés-Rodríguez, D., Álvarez, P., Béjar, R., Muro-Medrano, P.R.: Idezar: an Example of User Needs, Technological Aspects and the Institutional Framework of a Local SDI. In: EC-GI&GIS/ESDI 2005, pp. 56–58. Utrecht (2005)
12. Sigem, http://www.planavanza.es/avanzalocal/soluciones/paginas/sigem.aspx
13. Verginadis, G., Gouscos, D.: MentzasG.: Modeling e-Government Service Workflows Through Recurring Patterns. In: Traunmüller, R. (ed.) EGOV 2004. LNCS, vol. 3183, pp. 483–488. Springer, Heidelberg (2004)
14. Wanda, http://www.juntadeandalucia.es/repositorio/usuario/listado/fichacompleta.jsf?idProyecto=33
15. Palkovits, S., Wimmer, M.A.: Processes in e-Government – A Holistic Framework for Modelling Electronic Public Services. In: Traunmüller, R. (ed.) EGOV 2003. LNCS, vol. 2739, pp. 213–219. Springer, Heidelberg (2003)
16. Wooldridge, M.J., Jennings, N.R.: Intelligent Agents: Theory and Practice. The Knowledge Engineering Review 10(2), 115–152 (1995)
17. XML Process Definition Language (XPDL), http://www.wfmc.org/xpdl.html
18. Zafeiris, V., Doulkeridis, C., Belsis, P., Chalaris, I.: Agent-mediated Knowledge Management in Multiple Autonomous Domains. In: Jurriaan van Diggelen, J., Dignum, V., van Elst, L., Abecker, A. (eds.) AAMAS/AMKM 2005, Utrecht, pp. 97–102 (2005)

The Co-Creation Machine: Managing Co-Creative Processes for the Crowd

John Debenham[1] and Simeon Simoff[2]

[1] QCIS, University of Technology, Sydney, Australia
debenham@it.uts.edu.au
[2] University of Western Sydney, Australia
S.Simoff@uws.edu.au

Abstract. Co-creative processes have spawned successes such as Wikipedia. They are also used to draw innovative ideas from consumers to producers, and from voters to government. This paper describes the initial stages of a collaboration between two Sydney-based universities to build a customisable co-creative process management system. The system has embedded intelligence that will make it easy and enjoyable to use. It will enable these powerful systems to be quickly deployed on the Internet to the benefit of the universities as well as industry and government. The innovation in the design of this project is that it is founded on normative multiagent systems that are an established technology for (business) process management but have yet to be deployed to support the co-creative process.

1 Introduction

Co-creation is an abstraction of: consumers working with producers to create value in the marketplace, individuals working with the likes of Wikipedia to generate intellectual property on the web, and programmers working on an open source software project monitored by some central body. Despite clear affinities between multiagent systems technology and what is needed to support co-creation [1], the multiagent systems community has largely failed to address these needs [2]. This paper describes the initial stages of a collaboration between the University of Technology, Sydney and the University of Western Sydney to build a customisable co-creative process management system. The core system manages the generic acts of co-creation and is customised by 'plugging in' a domain ontology and other domain-specific information.

This project is in its early stages. The aim of this paper is to share the innovative design, to build a customisable core, and the innovative implementation, based on normative multiagent systems technology. In this paper the following jargon will be used to synthesise the examples noted above:

- *consumers* (the possibly human agents who do the creating)
- *producers* (who constrain the process to ensure feasibility and maybe eventually produce a novel product)

A. Kő et al. (Eds.): EGOVIS/EDEM 2012, LNCS 7452, pp. 170–177, 2012.

– *ideas* (the things the consumers create) — an *idea* is a thought or suggestion of a possible course of action [OED]

The *experimental hypothesis* is that the *processes* involved in all co-creation systems have a major common core. Work to date has focussed on discovering what that common process core is. Interesting fragments have been identified, modelled, and mapped into a normative multiagent system architecture. Having modelled and implemented the common core then it is a matter of 'plugging in' domain specific ontologies and norms to the common core to create a working co-creative process management system.

Far from being a "free for all", successful co-creation is achieved when the producers maintain a firm control over the consumers' deliberations [3]. This leads to a requirement for a balance between controlled and free thinking — this balance is achieved by identifying appropriate *norms* in a normative multiagent system. The following key technologies are required to support co-creation:

– *negotiation and argumentation* to build consensus and develop ideas
– a *normative* 'institution' in which discussion between agents is focussed, moderated and controlled
– *mediation* to resolve differences between individuals and between "the ideas of a few" and "the opinion of the many"
– *excitement* measures of one individual's capacity to excite others to create — to *excite* is to set in motion, stir up, instigate, incite [OED] — measures how creative particular groupings are in context

Opportunities for co-creation are ubiquitous and university organisations are no exception. A key driver of this project is a desire from within both of the universities for more open governance and quicker response to market requirements. The following exemplar systems are being developed to assist in the identification of the generic processes in the core system:

– a system to evolve professional, post-graduate courseware in which the students are the consumers and the Faculty is the producer. This domain is selected as it is readily available. If this is successful then it could lead to a radically new, dynamic evolution of tertiary courseware. It takes account of the opinions of those who are most motivated to speak — the paying 'consumer' from the professional workplace.
– the design or re-design of academic faculty or department structures (and possibly the design and usage of university spaces e.g. designing a new building)

Additionally we are designing a trial for "Publish! Blue Mountains" which is an on-line solution provider in the publishing industry. This trial happens in two stages. First, the organisation's consultants are the consumers, the organisation is the producer and the ideas are solutions that are devised for a client. Second, if a contract is signed, the client is the producer, the chosen consultants are the consumers and the ideas are the delivered product — i.e. a publication.

The trials are generating insight into the identification of the generic processes. Particularly the requirements for the mediation function.

Section 2 discusses the variety of work on which this project builds. Section 3 describes the system architecture, and Section 4 concludes.

2 Background for the Work

This project builds generally on recent developments in: **co-creation systems**, **virtual institutions** (including their organisational structure, regulatory mechanisms and learning mechanisms), (agent) **argumentation**, **mediation**, **social measures**, and **information mining and pattern discovery**.

Co-Creation Systems. In this project, a *co-creation system* is a system that supports co-creative processes that involve producers and consumers. From the perspective of collective creativity, co-creation systems share much in common with participatory design systems that are 'one sided' collaborative design systems that may not include the producer role. The idea of co-creation as a marketing methodology dates to the 1990s. A large body of expertise has been established for co-creation including principles for success [4]. The early successes the triumphs in the context of Web 2.0 are astonishing with Wikipedia being a fine example. Given the rich interactive experience provided by Web 3.0 in virtual worlds it is reasonable to expect a further increase in the value of co-creation [5]. IdeaScale attempts to elicit consumer input in a structured way, it was used by the Open Government Dialogue initiative of the Obama Administration. A more significant system is found in the MIT Deliberatorium [3] that was one of the inspirations for this project. The Deliberatorium builds a map of ideas as "deliberation maps".

There are established research centres for co-creation research a notable group being the Danish Centre for Design Research, as well as dedicated research outlets a notable journal being CoDesign - International Journal of CoCreation in Design and Arts. There has been a flush of recent co-design systems particularly in engineering. For example Space Codesign Systems SpaceStudio that is focussed specifically at hardware and software co-design. The query "codesign platform multiagent" in Google scholar on 19/1/12 found ten papers all in the engineering field — of these four were 2011 publications and two 2010 publications. In contrast there appears to be little attention given to co-creation systems.

Social Measures. The social concept of *trust* has received considerable attention but is not directly relevant here where we are concerned with 'excitement'. The measurement of *intimacy* and *balance* that originated in [6] and the LOGIC model and its subsequent developments [7] are of greater significance to the measurement of 'excitement'. A major challenge in this project is to model the *excitement* between agents that ignites their joint ability to create, so developing a *social reputation* measure for groupings.

Argumentation, Mediation and Intelligent Agents. The agents in this project are to two types: each consumer has an agent that *supports* their argumentation and *manages* their argumentative process, there is also a *mediation agent* that operates independently to break deadlocks and to move the discussion to an agreed outcome. Most notable recent attempts for developing automated mediation agents include AutoMed [8], which operates with pre-defined set of issues and values, and proposes solutions that are combinations of these values, and MediaThor [9,10], which implements a case based reasoning approach, based on integrating analogical and common sense reasoning that allows both utilising experience with past cases in different domains and structurally transforming the set of issues for a new solution.

Mining Knowledge for and about the Co-Creative Process. Business process mining [11] is essential in understand large and complex distributed business processes like co-creation. In this project, we focus on the development algorithms for *crosscutting concern mining*, which targets those process features that are not assigned to a single module unit in the process and are thus scattered and tangled with other features [12]. Recent works in mining complex relation structures in social media [13,14] and multimedia data provide some starting points for doing that.

Virtual Institutions. The EIDE system developed by Spanish Scientific Research Council's IIIA laboratory in Barcelona is a seminal contribution to virtual institutions and the foundation for the work described here. In virtual institutions agents interact by exchanging *illocutions*, defined by a language and its ontology, and common protocols for communication. Agent *roles* are defined as standardised patterns of behaviour, constrained by a regulatory mechanism, enforced by the institution.

3 System Design

The following functions are required of a co-creation management system to support the 'consumer' user:

- to quickly provide *evaluations* on the feasibility of ideas — "the market view", "the expert view"
- the *boundaries* of acceptable ideas — limits within which the producer is prepared or able to produce
- a language and interaction medium in which the consumer *enjoys* developing ideas
- a repository of *existing* components and modules that could be incorporated in an idea
- the idea's *feasibility* and the producer's ability to produce it

The project is being managed as four sub-projects: *social measures*, *agent framework*, *context mining* and *virtual institutions*. These are now described.

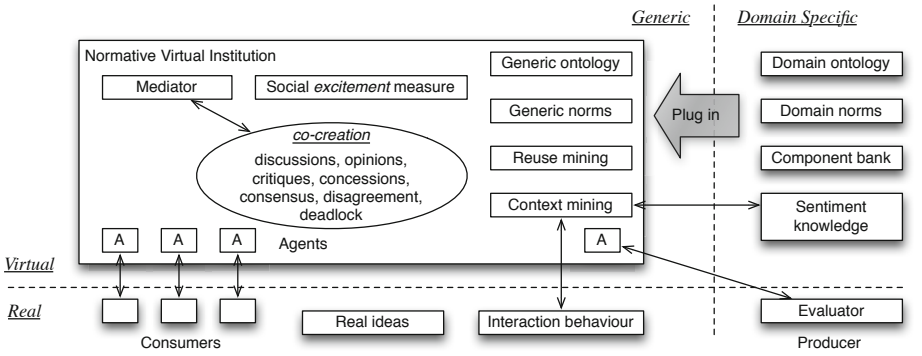

Fig. 1. Conceptual Framework of the Co-Creation Machine

3.1 Social Measures

This work builds on the rich models of relationships in our information-based agency project [6]. The artefacts under discussion are ideas and opinions of ideas. The *excitement* that a collection of agents generate during co-creative interaction is measured and fed to the excitement model. One important use of these measures is to assist the identification of fruitful partners that under given circumstances can be expected to 'spark' creative ideas — *emergent intelligence*. All of this being achieved by relating an analysis of past behaviour to and an assessment of the extent to which the present context is similar to that when the past behaviours were observed.

A key innovation in this project is the measurement of the *excitement* generated in the context of a co-creative process. As in previous work [7], we model excitement not as a single parameter but with reference to a framework. Using objective reporting the behaviour of agents and groups is measured with respect to their ability to *generate*, *reason* about and *critique* creativity that leads to three key dimensions of *excitement*. All of this happens in a highly volatile environment where opinions on opinions and on agents are uttered in the context of the moment. From these contextual pronouncements and using the structure of the ontology the agents form a view on the expected excitement generated by another agent at another time when the context may be similar but different.

3.2 Agent Framework

The language *language* designed is expressive enough to enable discussion on the extent to which opinions are valid or justified, and to modify and manipulate opinions in attempts to reach a consensus view. It is based on a Prolog-like notation. The objects of argumentation are ideas. An argumentation *protocol* and a *method of argument selection* are being implemented to gauge the extent to which it supports the development of ideas between agents. The design of the *mediation agent* is a substantial task as it too is operating in 'opinion

world'. It monitors interactions and, if they reach a deadlock, starts with eliciting and analysis of co-creators' opinions. Then it deploys *problem interpretation and reframing capabilities* in order to offer new opinions, combined with various *facilitation strategies and procedures* in order to communicate convincingly these opinions and move co-creators through various impasse-points in the process. The mediation agent is built on the architecture in [9,10] and approaches argumentation as a means for implementing facilitation strategies and processes. The agents all operate in the bounds set by the ontology and the norms, and attempt to key reusable components to ideas under discussion.

The subject of the agents' interaction utterances is opinions about ideas and opinions about opinions about ideas. There is no right and wrong here — just different opinions. The agent *argumentation language* supports reasoning on this abstract level. A rhetorical argumentation approach is used to attempt to draw ideas to a consensus. Further the *mediation agent* has the tricky task of understanding the essence of the point of difference between agents in a group and then constructively resolving that point of difference. The language supports a broad range of dialogues that includes argumentative dialogue about the way in which the interactions themselves should be moderated. The implementation of such a rich language in intelligent agents, whilst providing them with the necessary deliberative machinery both to go about their normal business and to engage in dialogues concerning opinions that are not right or wrong, is a major undertaking.

3.3 Context Mining

The context mining is founded on the specification of a rich data structure for the institutional information log so that it is suitable for process mining and sentiment knowledge discovery. It employs two sets of algorithms, focused at the individual and the system level, respectively in order to detect emergent individual behaviour from the logs and content of the exchanged messages between individual agents within the institution, suitable for evolutionary adoption. Behavioural pattern mining algorithms and sentiment knowledge mining algorithms (including sentiment lexicon miners) are time sensitive, i.e. capable of detecting specific behaviour, facts and lexicons with respect to specific episodes in time. The later include action sequence and related content to the scenes in the virtual institution [15].

The term *context* includes the environment in which each individual agent operates and the world in which the institution operates. Methods detect the need for change in an institution *based on both an "individual agent's" and an "institutional" perspectives.* The first group of mining algorithms operate over the data from the environment of an individual agent, by identifying patterns in the interactions, relations and transactions in which that agent is involved both within and beyond the "walls" of the institution. The second group of algorithms analyse the entire world in which an institution and co-creators are situated with respect to the evolution of institutional processes and individual.

The algorithms detect sentiment knowledge and behaviour patterns through *the identification of knowledge structures and episodes that may not necessarily be either frequent or outliers, but have the potential to lead to improved institutional performance outcomes* with respect to the key performance indicators.

3.4 Virtual Institutions

The virtual institution is the regulatory container for the co-creation system. A key challenge when designing any normative system is to determine norms that simplify agent interaction *whilst not preventing* the agents from creating new ideas. The foundation for the virtual institution is a *generic ontology* that enables agents to discuss, evaluate, criticise, disagree with, concede to, and otherwise manipulate opinions about ideas. The "Mediation Core Ontology" [16] was used as the starting point. The structure[1] of the institution is then conceived around the 'scenes' that agents choose to play out.

The normative virtual institution is the 'container' for the system. It is also the home of the regulatory normative apparatus that aims to keep ideas within the 'comfort zone' of the producer by constraining the dialogue. This is a delicate issue. If the consumers see the norms as being annoyingly restrictive then their enthusiasm may wane. If the norms are too lax then the consumers may waste time discussing the infeasible. The problem is to *strike a balance* between leaving the consumers' minds free to wander productively whilst preventing the conversation drifting out of the domain that the producer is prepared to sponsor.

4 Discussion

This short paper aims to generate interest in the multiagent, process management community in the problem of rapidly deploying co-creation systems. Creating value relies on mechanisms to manage and control the processes involved, mechanisms to value and appraise the agents involved, and integrated mining technology to produce the right information at the right time. This project is focussing on the generic co-creative process core into which domain specific details is 'plugged' to form a working system. In due course we will consider future immersive technologies of Web 3.0 that provide additional seductive visual stimuli in a 'real' social environment that will make the systems engaging and enjoyable to use. Unlike much of the work to date in co-creation, the work proposed has universal application as it focusses on modelling, understanding and supporting the co-creation *process* rather than the domain specifics of an application.

The problem of designing rapidly deployable co-creation systems is an open issue. We believe that this project is founded on the correct mix of intelligent technologies, and makes a significant contribution to the solution of this problem.

[1] EIDE is conceived using the theatrical metaphor in which there are *scenes* populated by *agents* that play certain *roles*.

References

1. Purvis, M.K., Long, A.L.: Affinities between multi-agent systems and service-dominant logic: Interactionist implications for business marketing practice. Industrial Marketing Management 40(2), 248–254 (2011)
2. Zwass, V.: Co-creation: Toward a taxonomy and an integrated research perspective. International Journal of Electronic Commerce 15(1), 11–48 (2010)
3. Klein, M.: How to harvest collective wisdom on complex problems: An introduction to the mit deliberatorium. Technical report, MIT Center for Collective Intelligence (2011), http://cci.mit.edu/klein/
4. Nambisan, S., Baron, R.A.: Virtual customer environments: Testing a model of voluntary participation in value co-creation activities. Journal of Product Innovation Management 26(4), 388–406 (2009)
5. Kohler, T., Fueller, J., Stieger, D., Matzler, K.: Avatar-based innovation: Consequences of the virtual co-creation experience. Computers in Human Behavior 27(1), 160–168 (2011)
6. Sierra, C., Debenham, J.: The LOGIC Negotiation Model. In: Proceedings Sixth International Conference on Autonomous Agents and Multi Agent Systems AAMAS-2007, Honolulu, Hawai'i, pp. 1026–1033 (May 2007)
7. Debenham, J., Sierra, C.: An Agent Model of Business Relationships. In: Bringas, P.G., Hameurlain, A., Quirchmayr, G. (eds.) DEXA 2010. LNCS, vol. 6262, pp. 126–140. Springer, Heidelberg (2010)
8. Chalamish, M., Kraus, S.: AutoMed: an automated mediator for multi-issue bilateral negotiations. Autonomous Agents and Multi-Agent Systems 24(3), 536–564 (2012)
9. Simoff, S., Sierra, C., López de Màntaras, R.: Mediation = Information Revelation + Analogical Reasoning. In: Meyer, J.-J.C., Broersen, J. (eds.) KRAMAS 2008. LNCS, vol. 5605, pp. 145–160. Springer, Heidelberg (2009)
10. Baydin, A.G., López de Mántaras, R., Simoff, S., Sierra, C.: CBR with Commonsense Reasoning and Structure Mapping: An Application to Mediation. In: Ram, A., Wiratunga, N. (eds.) ICCBR 2011. LNCS, vol. 6880, pp. 378–392. Springer, Heidelberg (2011)
11. Goedertier, S., De Weerdt, J., Martens, D., Vanthienen, J., Baesens, B.: Process discovery in event logs: An application in the telecom industry. Applied Soft Computing 11, 1697–1710 (2011)
12. Di Francescomarino, C., Tonella, P.: Crosscutting concern mining in business processes. IET Software 5(6), 552–562 (2011)
13. Tang, L., Liu, H.: Leveraging social media networks for classification. Data Mining and Knowledge Discovery Journal Online first (2011)
14. Lin, Y.R., Sundaram, H., De Choudhury, M., Kelliher, A.: Discovering multirelational structure in social media streams. ACM Transactions on Multimedia Computing, Communications and Applications 8(1), 4:1–4:28 (2012)
15. Kakishita, Y., Sasahara, K., Nishino, T., Takahasi, M., Okanoya, K.: Ethological data mining: an automata-based approach to extract behavioral units and rules. Data Mining and Knowledge Discovery Journal 18 (2009)
16. Poblet, M., Casellas, N., Torralba, S., Casanovas, P.: Modeling expert knowledge in the mediation domain: A mediation core ontology. In: In Casellas, N., et al. (eds.) 3rd Workshop on Legal Ontologies and Artificial Intelligence Techniques (2009)

A Worked Proposal on eParticipation for State Wide Elections

Artur Afonso Sousa[1], Pedro Agante[2], and Luís Borges Gouveia[3]

[1] Polytechnic Institute of Viseu, Viseu, Portugal
ajas@di.estv.ipv.pt
[2] Libertrium, Viseu, Portugal
pedroagante@libertrium.com
[3] University Fernando Pessoa, Porto, Portugal
lmbg@ufp.edu.pt

Abstract. Web 2.0 and, more recently, Social Media, created new forms of social behavior and political engagement. This paper presents a proposal for digital mediation for direct public participation during electoral periods. Mediation is implemented by a web application based on social media principles, *iLeger*, specifically designed to gather voters and candidates in a shared deliberative space. Interaction and collaboration between these key stakeholders is supported through questions, answers, suggestions, comments, votes and live debates. With this proposal it is intended to contribute to narrow the communication gap between voters and candidates, make campaigns more open and encourage citizens to become involved and participate in electoral debates. This paper includes results of a case study about the Portuguese Parliamentary Elections held in 2011 and conclusions derived from the use of *iLeger*.

Keywords: Elections, Campaigning, eDemocracy, eParticipation, Social Media.

1 Introduction

Today, the Internet is a tool that shapes lives in many respects. For some, the Internet is an open source of information, and for others it is a means by which they manage their bank accounts, shop and use public services. Many real life activities already have an online equivalent. Following this trend, the field of public participation has seen a growing integration of ICT and the Internet, leading to the concept of electronic participation - eParticipation [1].

Recently, uses of the Internet are becoming relatively more interactive and user-oriented. The Web 2.0 and more recently the rise of Social Media have not only created new playing fields for communication and self-expression but also new forms of social behavior as well as societal and political engagement [2]. Today, social websites such as Facebook, YouTube, Twitter, LinkedIn, Wikipedia and Flickr have millions of active users. With examples of mass mobilization such as the Arab Spring and protests against

A. Kő et al. (Eds.): EGOVIS/EDEM 2012, LNCS 7452, pp. 178–190, 2012.

the global economic crisis such as the We Are the 99 Percent (*http://wearethe 99percent.tumblr.com/*) and Occupy Wall Street (*http://occupywallst.org/*) movements, it is safe to argue that Social Media are changing the game of politics. In the literature review about Social Media and participation, Effing and colleagues state that Internet use by citizens is also becoming more social and participatory [3]. They furthermore argue that a key factor of Web 2.0 and Social Media is participation.

Growing numbers of citizens interacting with networked digital devices converts the Internet into an important communication medium in electoral disputes with clear differences from campaigns based on traditional media. According to [4], the real democratic contribution of online campaigns consists of exploring the Internet potential for interactivity and take electors from their role of passive mere spectators.

Nevertheless, considering, in electoral campaigns, either general online tools such as blogs, Internet campaign sites of the political parties, email, newsletters, or more traditional media covering TV broadcasts, debates, telephone calls, door-to-door contact or town hall speeches, they are mostly concentrated in unidirectional communication and do not support an efficient, scalable communication process based on all stakeholders' goals and needs.

After observing the traditional type of political communication and media coverage in electoral campaigns, a preliminary important research question emerged: How to engage citizens to participate actively in electoral discussions through digital mediation?

In order to address this question, we consider that it would be useful and desired to develop an application that unites, in a single, neutral and regulated place, the stakeholders in the electoral process, so as to allow structured and multidirectional communication between them. Such solution would take the form of an eParticipation tool and take into account the requirements and needs of the main actors: voters and candidates. On the one hand it would enable citizens to become clarified on the most important questions and problems of society and, on the other hand, enable candidates to be aware of citizens' ideas and main concerns by the general community in different governance topics (education, health, economy, justice, and so on).

As a result, we propose a Web application, *iLeger*, specifically designed to gather, during the election period, voters and candidates in an election in a shared deliberative space. With this application it is intended to narrow the communication gap identified between these two key stakeholders, make campaign representatives increasingly open to discussions with the electorate and convert the elector - from the traditional role of information consumer – into an agent with the capability to intervene and produce information.

ILeger is integrated into the project *Liberopinion* (*http://www.liberopinion.net*) which aims to create a technology platform in the field of participation and Social Media, with emphasis on interaction between users. Currently, the platform Liberopinion consists of two applications, the one described in this paper, *iLeger*, and *Governmeter* [5], which is intended to monitor the performance of governmental activity. In summary, *Governmeter* is a web application based on the principles of eParticipation, specifically designed to monitor and discuss, objectively and independently, the government activity and new laws at national, regional or local level. In a first stage, *Governmeter* is mainly focused on three aspects: the evolution of conjuncture indicators, the government objectives and government measures.

In more detail, *iLeger* combines in a neutral and regulated single space the key stakeholders in an election, the candidates and citizens, and promotes multidirectional communication between them. Interaction and collaboration is supported through questions, answers, suggestions, comments, votes and live debates. *ILeger* was recently tested in the Election of the Chairman of the Portuguese Medical Association (*http://om.ileger.sapo.pt*) and used in partnership with the largest Portuguese Web portal (SAPO – *http://www.sapo.pt*), property of Portugal Telecom, in the Portuguese Presidential Election of 2011 (*http://presidenciais.ileger.sapo.pt*) and in the Portuguese Parliamentary Elections of 2011 (*http://ileger.noticias.sapo.pt/legislativas/2011/*). In [6] are presented the results from a case study about the Portuguese Presidential Elections held in 2011.

Several online initiatives have been made available to help citizens clarify the issues and proposals by the different candidates. A known approach presents a questionnaire to citizens covering different issues, make a statistical comparison with the candidates' stances and derive the candidate that best matches the user answers [7]. This does not allow the citizen to communicate and submit questions to any of the candidates. The questions formulated are based in the electoral program as defined by each candidate and does not provide any basis for interaction. Other websites comparing the different candidates' proposals in several topics also exist [8].

On the other hand, another approach seeks to close the communication gap between citizens and politicians [9]. The list of political representatives, as well as election candidates, is displayed and it is possible for citizens to submit questions and for the politicians to answer. However, the website is designed around each political representatives and does not seem to provide neither a scalable solution when the number of questions increase, nor a direct comparison of candidates' answers to the same question and debate around the question and answers.

In [10] it is described a participation initiative by José Serra, a candidate to the Brazilian presidential elections of 2010. In summary, during the first round of elections, the campaign of José Serra launched an online communication platform with the objective to build a collaborative government plan, which enabled to gather contributions by citizens, specialists and other parties interested in political issues relevant to Brazil. To this end, several forums were created and classified according to the country region and topic being addressed. In [11, 12] is analyzed, from the perspective of eParticipation, the successful presidential campaign of Barack Obama during the 2008 elections. These approaches are essentially directed to involve the citizens around a particular candidature and do not bring together in a single space the set of candidates and citizens for multiparty communication and sharing of ideas and opinions among them, the purpose of the application presented in this paper.

The U.S. Politics on Facebook page (http://www.facebook.com/uspolitics) highlights the use of Facebook by politicians, elected officials, and political campaigns. In 2012, Facebook and NBC established a partnership and broadcasted live in http://www.facebook.com/uspolitics?sk=app_201387976576727 the Republican Presidential Debate. For this event, citizens were invited to submit questions in advance to the candidates. A selection of those questions was then used during the debate in addition to the questions from the moderator, David Gregory.

The selection criteria for the submitted questions was not public casting therefore doubt about how were these questions chosen. Another limitation has been recognized on the information organization level since there were no defined topics to frame the questions submitted by the citizens. Lastly, citizen submissions were limited to questions and it was not foreseen that citizens submit ideas or suggestions.

This paper is structured as follows: Section 2 describes the functional architecture of the *iLeger* Web application, while section 3 presents the results from a case study about the Portuguese Parliamentary Elections held in June 2011. Section 4 includes lessons learned, topics for future research and conclusions.

2 *iLeger* – Functional Architecture

ILeger is a Web Application designed and developed from the ground up to meet the needs and stakeholders goals in the electoral process, considering the two major groups of citizens and candidates. As illustrated in Figure 1, it consists of five main areas: questions from the citizens and corresponding answers from the candidates, proposals and ideas from the community, citizen surveys, the candidates´ electoral program and finally live debates. The editor is responsible for managing the platform, users and participation events.

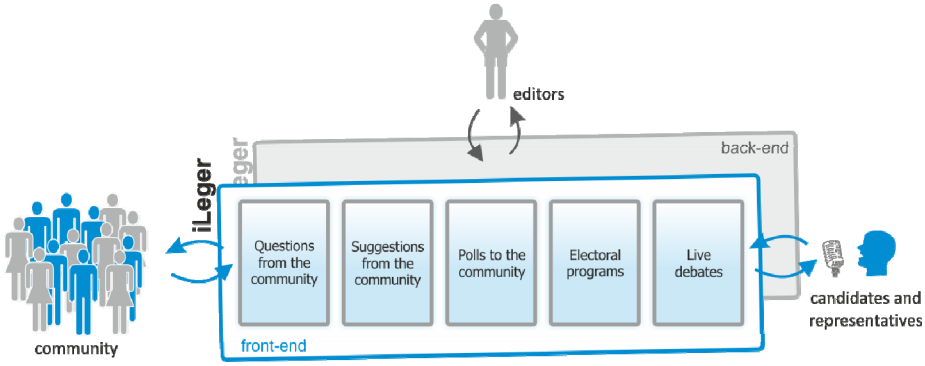

Fig. 1. Functional architecture of *iLeger*

In relation to user registration and access to the platform, by default, each user must be previously registered on the platform and have to login to take advantage of key capabilities such as submit questions, suggestions, comments and voting. If the user is not logged in, it is only possible to view the contents of the application. Nevertheless, it is possible to configure *iLeger* for different settings so as to enable interaction by non-registered users. For example, there is a setting in which non-registered users can vote but cannot introduce content and other that allows voting and content introduction. In the latter configuration, the only limitation to unregistered users is the lack of email notifications and additional features known from social networks such as following user and the access to a public profile.

By default, all the content submitted by citizens is subject to moderation [13] according to the platform Terms of Use. When the user registers himself or herself in the platform, it his mandatory to accept these Terms of Use. The actions of the candidates, on the other hand, are not moderated. The platform is configured to support different settings for moderation. For example, it is possible to publish directly all content, i.e. disable moderation, or moderate only entries denounced by the platform users. In order to encourage participation, citizens are permitted to request anonymity for all content submitted to the platform.

We believe that online social networks will be increasingly important for communities and citizens. We considered from very important to provide *iLeger* platform with social networking features at an early stage. Therefore, a registered user can follow other users registered on the platform, and see all the questions, suggestions and comments made by those users. All registered users have a profile area with personal information such as contact information, links to their social networks and personal blogs. In the public profile, the user activity as well as the associated social network in *iLeger*, i.e. followers and followed users, are displayed.

Seamless integration of the platform with existing social networks is also of paramount importance [14]. For this reason, and as a first step in that direction, it is possible for a citizen to publish his questions and proposals to Twitter and Facebook directly from the platform. Thus provide a more open interface to foster participation of enhanced opinion voice, as it augments the scope and potential impact of each individual's participation.

At the moment, *iLeger* can be configured regarding the type of interaction of candidates. *iLeger* is foreseen to be used in two scenarios: with or without direct interaction by candidates. With interaction, the candidates have an access account and are responsible for the introduction of content, allowing direct communication with other users. In the absence of candidate interaction, *iLeger* can still be used to identify key issues and suggestions from voters, as well as their views on the key issues about the election. The editor can also publish information about the candidatures for citizens to analyze and comment.

Next, using UML-based use case diagrams we present the main functional requirements of *iLeger* per main actor. They illustrate the main interactions each one of them can perform within the platform.

2.1 Citizens

Citizens can submit questions, suggestions, comments, vote, join live debates, set criteria for receiving notifications (e.g. when a candidate answers a question or publishes a comment to user submitted suggestion, when another user replies to a submitted comment, among others), follow another citizens and candidates, edit public profile and propose improvements to *iLeger*.

As depicted in Figure 2, citizens have also access to a large amount of information. For example, they can consult and compare the answers from candidates to the questions submitted; consult, evaluate and comment on the different electoral programs presented by each candidature; consult the public profile of the candidates

and their followers; view the activity of the candidate on the platform; consult the events archive; visualize statistical results; view the most voted questions and most popular suggestions, among others.

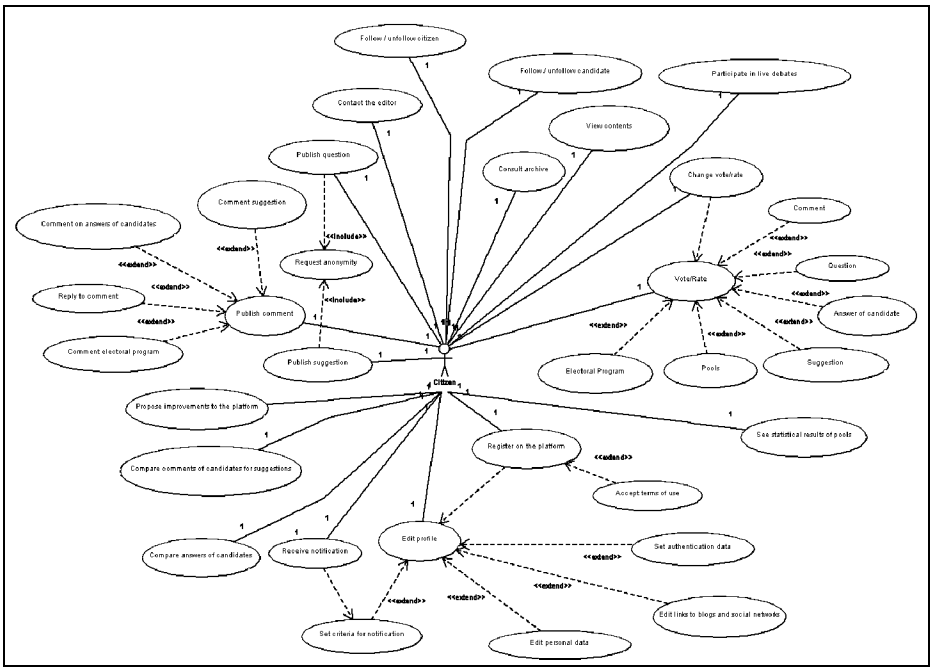

Fig. 2. Simplified use case diagram for a citizen

2.2 Candidates

If *iLeger* is configured to have direct interaction by candidates or their representatives, as illustrated in Figure 3, they can edit their profile, answer questions submitted by citizens, comment on suggestions, mark questions and suggestions to answer or comment later, comment on submissions from other candidates, participate in live debates, view results from user surveys, define settings for receiving notifications (e.g. receive an automatic notification whenever another candidate comment his own answer to a user question, whenever another candidate publishes a comment to his electoral program, among others), publish his Electoral Program – EP – incorporate citizen suggestions into his electoral program and comment other condidate's electoral program.

The wide range of information mentioned as being available for citizens is likewise available for candidates. In addition, the candidates can also view statistics about their performance, including ratings to their answers and to their electoral programs, their activity level in the platform, as well as their position within the ranking of best answers, among others.

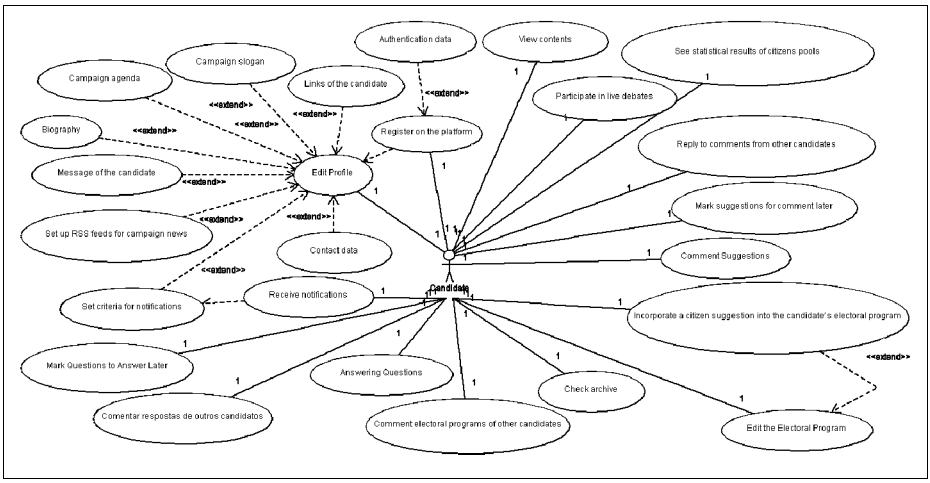

Fig. 3. Simplified use case diagram for a candidate

2.3 Editor

User management, platform configuration and editorial management of participation events are performed via a dedicated section, the Backoffice. The editor can create participation events for gathering questions and suggestions, for surveying the community and for holding live debates. The editor can highlight and give emphasis to these events by publishing information about them in the front web page of each section (questions, suggestions and live debates) up to a maximum of four simultaneously. In regard to moderation of user submitted content, the editor can define the moderation level applied to individual participation events. If the editor activates moderation for a participation event, all content submitted by citizens will be subject to moderation. In this case, the editor as a moderator scrutinizes content according to the Terms of Use of *iLeger*. Finally, the editor can mark particular questions or suggestions among the full set of questions or suggestions to be included in an editorial selection named Top Questions and Top Suggestions.

If *iLeger* is configured for no direct interaction by the candidates, the editor can use the platform to publish information about each candidate including campaign slogan, biography, campaign schedule, personal messages, news via RSS feeds, campaign images, campaign videos, links to the candidates' official website, social networks and election program. In this scenario, the editor can still use *iLeger* to identify the best questions submitted by users. These will then be forwarded to all candidates giving them the possibility to answer them by other means such as email. Finally, the editor uses the platform to publish the answers of the candidates allowing thus citizens to compare their stances on the issues questioned. Figure 4 illustrates the main interactions supported by the platform in regard to the editor.

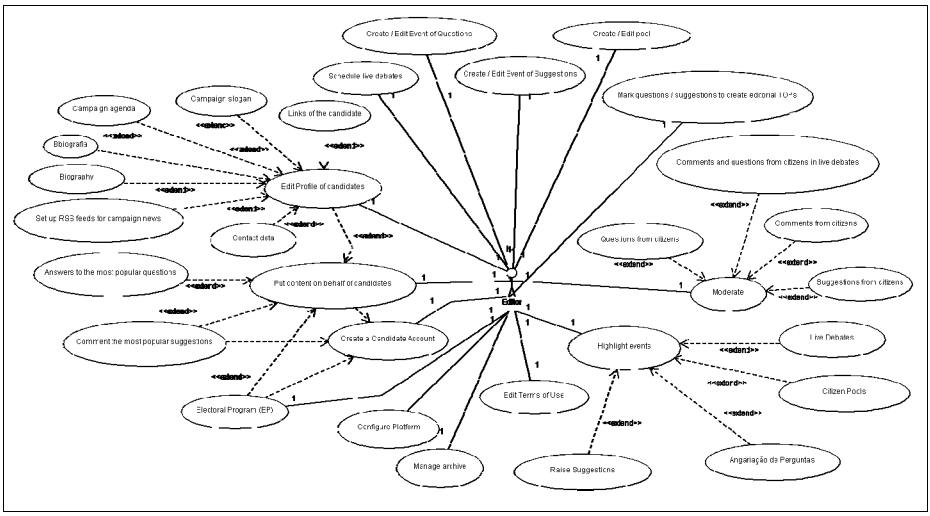

Fig. 4. Simplified use case diagram for an editor

3 Case Study: The 2011 Portuguese Parliamentary Elections

iLeger was used in partnership with SAPO, the largest Portuguese Web portal and property of Portugal Telecom, during the Portuguese Parliamentary Elections held in June of 2011. It covered the last two weeks before the elections, from 20 May to 3 June.

The version of *iLeger* used in these elections was configured so that users had to be registered in order to submit content (questions, suggestions and comments) and vote. All written content submitted by citizens was thus subject to moderation. Representatives of the different candidatures only participated in live debates, which in this last case did not require prior registration before participation.

For user (citizen) registration, the single sign on (SSO) mechanism from our partner was used. This way, users already registered on SAPO could log in to *iLeger* without the need for new registration. We recorded 290 distinct users who have logged in, that is, who were enabled to submit written content and vote. Statistics extracted from Google Analytics showed that during the two weeks 21.486 unique users visited *iLeger* (total of 44.777 page views). The logged in to (unique) visitors ratio amounts therefore to 1,3%.

Citizens were invited to submit and vote on questions on different topics to create the ten most voted questions, the top 10, to be posed simultaneously to candidates during a live debate held in 31st of May in *Instituto Superior de Ciências Sociais e Políticas* (ISCSP). The Institute for Social and Political Sciences - ISCSP, one of the Technical University of Lisbon units, is a school aiming at education and research in the areas of Social and Political Sciences. In total, three participation events were created for this purpose. Each one of them was assigned a deadline for submissions, 30th of May, and a different topic: economic growth, social state and foreign aid. It

should be noted that given the economic and financial context of Portugal at that moment these were the dominant topics addressed during the electoral campaign.

To this end, registered citizens submitted questions and voted for their relevance. In total the moderator accepted 107 of the 116 questions, yielding thus a rejection rate of 8%.

The debate held in ISCSP was moderated by the director responsible for the news channel of online portal SAPO and, through a partnership between SIC TV News channel and SAPO, it was broadcasted live in *iLeger* over an online streaming channel. The ten most voted questions in *iLeger* were used in the debate and were answered by each of the political guests. Figure 5 illustrates the broadcasting of this debate using the area in *iLeger* intended for live debates.

Fig. 5. Live debate transmitted over an online streaming channel in *iLeger*

Highly reputed politicians have acceded to participate in this initiative, including parliamentary leaders and politicians that became part of the elected government as ministers.

Additionally, in the second week of campaign six live debates were conducted, one with each candidature. Each debate lasted an hour and a half. Over the six debates

there were 3779 entries submitted in the form of questions or comments. However, by restrictions of time and moderation, only 133 of these entries were addressed by candidatures. Users were not required to be registered in *iLeger* to take part in live debates.

It is important to note that, according to Google Analytics, from the 21.486 unique visitors over the two weeks, 19.419 entered *iLeger* for the first time during the live debates, demonstrating the interest of citizens to participate in live events of short duration. In Figure 6 it is shown the number of *iLeger* visitors between 20 May and 3 June 2011.

Fig. 6. Number of *iLeger* visitors between 20 May and 3 June 2011

We believe that the high attendance level during the days of live debates was due to prominent and frequent advertisement of these events in our partners' homepage. This demonstrates the importance of advertisement and awareness among the electorate and general population required for the success of this kind of events. We consider that the media, both traditional and online, have a very important role when pushing forward citizen-based participation initiatives such as this one.

Over the two weeks of campaign registered users submitted a total of 50 suggestions, with 9 rejected by the moderator. In this section of *iLeger,* the editor created three simultaneous events for gathering user suggestions on what they would do if they were: the German Chancellor, the president of IMF (International Monetary Fund) and the president of the European Union. The editor assumed that these roles as decision-makers had a major role in any foreign aid program to Portugal.

Overall there were 299 votes on questions, 92 votes on suggestions and 1073 votes on the 15 questions of the survey.

It is also interesting to note that, without taking into account the live debates, from the 290 users who have logged in, 156 have submitted written content (116 questions and 50 suggestions) or have performed the action of voting on the questions, suggestions and inquiries. This indicates that, as illustrated in Figure 7, approximately 54% of the users that logged in, participated actively in *iLeger*.

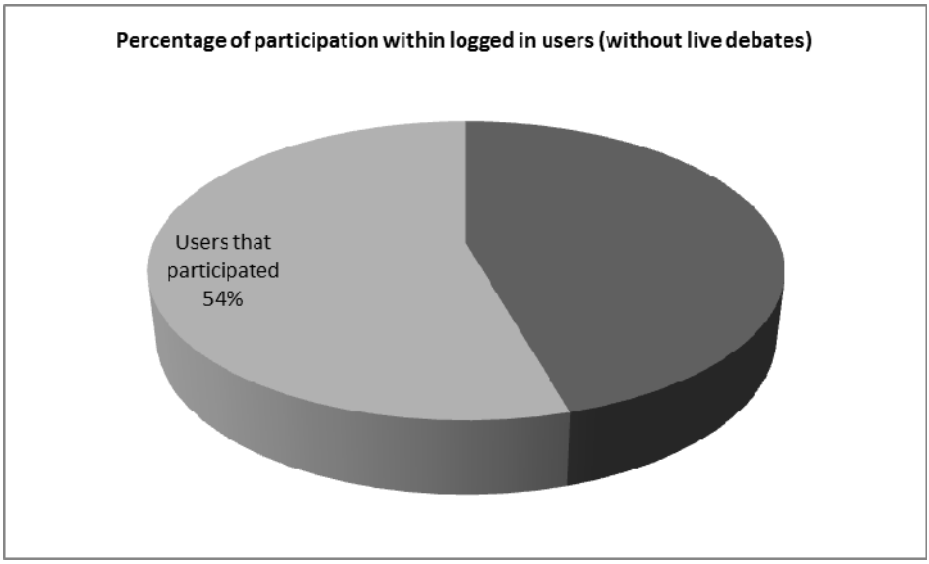

Fig. 7. Percentage of participation within logged in users (without live debates)

In these elections *iLeger* was primarily used to identify key issues and suggestions from voters, as well as their views on the key issues of the election. Through live debates, it was also possible to obtain a better insight of the viewpoint of representatives of the candidatures regarding the 10 questions most voted by the citizens in the first week as well as other live questions. By comparing the viewpoints, the citizens will have additional information about the candidates´ position on the important issues, helping them decide for their best candidate.

4 Conclusion

In the use of Web communication tools to reach voters on general elections, there has been major investments by political parties and corresponding candidates on Weblogs, social networks such as Facebook, Twitter, Youtube, MySpace, and on dedicated websites through which the candidates attempt to present their positions and their electoral program.

In this paper an approach based on digital mediation for supporting direct public participation during electoral periods is proposed. More precisely, it is proposed a Web application based in Social Media principles, *iLeger*, specifically designed to gather voters and candidates in a shared deliberative space. The main objectives consist of contributing to narrow the communication gap between voters and candidates, making election campaigns more open and encourage citizens to participate in electoral debates.

Although we strongly believe that participation tools based on the Internet and Social Media, such as social networks and the application presented here, will be

increasingly important in election campaigns and, if properly used, have the potential to contribute significantly to reversing the current alienation of citizens from election debates, it is argued that the main focus must be primarily on participation and the people (citizens and candidates) rather than on technology.

In view of the results and experiences with the use of *iLeger* in the election of the President of the Medical Association, the Presidential and Legislative elections of 2011 held in Portugal, and in light of feedback received from some of the actors involved in these elections, when faced with the research question "How to engage citizens to actively participate in electoral discussions through digital mediation? ", it was still not possible to reach a conclusive answer. Nevertheless, from the results of *iLeger*, we concur with the statement in [15, 16] that the problem of eParticipation is not just a matter of technology but also of a social shift to a more open and collaborative culture.

It is expected that candidates and other political representatives take advantage of Internet ubiquity and shift their main focus from traditional media in favor of Web 2.0 and Social Media for their electoral and communication strategy and spend more time and human resources to promote and participate in initiatives that bring them closer to citizens.

In regard to results from the use of *iLeger*, we consider that in participatory initiatives like this one broad advertisement is a key factor for its success. It was clearly noticeable that whenever an ad about an initiative in *iLeger* was published in our partner homepage the number of visitors increased considerably (about 90%). The partnership with one of the major online media agency in Portugal was also an important enabling factor for attracting politicians to participate.

Hence, it is considered that the media can play a major role in eParticipation initiatives. They have already a large community of users and visitors with some habits of participation, e.g. by comments to the news. On the other hand, they possess an established group of experts and analysts who can greatly contribute to a high quality of debates. Journalistic experience can also be an advantage to ensure a high standard of quality for the editorial content introduced. Nevertheless, it is of paramount importance that the editorial content published in the platform remains under absolute political neutrality.

Another important contribution from our experience concerns the editorial management of this kind of applications. The traditional user of the Internet seeks constantly new content. Thus, it is considered that citizens (and politicians) should be invited to participate in events of short duration and about the news of the moment. Media are in a privileged position to become the major information curator [17] of platforms dedicated to eParticipation.

During the Portuguese Parliamentary Elections held in June of 2011 all written content submitted by citizens to iLeger was subject to moderation. As a topic for further research, it would be interesting to use iLeger without moderation and compare the results with other eParticipation platforms designed under the concept of liquid democracy such as open source liquid feedback software (http://liquidfeedback.org/) and Adhocracy (http://code.adhocracy.de/en).

Finally, the following question is left open for future research: What is the impact of mechanisms of digital mediation in participation?

References

1. Sanford, C., Rose, J.: Characterizing eParticipation. International Journal of Information Management 27, 406–421 (2007)
2. Kes-Erkul, A., Erdem Erkul, R.: Web 2.0 in the Process of e-participation: The Case of Organizing for America and the Obama Administration. National Center for Digital Government, Working paper No. 09-001, submitted October 6 (2009)
3. Effing, R., van Hillegersberg, J., Huibers, T.: Social Media and Political Participation: Are Facebook, Twitter and YouTube Democratizing Our Political Systems? In: Tambouris, E., Macintosh, A., de Bruijn, H. (eds.) ePart 2011. LNCS, vol. 6847, pp. 25–35. Springer, Heidelberg (2011)
4. Bimber, B., Davis, R.: Campaigning Online: The Internet in U.S. Elections. Oxford University Press (2003)
5. Sousa, A.A., Agante, P., Gouveia, L.B.: Governmeter: Monitoring Government Performance. A Web Based Application Proposal. In: Andersen, K.N., Francesconi, E., Grönlund, Å., van Engers, T.M. (eds.) EGOVIS 2010. LNCS, vol. 6267, pp. 158–165. Springer, Heidelberg (2010)
6. Sousa, A.A., Agante, P., Gouveia, L.B.: *iLeger*: A Web Based Application for Participative Elections. In: Tambouris, E., Macintosh, A., de Bruijn, H. (eds.) ePart 2011. LNCS, vol. 6847, pp. 228–239. Springer, Heidelberg (2011)
7. SmartVote, `http://www.smartvote.ch/` (accessed March 15, 2011)
8. CNN ElectionCenter 2008, `http://edition.cnn.com/ELECTION/2008/issues/` (accessed May 6, 2010)
9. Abgeordneten, `http://www.abgeordnetenwatch.de/` (accessed May 20, 2010)
10. Aggio, C., Marques, J., Sampaio, R.: Campanhas Online, Participação Política e Esfera Pública: O Caso do Plano de Governo Colaborativo nas Eleições Brasileiras de 2010. Public Sphere Reconsidered -Theories and Practices, pp. 3–21. LabCom Books (2011)
11. Talbot, D.: How Obama Really Did It: The social-networking strategy that took an obscure senator to the doors of the White House. Technology Review 9/10 (2008)
12. Greengard, S.: The First Internet President. Communications of the ACM 52(2), 16–18 (2009)
13. Wright, S.: Government-run Online Discussion Fora: Moderation, Censorship and the Shadow of Control. British Journal of Politics and International Relations 8(4), 550–568 (2006)
14. Taylor-Smith, E., Lindner, R.: Using Social Networking Tools to Promote eParticipation Initiatives. In: Prosser, A., Parycek, P. (eds.) Proceedings of EDEM 2009 - Conference on Electronic Democracy, Vienna, pp. 115–121 (2009)
15. Moreira, A.M., Moller, M., Gerhardt, G., Ladner, A.: E-Society and E-Democracy. In: eGovernment Symposium, Berne, Switzerland (2009)
16. Stromer-Galley, J.: On-Line Interaction and Why Candidates Avoid It. Journal of Communication 50(4), 111–132 (2000)
17. Rosembaum, S.: Curation Nation: How to Win in a World Where Consumers are Creators, 1st edn. McGraw-Hill (2011)

Test Implementation of the "Guarantor" Internet Voting System: Design Principles, Operation, and Approbation

Sergey Ablameyko[1], Nikolai Kalosha[2], Sergey Bratchenya[3], and Vitali Lipen[3]

[1] Belarusian State University, Minsk, Republic of Belarus
ablameyko@bsu.by
[2] Institute of Mathematics, National Academy of Sciences of Belarus, Minsk, Republic of Belarus
n.kalosha@gmail.com
[3] United Institute of Informatics Problems, Minsk, Republic of Belarus
(lipen,bratchenya)@newman.bas-net.by

Abstract. An experimental web portal realizing the functions of the "Guarantor" internet voting system is presented. Basic design principles of the system are summarized, together with the motivation behind their choice and the benefits of implementing the "Guarantor" system or a different e-voting system offering similar functionality to emerging democracies. Structure and operation of the system are explained, also touching upon the cryptographic instruments used in the system.

Keywords: e-voting, e-democracy, e-participation, internet voting, trusted voting, election transparency.

1 Introduction

Analysis of worldwide developments in electronic voting (EV) technologies, the authors' research experience from the end of the 90s to the present day, as well as recent papers and conference talks on the subjects of e-voting, e-government, and e-democracy have strengthened the authors' conviction, which is shared by other researchers in the field, that the readiness for the transition to EV as well as the optimal choice of a particular EV technology significantly depends on the level of general IT readiness, the mindset of the citizens, and the structure of the government-societal relations. In the authors' recent publications [2], this connection was explored with respect to Belarus and other emerging democracies, giving a justification for a development of an EV system taking the factors outlined above into account. An example of the realization of the developed principles is the "Guarantor" system presented in this paper.

In the countries with long-established traditions of democracy, e.g. most of the EU countries, paper ballot voting raises few concerns from the citizens as the danger of election fraud is perceived as nonexistent by the public. The citizens also aren't apprehensive about openly stating their political views, and the election results generally agree with the previously conducted evaluations of the ratings of different political

A. Kő et al. (Eds.): EGOVIS/EDEM 2012, LNCS 7452, pp. 191–201, 2012.

parties and individual leaders, as well as the exit poll results. The major reasons for transitioning to EV for such countries are lower costs and vote tallying times compared to traditional technologies, and the desire to increase the involvement of younger citizens in elections through introducing new more attractive technologies.

In the emerging democracies, which are most of the ex-USSR countries, African and Middle Eastern states, the subject of real or imagined election fraud is an extremely polarizing topic. Even a cursory examination of elections held in one of these countries and its aftermath reveals the numerous issues with the paper ballot voting, such as the lack of transparency and a high degree of vulnerability to fraud committed by election officials. Looking at Russia and several other countries, it is obvious that the local administration, which is the main organizer of the election process, is often pressured into producing the election results, which have been defined in advance by the central administration, by any means possible.

On the threshold of presidential elections in Russia the question of election fraud has become one of the hottest topics in the Russian media and the society. The government spent over 400 million dollars just to enable real-time internet forecasting of the elections through web cameras. Additional expenses included employment of thousands of observers, purchasing transparent ballot boxes, and electronic scanners to automate vote tallying. However, the aftermath of the elections has proved that all of these measures have neither eliminated fraud nor had the desired effect on the opinions of the Russian public and the international community. Accusations of fraud and mass manifestations demanding honest elections have followed immediately after the results have been announced.

Experts point out that one of the key reasons why the public is inclined to believe accusations of election fraud, even if the evidence is far from definitive, is that it is impossible to prove to an individual elector that his or her vote has not been tampered with. Indeed, paper ballot voting involves immediate and complete depersonalization of the votes, and any drill-down procedures can only operate on the ballots collected by election officials at each polling station. Mistrust in the fairness of elections, as well as negative feelings for the immutable authoritarian regime, result in a large proportion of the voters ignoring the elections altogether, and many of the rest being apathetic towards their choices. After the elections, the media soon make it common knowledge that at least some of the officials committed election fraud in favor of the ruling party, and the opposing parties never fail to claim that they have been robbed of a victory. This often leads to lengthy and numerous mass manifestations, which sometimes turn into violence.

Traditional voting technologies make it incredibly hard for the losing side to collect enough evidence of election fraud, proving any claims of unfair elections in court. On the other hand, as shown by the Russian parliamentary elections of 2011 and the presidential elections in 2012, the winning side also doesn't have an instrument for convincing the public that the accusations of fraud are groundless, or at least that fraud only took place in a few isolated cases.

In the authors' opinion, an independent computer system that automates the elector registration, voting, tallying and publishing of the election results can eliminate the possibilities of fraud, and thus take the wind out of the accusations thrown around by the losing sides. The cost factor is also significant, as Russia plans for an increase in the number of elected officials (such as governors and municipality leaders), leading

to increased costs of elections, which could be partly mitigated by introducing a centralized automated systems capable of holding election events in remote organizations and regions.

Deficiencies of paper-based technologies also become evident during the nomination of the presidential candidates. In Russia, both Grigori Yavlinski and Vladimir Prokhorov have collected the required 2 million signatures in their favor. However, Yavlinski was barred from the elections on the grounds that a part of the signature sheets were presented as digital copies and not the originals. This led to an outcry in the media, raising two valid questions: is it necessary to collect such an immense amount of signatures, and was it right to reject the digital copies without any evidence of the signatures having been fraudulent? The traditional procedure of nominating the candidates through collecting manual signatures on paper seems both archaic and unreliable, prompting the transition to an electronic nomination process similar to the one used in the EU.

It is easy to see from the above that for the countries where the civil society is still emerging, a transition to electronic voting should be extremely attractive. Not only would EV be more cost-effective, but implementation of an EV system specially designed to solve the identified problems of paper ballot technologies, it could also break the "tradition" of post-election accusations of fraud, followed by a media storm, mass manifestations, and ultimately violence.

2 Basic Principles behind the "Guarantor" System

Emergence of the proposed "Guarantor" system was a logical next step in the development of computer systems designed to automate voter registration, voting, tallying and publishing of votes, printing of paper voting protocols and submission of the local results to a central server at polling stations. Such a system was developed and patented by one of the authors in 2003–2005 for the Republic of Kazakhstan, serving as a prototype for the "Sailau" voting system, which has been installed at 1446 polling station and used for multiple nationwide elections [3], [6].

The main motivation for the development of the system was that despite quick acceptance of electronic voting in USA, Canada, Australia, India, Brazil, Venezuela, Russia and several other countries, Ireland, the Netherlands, Germany and Switzerland have halted their e-voting programs. Another important factor is cost-efficiency: the existing e-voting systems are quite expensive, requiring installation of costly equipment at the regional polling stations. It is notable that this equipment remains unused for most of the time, and is only activated during the voting events. The authors have also analyzed the recently introduced Estonian e-voting system and the Austrian student elections of 2009 [4]. In the opinion of the authors, the main drawbacks of the mentioned systems are the same immediate depersonalization of votes as in traditional paper ballot voting and lack of provisions for audits and vote recounts. The authors aim to address these issues in the proposed system.

The next-generation system jointly developed and approbated by the authors was based on the concepts of the "Guarantor" system. It realized a number of functions available in that system and can interface with its central server. Results of testing this EV

complex realized as a standalone digital system to enable electronic voting (and other functions mentioned above) at polling stations was presented at E-Dem-2009 [1].

1. The subsequent development of an internet voting server of the "Guarantor" system was motivated by explosive growth of internet users in Belarus, Russia, and many other emerging democracies. Internet voting doesn't require any specialized on-site equipment, instead, one of the millions internet access devices such as personal computers, smartphones, tablets or even electronic books. In the opinion of the authors, implementing a voting system as an independent internet-based processing center, which would communicate with personal or office computers, as well as various web-enabled mobile devices, presents a solution to most of the issues mentioned in the introduction for the least cost. Below the authors formulate the ideas and principles behind the "Guarantor" system which make it essentially different from the various existing EV systems described, for instance, in [7], [5], [8].
   The "Guarantor" system is a basic component of a non-governmental processing center, which acts as a provider of services for organizing polls, elections, popular votes, nominations of candidates, etc., to remote organizations, municipalities, towns, and countries.
2. Registering an election event in the system requires, aside from making the required payment, filling an electronic form with the information about the future election event, and submitting a list of the electors, as well as detailed information on the possible voting choices. The organizer then receives a list of cryptographic codes, and the credentials for moderating the election event, i.e. starting and stopping various stages of the election process. An administrator of the "Guarantor" system makes the decision on whether the correct procedures were followed and if the election results are valid.
3. All of the operations required for voting are performed by the electors by accessing the independent registration and casting servers, as well as the web portal of the system. Vote anonymity and accuracy of the tallying is guaranteed by the design of the system and cannot be compromised by the staff supporting the operation of the "Guarantor" system or the organizers of the event.
4. Every elector is given the ability to control every stage of personal registration and voting. Electors and external auditors can verify every stage of the tallying of the votes.
5. Authentication procedures use 'captchas' to protect the system from 'bot' attacks.
6. Confidentiality of votes is guaranteed through use of independently operating authentication/registration and casting servers.
7. Every voter may confidentially verify the accuracy of recording his personal vote. This is achieved by storing not only the depersonalized aggregated voting results, but also individual votes through hidden personalization.
8. The system does not depend on costly identification cards, relying instead on confidentially distributed credentials for registering as a voter.

3 Structure and Operation of the "Guarantor" e-Voting System

Presented in Fig. 1 is an outline of the interactions between the subjects of the electoral process with the 'Guarantor' system acting as the trusted third party. The system is comprised of four servers: the web portal server, the authentication/registration server, the casting server and the cryptoserver.

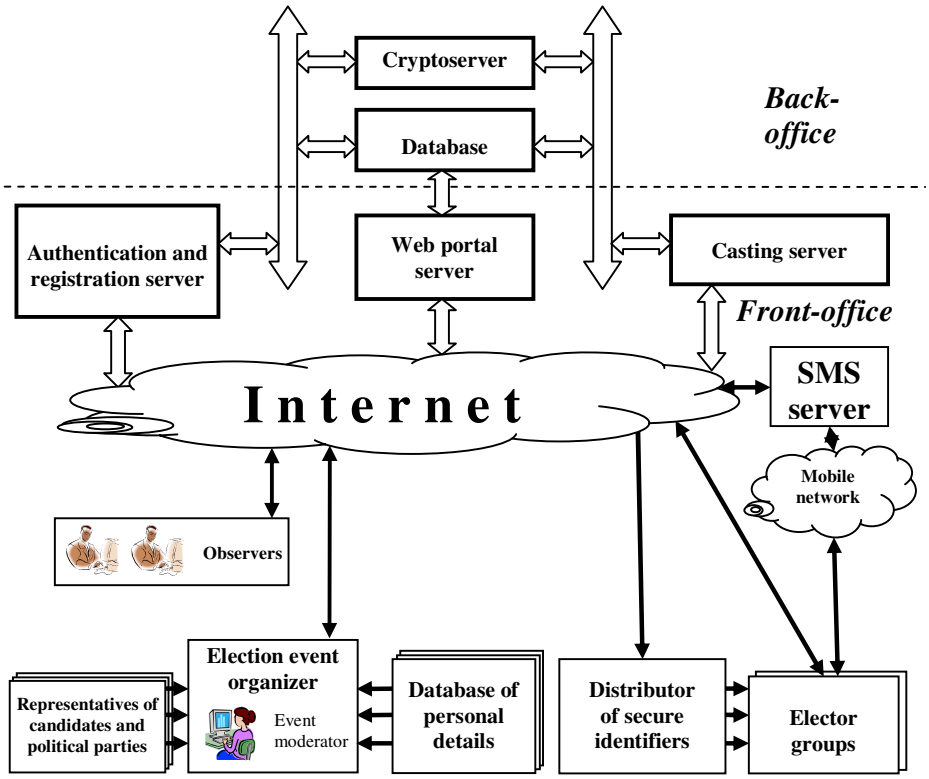

Fig. 1. Internet voting using the 'Guarantor' system

A notable feature of the proposed voting system is the mechanism used to authenticate the electors, based on using personal data in conjunction with SIDs (secure identifiers) distributed to the electors in confidence before the elections. A detailed description of SID generation can be found in [1]. To briefly describe the properties of SID, we will note that each SID is generated as $SID_i = EID_i \oplus F_{crypt}\ (EID_i, K, R_i)$, where EID_i is a unique number identifying the elector, $\oplus$ is the concatenation operator, and F_{crypt} is a secure cryptographic function taking as arguments the identifier EID_i, the secret key K, and a randomly generated number R_i, which is stored in a remote database accessible only to the cryptoserver. The function F_{crypt} is designed so that generation of valid SIDs requires not only the knowledge of the secret key K, but also the random numbers used in

the procedure (and thus access to the database storing these numbers). These properties make generation of counterfeit SIDs unfeasible. An attacker trying to find a valid 10-digit SID will need to send around 10^{10} verification requests to the cryptoserver, and even with prior knowledge of the secret key K 10^5 requests would be necessary. At the same time, secrecy of SIDs is only essential before voting has ended. After the voting server has been closed and the results of the election event have been published and made final, it is possible to allow public access to the cryptoserver, the key K and the database of random numbers R_i so that every remote observer can verify that only valid SIDs have been used in the voting.

Stages of election events using the 'Guarantor' systems are formally described in the following three subsections.

3.1 Operation of the System Prior to the Voting Day

Fig. 2 below shows a diagram of the interactions with the "Guarantor" system prior to the voting day.

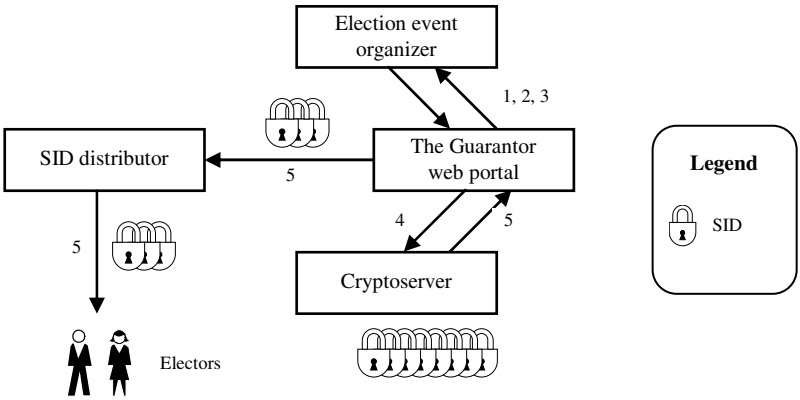

Fig. 2. Operation of the system prior to the voting day

i. Pre-Election Stage

Input: complete information about the election event, personal data of the electors.
Output: credentials for managing the election event.

At the pre-election stage, the organizer of the election event uses the administrative interface of the 'Guarantor' system to create a new election event and to submit the complete information about the event and the personal data of the electors (1). He then receives the login and password valid for managing the election event (2).

ii. Preliminary Stage

Input: confirmation of the data input during the pre-election stage.
Output: a set of SIDs used for voter authentication.

The preliminary stage of the election event is started immediately after the information gathered in the pre-election stage has been processed by the 'Guarantor' system. A web portal of the election event is created, containing the information about the election event. The organizer reviews the web portal and authorizes publishing it online (3). From this moment the information about the election event becomes accessible to the public and is recorded by the voting server.

At the same time, a request is placed for the cryptoserver to generate an SID for each of the electors (4). The generated SIDs are assigned to electors and delivered to them in confidence (5).

3.2 Operation of the System on the Voting Day

The voting procedure is illustrated in Fig. 3 below.

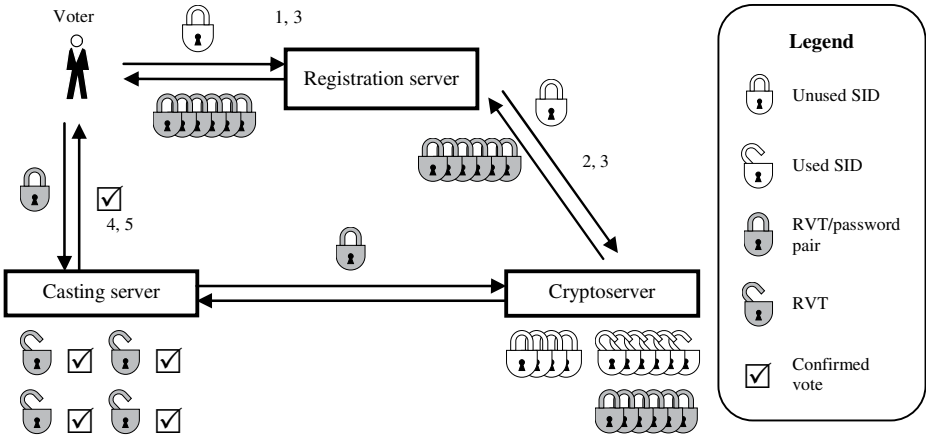

Fig. 3. The voting procedure

iii. Voting Stage

Authentication/registration server input: SID.
Authentication/registration server output: randomized voting token and password.

Voting server input: randomized voting token and password, vote.
Voting server output: confirmation that the vote has been received.

Voting begins and ends at a time set by the organizer of the election event. In order to place his or her vote, the elector must perform the following steps:

1. Input the SID received at the preliminary stage using the web interface of the authentication/registration server (1). The SID is sent to the cryptoserver for verification (2). If the SID hasn't yet been used for voting, a set of 8 randomized

voting tokens (RVTs), which are random numbers not linked to the EIN or the personal data of the voter, is generated (or reused) together with the passwords corresponding to them (3).
2. Record one of the eight RVT/password pairs.
3. Access the voting server and input a valid RVT/password pair (4). The remaining 7 pairs that were shown to this voter then become invalid. The invalidated RVTs can be used by a different voter later.
4. Place the vote and confirm it (5).

3.3 Operation of the System at the End of the Voting Day

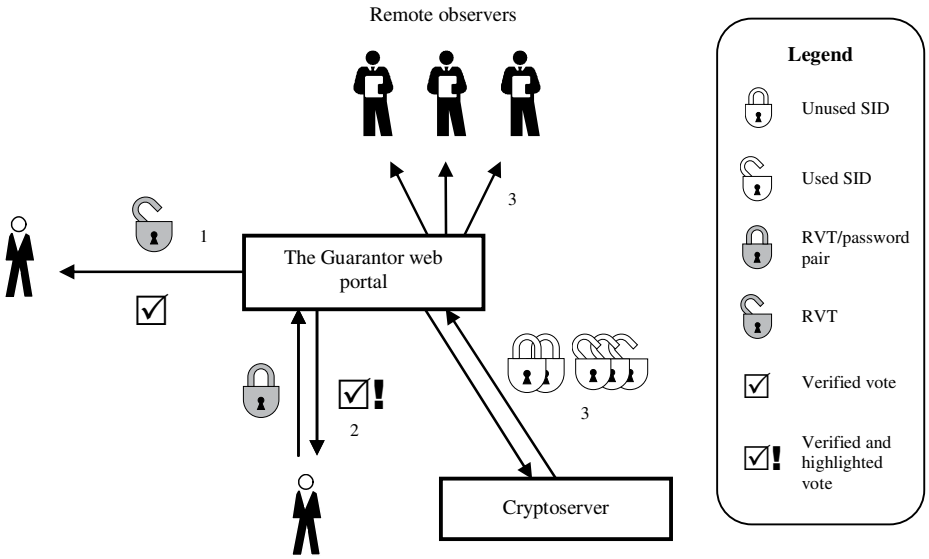

Fig. 4. Publishing the election results, audit and verification of votes

iv. Post-Election Stage

Input: RVTs or RVT/password pairs received by the electors.
Output: votes corresponding to the RVTs used in the elections, SIDs submitted to the authentication/registration server, election event results.

Post-election the authentication/registration and voting servers become inactive. Preliminary results of the elections are tallied and published at the web portal of the election event. Lists of RVTs used in the elections appear together with the corresponding votes.

At the post-election stage every elector can:

1. Check the published lists of RVTs to verify that their votes have been correctly tallied (1).
2. Input the RVT/password pair used for placing the vote. In that case the RVT is highlighted in the list, indicating that it has been verified by the elector. Assuming that

enough electors perform this procedure and no instances where an elector saw his or her RVT highlighted prior to entering the RVT/password pair have occurred, this proves that each unique RVT corresponds to a unique vote (2).

The organizers of the election event resolve the possible disputes raised by the voters and the observers. After all of the disputes have been resolved, the results of the election become final and are published as such at the web portal.

Once the results have been finalized, the entire database of SIDs used in the elections is published, allowing anyone to verify that every SIDs received by the authentication/registration server is valid and that the total number of votes doesn't exceed (or significantly differ) from the number of recorded SIDs, proving that no 'ghost voters' have participated in the elections (3).

Presented below is a more formal description of the verification mechanisms available to the public.

Let us assume that N electors are participating in the event and that SID set $S = \{S1, S2, \ldots, SN\}$ has been generated at the pre-election stage. Some of the electors may choose not to vote, leaving a set $S' \subseteq S$ of SIDs that have been used by electors to authenticate themselves at the authentication/registration server, and the size of set S', which will be denoted as N', satisfies $N' \leq N$. Again, it is possible that not every elector who has registered will choose to vote. Therefore, the set of N'' votes $V = \{V1, V2, \ldots, VN''\}$ recorded by the voting server must satisfy $N'' \leq N' \leq N$. After the raw data collected by the authentication/registration server and the voting server is published, any remote observer can verify this relation and ensure that every SID in the set S' as recorded by the authentication/registration server is valid. This relation can be presented differently. Let us number the available choices in the voting from 1 to M, and let $C1, \ldots, CM$ be respectively the total numbers of votes given in support of each of the choices. Then $C1 + \ldots + CM = N'' \leq N' \leq N$.

It must be noted that in the proposed system every honest voter can use the RVT used for voting to ensure that his or her vote has been tallied correctly. Unfortunately, unless every vote is accompanied by an elector's electronic signature, it is impossible to prevent dishonest voters from claiming that the system doesn't work as intended. However, the authors believe that such dishonest voters will be a small minority, and that their efforts will be wasted. After all, unlike the case of traditional paper ballot voting, every honest voter can use his RVT to see that the vote has been properly recorded, and every honest elector who didn't vote can verify that his or her SID has not been captured by the authentication/registration server.

4 Test Implementation of the System and Approbation

A test implementation of the system, as well as additional information on the "Guarantor" voting system available at http://e-vote.basnet.by/eng/. The webpage http://e-vote.basnet.by/demo/eng/ presents mock results of different types of election events based on a database of 200 000 virtual electors using 400 polling stations in 20 voting districts.

The test implementation realizes all of the principal functions of the system, allowing remote organizations to conduct small-scale election events. However, it is unable

to handle large-scale events and is vulnerable to a number of denial-of-service attacks. The authors are currently conducting experiments to approbate the system on election events such as elections of student governing bodies in secondary schools and universities. Approbation results will be included in the presentation at the conference.

The test implementation is based on ASP.NET; communications between the components of the system use WCF.

5 Conclusions

The authors are convinced that the issues with the transparency and fairness of traditional paper ballot elections outlined in this paper, as well as the costs associated with the work of the polling station staff and the observers, make paper voting an outdated and impractical technology. The proposed alternative is the use of modern transparent electronic voting technologies specifically designed to address the issues that have become identified with traditional voting. The authors realize that they don't have the manpower or the resources required to develop a working state-scale election system based on the principles outlined in the paper. Nonetheless, it is our hope that the presented ideas and the prototypes that have been developed will lead to a joint project by various IT experts to create a pilot e-Voting framework that would fully comply with the OSCE requirements and which could be approbated under international supervision. It is our firm belief that realizing the proposed ideas could benefit not only the ex-soviet countries and the troubled countries of Africa and Middle East, but also the countries of the European Union where use of electronic voting has been limited or banned legally (Ireland, the Netherlands, Germany) or where electors have shown mistrust or lack of interest in electronic voting (Estonia, Austria).

The authors welcome any feedback or suggestions to further improve the proposed system and are open to offers of joint research.

References

1. Ablameyko, S., Kalosha, N., Lipen, D., Lipen, V.: New technologies for remote observation and verification of electronic votes: foundations of a better E-voting system. In: EDEM 2009—Conference on Electronic Democracy: Proceedings of EDEM 2009, pp. 255–264. Osterreichische Computer Gesellschaft, Vienna (2009)
2. Ablameyko, S., Kalosha, N., Lipen, D., Lipen, V.: The Guarantor: a web-centric system for organization and remote monitoring of election events. Transforming Government: People, Process and Policy. – Electronic Citizen Participation – State of the Art 5(1), 56–67 (2011)
3. Internet voting in Kazakhstan, `http://election.kz/portal/page?_pageid=153, 75206&_dad=portal&_schema=PORTAL`
4. Krimmer, R., Ehringfeld, A., Traxl, M.: The Use of E-Voting in the Austrian Federation of Students Elections. In: The 4th International Conference on Electronic Voting, Bregenz, Austria (2010)
5. Kripp, M.: How to Build and Internet Voting System. Modern Democracy—The Electronic Voting and Participation Magazine 2, 8–9 (2010)

6. EAPO patent No. 006712. Electronic voting system, http://www.eapo.org/rus/reestr/patent.php3?id=6712
7. Maaten, E., Hall, T.: Improving the Transparency of Remote E-Voting: The Estonian Experience. In: The 3rd international Conference on Electronic Voting, pp. 31–43. Gesellschaft für Informatik, Bonn (2008)
8. Scheidl, A.: Towards a Collective Verified Recounting Solution in e-Voting. In: EDEM 2011 – Conference on Elektronic Democracy: Proceedings of the 5th International Conference, Vienna, September 8-9, pp. S.111–S.120. Osterreichische Computer Gesellschaft (2011) ISBN 978-3-85403-284-7

EBEST Platform Supporting SMEs to Manage Supply Chain and Collaborate

Katalin Ternai and Ildikó Szabó

Department of Information Systems, Corvinus University of Budapest
1093 Budapest, Fővám tér 13-15., Hungary
{ternai,iszabo}@informatika.uni-corvinus.hu

Abstract. An ICT system can help small and medium-sized enterprises to overcome barriers in the way of applying for public procurement. Forming an ecosystem gives them a synergy with which they will become potential competitors in this market. In the eBEST project (Empowering Business Ecosystems of Small Service Enterprises to Face the Economic Crisis) an integrated platform was developed which equips SMEs and SME associations with state-of-the-art software tools for ecosystem-wide business collaboration. The eBEST approach proposes three interlinked software environments specifically conceived for networked small organizations, supported by advanced suite of ICT services and applications. In our paper the benefits brought by the eBEST platform components are described.

Keywords: public procurement, SME, supply chain management, collaboration framework.

1 Introduction

The public procurement market in the EU is estimated to be worth around one-sixth of total GDP in EU. 2004 EU Directives increased the small and medium enterprises (SME) opportunities to bid for public contracts. There are still many barriers related to information acquisition, preparing procedures, collaboration with partners etc. which discourage SME's from applying for tenders [28]. Clustering can be an effective strategy for small and medium size enterprises (SME) to gain competitive advantages through sharing of information, managing supply chain and other resources, developing innovation in product, service and production processes. Clusters traditionally have been geographically defined. To prosper in our rapidly changing global economy, the next generation of clustering should be dynamic and extended. A dynamic business or cluster is able to "integrate, build, and reconfigure internal and external competencies to address rapidly changing environments", while "extended" refers to cooperation across regional or international boundaries [10].

An EU-funded project, EFFORT (FP6 SSA - IST-2004-035088) was aimed at studying the behavior, governance, sustainability and constituency drivers of dynamic cross-border and cross-regional clusters of SMEs. It helps to improve their ability to

A. Kő et al. (Eds.): EGOVIS/EDEM 2012, LNCS 7452, pp. 202–215, 2012.

access the global market, facilitating collaborative production of products and services, as well as responding to procurement contracts of public or private organizations. The project, carried out in the frame of the Digital Business Ecosystem[1] initiative, analyzed this problem in depth and produced interesting guidelines like dynamic company clustering within an ecosystem (see in Section 3.1). This is strongly facilitated by communication specifically addressed to community building, by the adoption of proper supports for eSkills, knowledge representation and management, by building collaboration including workflow management and process management tools. [12] .The basic ICT infrastructure comes from the SEAMLESS project (IST-FP6-26476) and extends it to cope with the identified needs [23]. Based on these projects' the general goals of the FP7 SME 243554 eBEST project are to attract organizations to work with the companies within the cluster, to facilitate companies the collaboration with each other, and to foster the devised innovation among the firms. The project proposes three interlinked software environments specifically conceived for networked small companies, supported by advanced suite of ICT services and applications [11].

So the collaboration among cluster partners tends to run an appropriate supply chain. The paper first presents a theoretical overview about "Supply chain management" and "Coordination and collaboration with channel partners". In the following section the benefits brought by the eBEST platform components are described. Finally, the Hungarian SMEs participative possibilities in an electronic public procurement facilitated by eBEST platform are shown.

2 Supply Chain Management

Supply chain management (SCM) is a rather practical-oriented than theoretical domain. Therefore many authors [4], [8], [26] deal with creating a research framework of supply chain management. Tan [26] presents an evolution way of this domain which derives from the purchasing and supply activities, as well as the transportation and logistics functions, with a focus on integration, visibility, cycle time reduction, and streamlined channels. Croom et al. [8] shows that many other subject literatures beyond the afore-mentioned literatures (e.g. marketing, network literature etc.) contribute to the emergence of this discipline. Due to the multidisciplinary origin and the evolution way of this domain there isn't a universal supply chain management definition. Mentzer et al. [17], Tan [26] and Cooper et al. [5] consider SCM as a management philosophy, whilst the next definition given by Council of Supply Chain Management Professionals [7] emphasizes rather the activities and processes of SCM. This definition reflects better the eBEST approach than the others.

[1] **Digital Business Ecosystems** aims at implementing the ambitious objectives set at Lisbon Council: higher growth, more and better jobs and greater social inclusion, keeping in mind the peculiarities of the European development, mostly based on a diffuse network of SMEs and local innovation systems**."**
(Source: `http://www.digital-ecosystems.org/`**)**

> "Supply Chain Management encompasses the planning and management of all activities involved in sourcing and procurement, conversion, and all logistics management activities. Importantly, it also includes coordination and collaboration with channel partners, which can be suppliers, intermediaries, third-party service providers, and customers. In essence, supply chain management integrates supply and demand management within and across companies. Supply Chain Management is an integrating function with primary responsibility for linking major business functions and business processes within and across companies into a cohesive and high-performing business model. It includes all of the logistics management activities noted above, as well as manufacturing operations, and it drives coordination of processes and activities with and across marketing, sales, product design, finance and information technology [7]."

Based on this definition we can distinguish two main groups of supply chain activities which are related to each other: planning and management of all activities; coordination and collaboration with channel partners.

2.1 Planning and Management SCM Activities

There are several approaches to present SCM processes [9], [25] etc.. The most widely accepted framework for evaluating and comparing supply chain activities and their performance is the Supply Chain Operations Reference SCOR® model [25]. It is built on five primary management processes of Plan, Source, Make, Deliver and Return (Fig. 1.).

Fig. 1. Supply Chain Operations Reference SCOR® model [25]

The **planning** process ensures companies a strategy for managing all the resources to satisfy the actual or forecasted demand with products or services. The adaption to the changing environment by companies using ERP systems are discussed in [18-20], but if there are shortcomings of ERP systems in the area of planning, then the

Advanced Planning Systems (APS), that was developed by different software vendors independently, can fill this gap. The planning task supports the material flow across a supply chain and related business functions: procurement, production, transport and distribution as well as sales. The planning time horizon can be long-term, mid-term and short-term. These axes are presented in SCP Planning Matrix (Fig. 2.) [13].

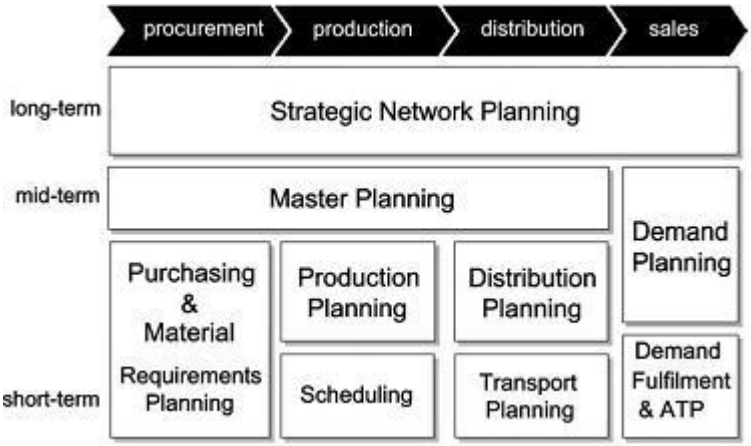

Fig. 2. SCP Planning Matrix [13]

The *Material Requirements Planning* gives a frame to elaborate the **sourcing** strategy. This methodology used to guarantee material availability in appropriate quantities at the right time for both internal purposes and for sales and distribution. Considering stocks and instruments providing production capacities in the light of these requirements companies can get an extent list up about the materials and tools, and they can start to choose the suppliers to deliver these goods. Burke et al. [3] characterized the sourcing strategy by three key decisions: (a) criteria for establishing a supplier base; (b) criteria for selecting suppliers (a subset of the base) who will receive an order from the firm and (c) the quantity of goods to order from each supplier selected. In the frame of inbound freight management received materials are inspected and tested to verify compliance with specifications.

Based upon directives of master planning *Production Planning and detailed Scheduling* is run within each production site. In production planning decisions focus on shifts, flow lines, loading of machine groups which may become a bottleneck, and operations to handle the occurring problems [6] [13]. The manufacturing flow process includes all activities related to **make** the products and to establish manufacturing flexibility required to serve the target markets. The master production schedule translates the output of demand management into resource and production planning in order to set priorities for suppliers (see sourcing strategy) and to establish manufacturing priorities. In the next step, a detailed capacity plan and a time-phased requirement will be available. The capacity and demand are compared to identify what inventory levels are needed for synchronizing the activities of the many supply chain members. Manufacturing planning and control leverage the overall manufacturing process, including

the creation of an overall manufacturing plan, the detailed plan of materials and capacity needs, and the execution of these plans [9].

Using the information about seasonal stock levels determined by master planning *Distribution Planning* handle the transports of goods to customers directly or via warehouses and cross docking whilst it applies rules and procedure to guide the flow of goods within the supply chain. *Transportation Planning* deals with outstanding orders from warehouses and customers, taking into consideration the specific need of customers and legal restrictions for drivers. *Demand fulfillment and available-to-promise module* in Advanced Planning Systems are responsible for track customer orders from order entry, via order execution to order delivery [13]. These planning activities may give a frame for activities of **deliver** process in SCOR model like demand management, order management, warehouse management, inbound/outbound freight management and rules to manage deliver infrastructure [25].

In the **return** process, the supply chain planners have to create and manage a flexible network on both supplier and customer side in order to handle the defective, excess products or recyclable/dangerous garbage.

2.2 Coordination and Collaboration with Channel Partners

Mentzer et al. [17] showed that cooperation is a requirement to manage supply chain in effective way. The beginning of this cooperation is a joint planning and its end is joint control activities to evaluate performance of the supply chain members, as well as the supply chain as a whole.

Due to the complexity of supply chain we can distinguish demand-side collaboration, supply-side collaboration or overall synchronization.

Barratt [1] showed that "collaborative" culture is one of the major supporting elements of collaboration. It consists of the following elements: trust, mutuality, information exchange and openness/communication. For moving from the current status quo to a collaborative culture it needs to manage change. It is necessary to spread the behavioral patterns of knowledge sharing and to deploy programs to support collaborative initiatives. The key elements that drive collaboration success are the following ones:

- Cross-functional activities are needed to develop of trust between collaborating partners.
- The commitment of senior management is required to align processes in effective way.
- The supply chain partners have to create forecasts commonly. So the forecasts have to be based on joint decision making.
- The supply chain metrics should be developed for whole supply chain because the metrics measuring internal logistics performance are not appropriate for this task.

In order to achieve an effective collaboration network it needs to decide what collaboration actually implies and when and with whom it is necessary to collaborate. The consortium of eBEST project elaborated a framework to facilitate the collaboration among channel partners and the coordination of their supply chain.[2]

[2] The platform is presented by the eBEST project documentation.

3 The Integrated Platform for Ecosystems

The project proposes three interlinked software environments (presented by Fig.3.) specifically conceived for networked small companies, supported by advanced suite of ICT services and applications [11]:

- Ecosystem shaping – provide functions to constitute and characterize new company clusters, and improve their image over time, out of the ecosystem of its members too.
- Collaboration framework - offers functions that the single cluster can use to seize business opportunities, possibly identified by the association, and to prepare itself by designing the corresponding distributed processes.
- Operational framework - provides customers, companies and company clusters with a suite of operational functions enabling them to communicate, plan the distributed processes and schedule the internal resources.

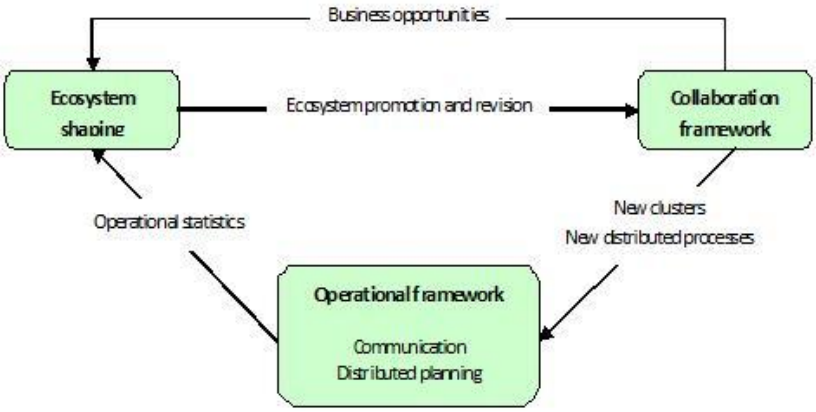

Fig. 3. The eBEST platform

Potential customers, internal or external to the ecosystem, are interested to propose new business opportunities or become lead partners of new dynamic supply chains. On the other side, lead companies and the SME-AG itself are in condition to grasp such business opportunities and participate or promote the definition of the relative distributed workflows. Capturing and supporting this huge potential is indeed an important objective of the eBEST project.

The eBEST platform is conceived as a software product that is expected to deliver different functions, for different users, within a common environment represented by the ecosystem. The software must be perceived by companies as a ready-to-use solution, possibly provided in SaaS mode. The eBEST platform requires a small number

of configuration steps that, in any case, simply imply editing of text files and installation and running without any programming expertise. The most of the commonly available hardware and software platforms should be able to host the software developed throughout this project.

By taking full advantage of the nowadays technologies, a thin client approach is considered the most appropriate choice in terms of graphical user interface. Every company can access the eBEST functions by means of a simple web browser, without installing specific software on the client side. The rationale behind the whole design is that each company works with a private instance of the eBEST software, containing data related to its own business. Additionally, a neat separation between user interface and service implementation is envisaged in order to make the solution really module-based and reusable with other presentation technologies.

Companies collaborate, hence their eBEST instances must be somehow connected. Communication between companies should be based on standard protocols to facilitate the possible integration with other applications. Then, a service-oriented approach is considered the natural way of integrating different company instances.

The eBEST platform is intended to host third-party applications and, more in general, to evolve with the addition of new functionalities and new modules that leverage the existing ones. To this purpose its structure has to be designed as an open architecture where any module can be added, modified, customized or removed independently of the others. The platform design will provide a number of interface specifications to facilitate this progressive evolution. The possibility for the single association, the single ecosystem and the single software developer is to adapt the eBEST environment to the local habits and needs.

3.1 Ecosystem Shaping

Nachira et al. presents ecosystem as “a biological metaphor that highlights the interdependence of all actors in the business environment [22], who co-evolve their capabilities and roles [21].” Based on an analogy given by Iansiti and Levien business networks can be characterized by biological ecosystem features like the strength of the connection among participants, share of a common fate, a not homogenous structure of the network, and the existence of hubs. These hubs “take the form of active keystones whose interests are aligned with those of the ecosystem as a whole and who serves as critical regulators of ecosystem health” [14] [15].The generalization of the Digital Business Ecosystem term emphasize “the co-evolution between the business ecosystem and its partial digital representation: the digital ecosystem [22].” In our approach digital business ecosystems are clusters of companies, small companies in particular, that collaborate within an operational context. While some ecosystems might be created bilaterally without any intervention from a third party, but when key stone organizations play a pivotal role in the business ecosystem they provide a stable and predictable set of common assets for others to build their own offerings. In eBEST approach the active role is played by a key person, an Ecosystem Architect (EA), in discovering, exploring and shaping interesting potential ecosystems. This person plays an organizer role firstly.

An Ecosystem Architect is a person who actively explores, discovers, shapes, launches, observes and evaluates potential business ecosystems out of companies in diverse contexts. In theory, the EA continuously synthesizes information into a knowledge model and utilizes this model to explore potential win/win scenarios for multi-company collaborations. The Ecosystem Architect also facilitates further exploration by the target partners to explore the initial potential and transform this into new collaborative market offerings.

The focus in this part of the system is not primarily supporting the SME actors themselves, but rather on supporting the work of a group of Ecosystem Architects. Experts typically work together on creating and shaping potential eBEST ecosystems. The system can support early, pre-operational, incubation of ecosystems. Ecosystems ready to start an operational collaboration can be incepted onto the full eBEST support infrastructure.

Many tools such as CRM (Customer Relation Management) systems support efficient uniform data collection. An exploration and discovery component targeted directly at the specific EA build on knowledge representation, knowledge exploration, integrated within the eBEST platform.

The primary objective of the Ecosystem Architect in relation to the eBEST Ecosystem Shaping module is to discover ecosystems through collaborative modeling and exploration.

The modeling component is flexible enough to support the design and change of modeled entities such as companies, technologies, people, business contexts, innovation programs and other potentially relevant items, as well as the intricate relationships between these.

The exploration component is able to support multiple forms of discovery (latent discovery, discovery through search/query or browsing or serendipity).

Apart from the technical implementation, there are functional requirements on the representation of the knowledge model:

- The chosen knowledge representation should be light weight, flexible extendible and supportive.
- The system provides opportunity inputting and maintaining of relevant types of local data.
- Imports and alignments with data residing and being maintained in external systems, both from eBEST as well as other sources, should be possible.
- All discovery modes (search/latent/browse/serendipity) listed above should be supported.

The eBEST knowledge solution will functionally resemble discovery over an Associative Graph structure. The suitability of this type of representation has been demonstrated successfully before in early research prototypes by team members [24].

After this phase the ecosystem can be seen as a network of nodes distributed on the Internet that publish services and exchange information among them and with external customers. The following picture illustrates a general eBEST environment with different ecosystems and configurations.

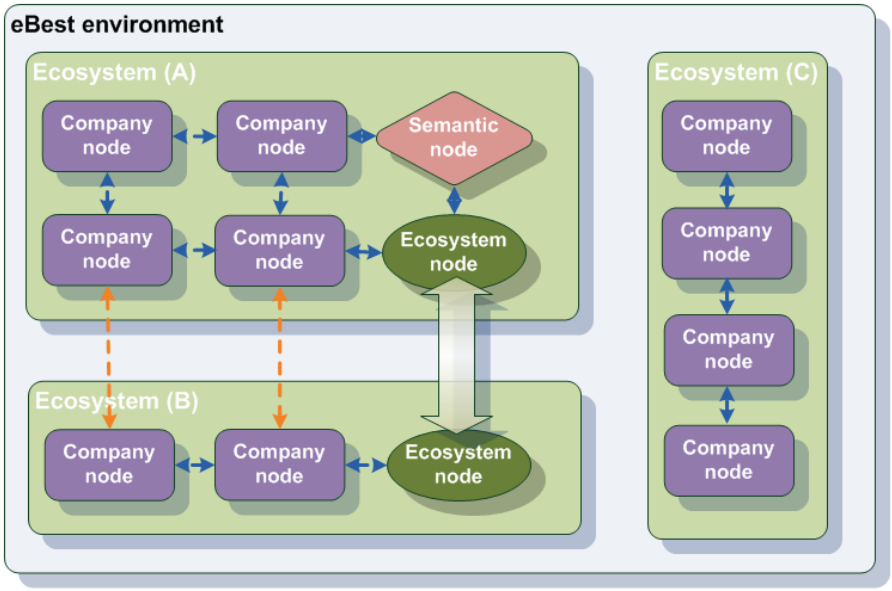

Fig. 4. The eBEST environment

3.2 Operational Framework

The eBEST platform is mainly focused on providing services for companies belonging to an ecosystem. It is useful that companies in different ecosystems might work together as well. The eBEST platform should provide some facilities that support the ecosystem-to-ecosystem communication. The main functional requirements related to cooperation are the following ones:

- Support network planning: the planning process influences all activities of supply chain (see in Section 2). So the eBEST platform planning support is intended to orchestrate the interaction with networked suppliers in the supply chain. In order to manage this situation the network planning algorithm is created as a distributed process by identifying the optimal tasks assignment to selected suppliers.
- Support internal resource scheduling: the eBEST platform must provide small service companies with functions that help them to arrange their production by automatically optimize the usage of the available internal resources. The resource scheduling algorithm must evaluate all possible solutions by taking into account the current resource availability, and select the optimal resource usage schedule. The added value of this approach is immediately perceived in terms of better resource usage as well as better feedback information towards customers. A sourcing process supported by demand and offer catalogues, an ordering process derived from quotations, and a fulfillment and billing process are implemented by this platform.
- Communication inside and outside of the ecosystems: the eBEST platform facilitates the trust building by creating own company profile and offer in Company

Node, the semantic interoperability by document transformation and contents translation through Semantic Node. Business document editing and exchange give the basis for effective communication.

The detailed description of the functions and the infrastructure and architecture are described in detail in an eChallenges article authored by Bonfatti et al. [2].

3.3 Collaborational Framework

The eBEST Collaboration framework is intended to facilitate the identification of new business opportunities and involve the ecosystem actors, each for its role, in the dynamic development of collaborations for their own and for the ecosystem as a whole:

- Associations. By means of proper collaboration tools every association is put in the condition to collect information from other actors, especially about new business opportunities, which are useful for improving the whole ecosystem activity. Then the association can use the same tools for promoting the business opportunities at selected companies and discuss with them their implications and the possibility to create new clusters.
- Companies. By means of proper collaboration tools the companies belonging to the ecosystem are put in the condition to examine the new business opportunities, discuss them, identify the required skills, define the relative process and, if possible, establish relations and constitute new clusters. Successful negotiation of collaborating activities leads to collaboration conditions that will be managed daily by the eBEST Operational framework.
- Customers. By means of proper collaboration tools every company, internal or external to the ecosystem, willing to communicate its demand of new services is put in the condition to candidate suppliers and ask them to provide the corresponding offer either individually or as a cluster. The discussion will hopefully lead to a good match between parties and the consequent enrichment of the ecosystem.

Basic co-operation functions of the Collaboration framework are:

- Ecosystem company representation
- Search for collaborative partners
- Collaborative content and document management
- Task and ToDo management
- Ecosystem workflow process management
- Communicational services, news, notifications, etc.

The Collaboration framework provides a process workflow interface for managing regular processes of the ecosystem. There is a set of pre-defined processes, but the framework provides the opportunity to add specific workflow processes tailored to the needs of the ecosystems. The predefined processes currently are the following:

- Tender management
- Marketing campaign management
- Business or innovation award workflow
- Travel management
- Joint event organization

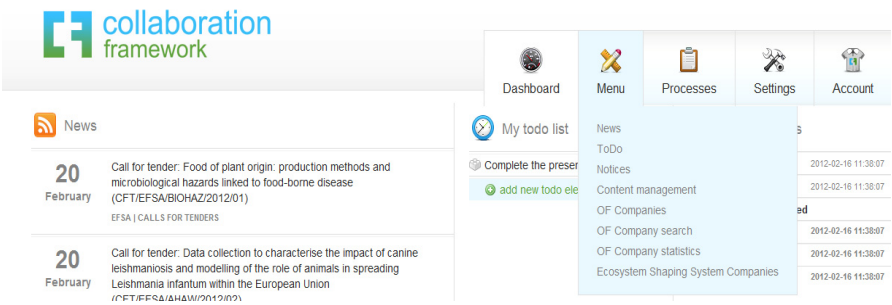

Fig. 5. The Collaboration framework

Specific processes can be designed with BPM modeling tools, and the implementation details further enhanced with ontology definition [16]. The models determine the structure and attributes of the workflow processes. The Collaboration framework is able to interpret the prepared workflow model and automatically generate the working software instance for workflow support. The functions and the ontology based workflow generation are described in detail in a publication authored by Ternai and Torok [27].

3.4 Framework Integration

This chapter depicts the expected interactions involving the three main software modules developed throughout the eBEST project. The main goal here is providing a high level overview of the integration issue.

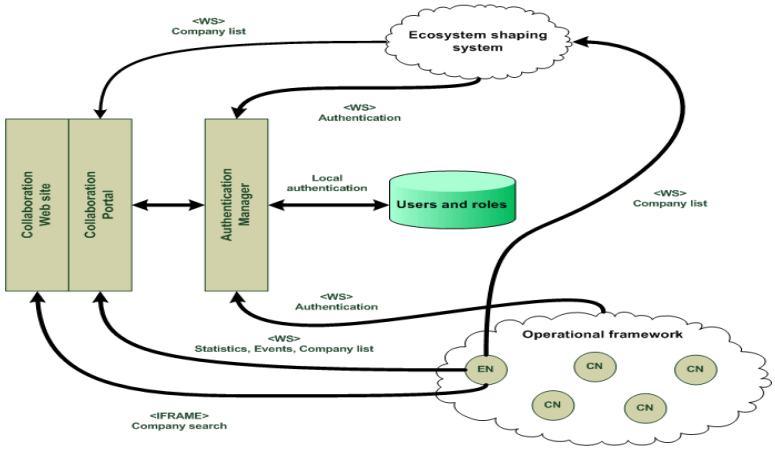

Fig. 6. The integrated platform

- Company search: the Collaboration Website publishes a user interface for searching companies within the Operational Framework. The result is a list of companies with related information and provided services. For every company, it is possible to access the relevant home page by following a simple html link. This gives casual user the opportunity of registering themselves and establishing business collaboration with the company. The Company search user interface is displayed by the Collaboration Portal Web site in an IFRAME whose content is generated by the Ecosystem Node. The Company search is displayed both in the Collaboration Portal and the Collaboration Website interfaces.
- Operational framework statistics: The Ecosystem Node provides statistic figures representing the activity progress within the Operational Framework. The Operational framework statistics can be retrieved by invoking an operation against the Ecosystem Node WSDL. The Collaboration portal invokes this service and publishes the data.
- Event dispatching: The Collaboration Portal publishes a list of events gathered from the subscribed companies. The Ecosystem Node contributes by dispatching the events raised within the Operational framework. A company of the Operational framework publishes a new service. The event notification can be triggered by invoking the operation against the Collaboration Framework WebService.
- Company list: the Collaboration Portal queries the Ecosystem Node for retrieving the complete list of companies available in that ecosystem. For every company, basic information are provided along with the URL address of the service needed for authentication users against every single company (see below for authentications details).The data provided by the service is published on the Collaboration website. At the same way, the Ecosystem Shaping framework can invoke the same operation for retrieving a live overview on the companies currently making business in the ecosystem. The company list can be retrieved by invoking the operation against the Ecosystem Node WSDL.
- Authentication: users registered in the Company Nodes can access their private workspace by means of the Collaboration Web site login form. To perform the authentication process, the Authentication Manager delegates the operation to the Company Node the user wants to access. In case of success, the user is redirected to his private workspace. In case of authentication failure, an error message is displayed.

4 Conclusion

In the course of disseminating the eBEST platform the consortium partners have to deploy the system for different companies. In Hungary the partner in this dissemination process is Hungarian Industrial Association (HIA). It is a non-governmental association but it is connected to governmental institutes in order to represent the interest of small and medium enterprises. With help of HIA many Hungarian SMEs can join to Italian or Spanish SMEs through eBEST platform and start to collaborate with each other for applying different governmental or EU tenders and to manage a common supply chain in order to achieve the goals of tenders.

The represented eBEST platform can provide several features with that SMEs can overcome the above-mentioned barriers in the way of responding tenders. The Tender Management in Collaboration Framework guarantees up-to-date information about actual public procurement tenders and any other message from the government presented by RSS feed(e.g. Tenders Electronically Daily journal).

The Ecosystem Shaping helps to find collaboration partners abroad and to constitute clusters and improve their image that facilitates the preparation of tender. The workflow management built in the system provides an appropriate base to harmonize the tender preparation process. With the help of Operational Framework the companies can associate to each other through a supply chain and accomplish the promised goals.

This paper cannot present results because the deployment of system is in progress.

References

1. Barratt, M.: Understanding the Meaning of Collaboration in the Supply Chain. Supply Chain Management 9(1), 30–42 (2004)
2. Bonfatti, F., Berselli, M., Martinelli, L., Stradi, F.: Reactive Planning and Scheduling in Clusters of Small Companies. Presented at the eChallenges 2011 (2011)
3. Burke, G.J., Carrillo, J.E., Vakharia, A.J.: Single versus multiple supplier sourcing strategies. European Journal of Operational Research 182(1), 95–112 (2007)
4. Chen, I.J., Paulraj, A.: Towards a theory of supply chain management: the constructs and measurements. Journal of Operations Management 22(2), 119–150 (2004)
5. Cooper, M.C., Lambert, D.M., Pagh, J.D.: Supply Chain Management: More Than a New Name for Logistics. The International Journal of Logistics Management 8(1), 1–14 (1997)
6. Council of Supply Chain Management Professionals. Glossary of Terms & Definitions, http://cscmp.org/digital/glossary/glossary.asp (accessed: January 16, 2012)
7. Council of Supply Chain Management Professionals. Supply Chain Management Definitions, http://cscmp.org/aboutcscmp/definitions.asp (accessed: January 16, 2012)
8. Croom, S., Romano, P., Giannakis, M.: Supply chain management: an analytical framework for critical literature review. European Journal of Purchasing & Supply Management 6(1), 67–83 (2000)
9. Croxton, K.L., García-Dastugue, S.J., Lambert, D.M., Rogers, D.S.: The Supply Chain Management Processes. The International Journal of Logistics Management 12(2), 13–36 (2001)
10. Dumortier, J., Parrilli, D.M.: Governance, Policies and Legal Conditions for Access to Market through Extended and Dynamic Clusteri (2012), http://www.law.kuleuven.be/icri/projects.php?projectid=163&where= (accessed: March 23, 2012)
11. eBEST, Empowering Business Ecosystems of Small Service Enterprises to Face the Economic Crisis, http://ebest.eu/ (accessed: March 23, 2012)
12. EFFORT, Governance behaviour, policies and legal requirements for facilitating access to market by dynamic clustering of SMES, http://www.effortproject.eu
13. Hartmut, S.: Supply chain management and advanced planning-—basics, overview and challenges. European Journal of Operational Research 163(3), 575–588 (2005)

14. Iansiti, M., Levien, R.: The keystone advantage: what the new dynamics of business ecosystems mean for strategy, innovation, and sustainability. Harvard Business Press (2004)
15. Iansiti, M., Levien, R.: Strategy as ecology. Harvard Business Review 82(3), 68–81 (2004)
16. Kő, A., Ternai, K.: A Development Method for Ontology Based Business Processes. In: eChallenges e-2011 Conference Proceedings. IIMC International Information Management Corporation Ltd., Florence (2011) ISBN: 978-1-905824-27-4
17. Mentzer, J.T., DeWitt, W., Keebler, J.S., Min, S., Nix, N.W., Smith, C.D., Zacharia, Z.G.: Defining supply chain management. Journal of Business Logistics 22(2), 1–25 (2001)
18. Molnár, B.: The Country-specific Organizational and Information Architecture of ERP Systems at Globalised Enterprises. Business Systems Research 2(2), 39–50 (2011)
19. Molnár, B., Szabo, G.: Information architecture of ERP systems at globalised enterprises in a small EU member state. In: Proceedings of the ITI 2011 33rd International Conference on Information Technology Interfaces (ITI), pp. 157–162 (2011)
20. Molnár, B., Szabó, G.: Investigation of Criteria for Selection of ERP Systems. In (ICEIS) 14th International Conference on Enterprise Information Systems, Wrocław, Poland, June 27-July 1 (2012)
21. Moore, J.F.: The death of competition: leadership and strategy in the age of business ecosystems. HarperBusiness, New York (1996)
22. Nachira, F., Dini, P., Nicolai, A.: A network of digital business ecosystems for Europe: roots, processes and perspectives. European Commission, Bruxelles, Introductory Paper (2007)
23. SEAMLESS, Small Enterprise Accessing the Electronic Market of the Enlarged Europe by a Smart Service Infrastructure, http://www.seamless-eu.org/ (accessed: March 23, 2012)
24. Stuer, P., Meersman, R., De Bruyne, S.: The HyperMuseum Theme Generator System: Ontology-based Internet support for the active use of digital museum data for teaching and presentation. In: Museums and the Web 2001: Selected Papers, Archives & Museum Informatics (2001)
25. Supply Chain Council, Overview of SCOR Process Reference Model, http://supply-chain.org/SCOR-overview (accessed: January 16, 2012)
26. Tan, K.C.: A framework of supply chain management literature. European Journal of Purchasing & Supply Management 7(1), 39–48 (2001)
27. Ternai, K., Torok, M.: A new approach in the development of ontology based workflow architectures. In: 2011 17th International Conference on Concurrent Enterprising (ICE), pp. 1–10 (2011)
28. Opening public procurement to SMEs - Small and medium sized enterprises (SME) - Enterprise and Industry, http://ec.europa.eu/enterprise/policies/sme/business-environment/public-procurement/index_en.htm (accessed: March 22, 2012)

Using Social Network Technology to Provide e-Administration Services as Collaborative Tasks

Ourania Hatzi, Mara Nikolaidou, Panagiotis Katsivelis-Perakis, Valentino Hudhra, and Dimosthenis Anagnostopoulos

Department of Informatics and Telematics, Harokopio University of Athens, Greece
{raniah,mara,pkatsiv,it20739,dimosthe}@hua.gr

Abstract. This paper presents an approach employing social network technology to facilitate e-administration within collaborative communities. E-administration services are provided through task coordination between specific participants. Task activities are performed by gadgets acting on behalf of participants. Task assignment is based on participant roles and relations in the community, explicitly defined within the social network. Interaction between gadgets is governed by rules based on participant roles, dictating the obligations and responsibilities of each party. Whenever the execution of a certain gadget depends on the previous execution of a series of other gadgets, a recommendation mechanism employing AI planning is used to provide a plan according to which gadgets should be combined. The implementation of a social network platform supporting e-administration based on extending the OpenSocial API is also presented. The proposed platform has been utilized to develop a social network for the academic community, featuring pilot implementation of specific e-administration services.

Keywords: Social Network, Collaborative Tasks, E-administration, Recommendation Mechanism, AI Planning, OpenSocial.

1 Introduction

Corporations and organizations have recently incorporated novel interaction models for knowledge dissemination, intra-organization communication and collaboration between their members, in order to facilitate electronic service provision, leading to e-administration. At the same time, social networks have emerged as a particularly widespread interaction paradigm.

In this paper we explore an approach that employs the familiar social networking interaction model to provide complex e-administration services in a collaborative community. Social network participants collaborate to perform complex e-administration tasks, having in mind their role in the community and the relations between them. E-service provision through task coordination between specific participants is performed by gadgets, corresponding to specific task activities, acting on their behalf. Interaction between gadgets is governed by rules based on the participant roles, which dictate the obligations and responsibilities of each party. In the proposed service delivery model, complex e-service functionality is not predefined, as for example using BPEL-like languages;

A. Kő et al. (Eds.): EGOVIS/EDEM 2012, LNCS 7452, pp. 216–230, 2012.

instead, gadget compositions resulting to e-service functionality are generated ad-hoc by the collaborating participants. To achieve this, participants should decide the conditions enabling the execution of a certain gadget. In the case that gadget execution depends on the previous execution of a series of other gadgets, a recommendation mechanism may be invoked to assist the participant in gadget composition. Such a recommendation mechanism employing AI planning techniques to provide plans according to which gadgets should interact to complete complex tasks is also discussed.

Implementation requirements to integrate collaborative e-gov service delivery in a social network platform and corresponding proposed extensions of the OpenSocial API, proposed by Google to implement interoperable social networks, has been presented (Dais, Nikolaidou & Anagnostopoulos, 2011). Based on these guidelines, the delivery of e-administration services in an academic social network was implemented, based on the proposed OpenSocial API extensions. A pilot implementation of specific e-administration services is currently available.

The proposed research does not simply targets a custom implementation of an ad-hoc social network for the academic community, but aims to propose a solution for the provision of services in a social network environment supporting communities or organizations. In this case, multiple roles are identified for the community members and e-services may be provided based on the collaboration of specific members according to their role (Lewis, 2006; Oreilly, 2007; Vossen & Hagemann, 2007). For example, in the academic community students may be served by the Admission Office personnel to complete specific tasks, such as an application for a grade certificate. This should be feasible in the academic social network as well.

E-government service provision utilizing social networking technology could also be extended to include multiple organizations or service provision authorities, taking part in the same social network, each having a specific role. For example, in the academic social network, services provided by the Ministry of Economy could be integrated to provide taxation data to students applying for scholarships or specific benefits based on their family income.

Advantages of the aforementioned approach, compared to traditional e-administration service provision, include the integration of e-administration services from different sources in a unified environment. Moreover, the interaction model utilized to provide such services is familiar to users, encouraging them to adopt the proposed framework. Finally, the proposed model contributes to the vision of Web 2.0, where participants use social medial not only for informational purposes but also for transactional service provision.

The rest of the paper is organized as follows: Section 2 presents related work in the area of collaborative community support through social networks. Section 3 describes the main characteristics of the proposed collaboration model, as well as the gadget coordination life-cycle mechanism. Section 4 briefly describes the implementation of the implemented academic social network platform, called Unity, while Section 5 provides an example for e-administration using the proposed collaboration model. Conclusions and future directions reside in Section 6.

2 Related Work

Business Process Management utilizing social networking concepts has recently gained momentum, due to social software characteristics such as weak ties and mutual service provision, which fulfill requirements of collaborative environments (Bruno et al, 2011).

The possibility of collaboration using social networking infrastructure has been explored for specific communities, such as healthcare/medicine (Boulos & Wheeler, 2007), learning/pedagogical (Hiltz, 1998; McLoughlin & Lee, 2007) and academic (Bermejo et al, 2012). Results are encouraging, as they indicate that novel technological concepts, such as the ones offered through social networking sites, tend to attract users and facilitate interaction. Collaboration through task coordination in such environments can significantly facilitate e-participation and e-administration in the form of service provision.

Organizations and companies, such as IBM, wishing to promote collaboration between their members, have been researching how social networks affect intra-organization interaction, serving the Enterprise 2.0 vision. As a result, they have embraced social networking through public social networks, such as the aforementioned ones, by creating groups with their members as participants. However, as security and privacy issues emerge, many organizations employ private social networks; for example IBM have created the Beehive research project (Geyer et al, 2008). Private social networks, featuring similar functionality with public ones, can be established using existing social network development platforms, such as Elgg (Elgg). Companies encourage their employees to use their enterprise social networks so they can connect with other employees, help people socialize when they take a break, or even help contribute to other work related issues (DiMicco et al 2008), leading to new forms of business interactions and the notion of Enterprise 2.0.

Currently, collaboration within an organization through a social network remains mostly at an informational or communicational level; that is, the social network infrastructure is used only for exchanging information or performing trivial tasks, such as arranging a meeting. Experimental efforts have attempted to provide enhanced functionality to assist collaboration, such as file sharing (Shami, Muller & Millen, 2011).

Other works, such as (Bruno, 2012), (Hoegg et al, 2006) and (Ploderer, Howard & Thomas, 2010), explore how services offered by existing social networks can be utilized to promote collaboration between their participants. Moreover, the application of business models through social networks is also examined (Richter & Riemer, 2009). However, the aforementioned research efforts attempt to adjust collaboration requirements to the existing social network models and infrastructure, instead of proposing extensions to social networking models, which would accommodate interaction.

Existing social networking platforms used to establish either public or private social networks serving collaborative communities do not discriminate any participant roles. Moreover, they offer either an established model of predefined relationships which cannot be altered, or resort to an entirely user-defined model of relationships. In both cases, there is a need for the development of a new interaction model and an underlying social network implementation platform supporting collaborative communities, featuring different participant roles and relations and enabling collaborative task coordination.

3 Performing Collaborative Tasks in a Social Network Environment

3.1 Collaboration and Task Coordination to Provide e-Services

Collaboration in a typical social network is performed through exchange of information and notifications in a distributed fashion. In addition to sharing content and notifications through discrete streams and groups, the social network model should also support the provision of specific e-services, simple or complex, and enable its participants to complete corresponding activities in collaboration with other participants to provide these services.

These services may be provided by co-operating applications executed on a specific participant profile, authorized to complete the corresponding activity. Typical social networks enable applications, usually named gadgets, written in Javascript, to be executed on the user profile. These applications usually read data from the user profile and may invoke external applications through a web service interface. They also have access to store data in the user profile. In order to ask for services rather than information from another participant, a more sophisticated communication mechanism is required, facilitating information exchange between applications executed on different profiles.

We propose to treat services as tasks consisting of specific steps (e.g. activities) which may be performed by a specific role or roles and may involve the invocation of external services to be completed. Each activity corresponding to a specific task step is handled as an application, or gadget, which may only be executed in the profile of a participant having the proper role.

In order for collaborative tasks to be supported, inter-gadget communication executed in different profiles must be enabled. Based on available social network technology, gadgets may access and store data in a specific area of the profile they are executed on, called Application Data. In the proposed model, gadgets may share access to Application Data stored in the profile they are executed on, but also in external profiles as well, under certain conditions. Whenever there is need for inter-gadget communication, the sender-gadget updates this data, and the receiver-gadget can read the updates. Only when all input data is available, the receiver-gadget is allowed to start its execution. While the task is progressing, proper notifications are issued to collaborating participants.

3.2 Gadget Recommendation and Composition through Planning

Each gadget, as any other program, needs specific input data to start its execution and when executed, produces output data. The co-ordination of tasks, e.g. the conditions under which specific activities may be executed, is performed based on the available input data of gadgets implementing the specific activities. A gadget implementing a specific activity cannot start its execution until all its input data are available. This data may be part of the user data stored in the profile the gadget is executed or produced as output data of other gadgets, which may be executed in the same profile, e.g. by the same user, or more frequently in external profiles corresponding to users having the proper role to invoke those gadgets.

As the number of available gadgets increases, an automated mechanism is required in order to perform gadget input-to-output matching and determine the composition of gadgets that produces the desired functionality. The proposed approach suggests the use of AI planning as a mechanism for automated gadget coordination, by formulating a gadget composition problem and representing it as a planning problem.

A planning problem is usually modeled according to STRIPS (Stanford Research Institute Planning System) notation (Fikes & Nilsson, 1971). A planning problem in STRIPS is a tuple $<I,A,G>$ where I is the initial state, A is a set of available actions and G is a set of goals. States are represented as sets of atomic facts. Set A contains all the actions that can be used to modify states. Each action A_i has three lists of facts containing the preconditions of A_i, the facts that are added to the state and the facts that are deleted from the state, noted as $prec(A_i)$, $add(A_i)$ and $del(A_i)$ respectively. An action A_i is applicable to a state S if $prec(A_i) \subseteq S$. If A_i is applied to S, the successor state S' is calculated as $S' = S - del(A_i) \cup add(A_i)$. The solution to a planning problem (plan) is a sequence of actions, which, if applied to I, lead to a state S' such that $S' \supseteq G$.

The representation of the gadget composition problem to a planning problem can be performed applying the following rules:

- The set of all available inputs that the user can provide to the social network formulates the initial state I of the planning problem.
- The set of all available outputs that the user wishes to receive by the desired functionality formulates the goal state G of the planning problem.
- The set of all available gadgets in the social network formulates the set A of actions. More specifically, each gadget is transformed into an action; the inputs of the gadget serve as the preconditions of the action, while the outputs of the gadget serve as the results of the action.

The planning problem can then be forwarded to external planning systems in order to acquire solutions, as the one presented in (Hatzi et. al, 2010). The produced plan will enable to determine the combination of gadgets that can be executed to perform the requested collaborative task.

3.3 Gadget Life-Cycle and Execution

In order to develop and incorporate gadgets with enhanced functionality in the social network platform, a gadget lifecycle mechanism was developed, focusing on the following tasks:

- Each participant gains access to a list of available gadgets, depending on their role. The participants may install any of these applications on their profile.
- Whenever a participant installs a new gadget on their profile, a new set of AppData, specific for this participant and this gadget instance is created to store information related to this gadget instance. To complete a specific task, other cooperating gadget may update or access this data, enabling a “conversation” between two or more of them. AppData is used in the case of application collaboration as a common workspace or whiteboard, where all gadget participating in a task can use for data exchange.

- In order to provide enhanced functionality, gadget composition is enabled. Participants may demand a functionality model, by describing its available inputs and desired outputs, which will consequently be used by the mechanism described in Section 3.2 for providing a gadget composition plan that fulfills these requirements. The corresponding recommendation mechanism will prompt for the installation of gadgets that are included in the composition but are not yet installed on the participant profile.
- The participant may delete any of the previously deployed gadgets from their profile. Upon uninstall, the AppData associated with this particular participant and gadget is also eliminated.

During the execution of a gadget, the following distinct steps can be identified:

1. The gadget checks if all required inputs are available, by checking the values of the required AppData items.
2. If not, the recommendation mechanism is invoked and the necessary gadgets providing this data as outputs are identified. These gadgets may involve external applications. The user is notified accordingly.
3. The gadget requests the remaining required data from the user as inputs.
4. When all mandatory input data is available, the gadget is executed. Execution may include communication with external systems.
5. The gadget produces output data, by updating the appropriate AppData items.

4 The Unity Academic Social Network

In order to provide a concrete reference example where the proposed approach can be applied, the case of the academic community was considered, resulting in the development of the Unity academic social network (Nikolaidou et al, 2012). Unity implementation is based on the OpenSocial API, which is properly extended to facilitate participant roles and task co-ordination. A screenshot of the interface of the academic social network constructed using the Unity platform is depicted in Figure 1.

4.1 Participant Roles and Supported Relations

Members of an academic community include faculty members and additional teaching staff, undergraduate and postgraduate students, PhD candidates, researchers, administrative and technical staff. Each of them has specific responsibilities in the community, may represent specific service provision authorities, as for the University Library or the Student Admission Office, and may perform specific tasks to serve other community members. Member tasks and responsibilities are predetermined by their role in the community. Based on their role, members may take advantage of the predetermined relations in the academic environment and co-operate with others to accomplish specific tasks. Provided services in many cases concern administrative tasks; using the proposed interaction model they can be performed in a paperless way, promoting e-administration.

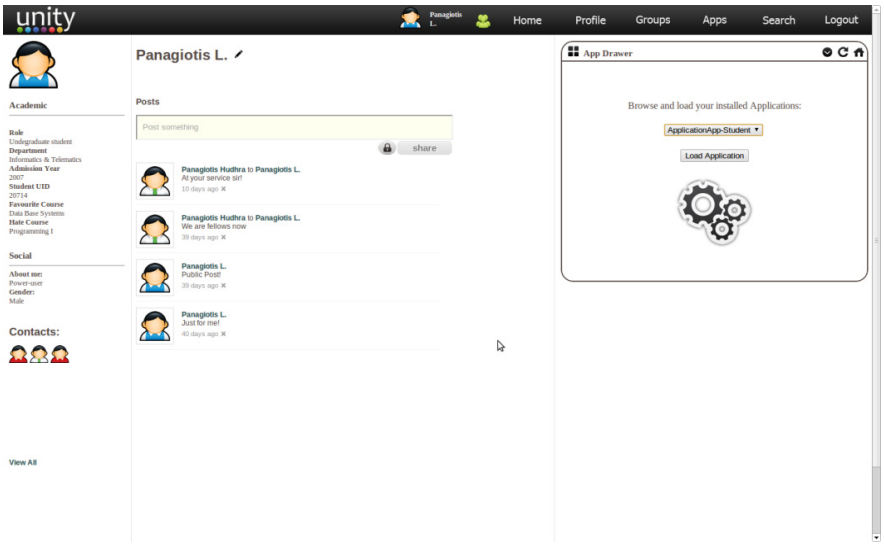

Fig. 1. Screenshot of an example profile of the academic social network

The discrete general roles defined in the proposed model that a participant of the academic social network can belong to are the following:

- Student: including undergraduate students, postgraduate students and PhD candidates
- Teaching staff: includes faculty members and additional teaching staff
- Administrative staff: includes secretariat employees, library employees, Erasmus office employees, Rector's office employees and all the rest of the University employees that could potentially provide services to community members.

Supported academic relations include:

- Tutor: a unidirectional relation declaring that a student is being taught / consulted by a member of the teaching staff. When this relation exists, the student benefits from specific services provided by the teaching staff member, as for example ask for a recommendation letter, or even co-operate with them to accomplish a task, for example the submission of a degree thesis assignment application, supervised by the teaching staff member, to the Student Admission Office.
- Facilitator: a unidirectional relation declaring that a community member is served by a member of the administrative staff. When this relation exists, the community member is the recipient of services provided by the academic staff member.

The social aspect of the network is not dismissed, therefore, the model also defines the social relation Fellow, denoting that two participants are socially connected, regardless of their roles.

4.2 The OpenSocial Framework and Apache Shindig

OpenSocial (OpenSocial) framework is a set of APIs for implementing applications for interoperable social networks. These social networks, known as OpenSocial containers, allow OpenSocial Gadgets to access information stored within the social network platform. Gadgets are built using OpenSocial APIs, which expose methods for accessing social data, application data and activities, within the context of a container. The same OpenSocial Gadget can run on more than one containers, e.g. a social network platform such as iGoogle or MySpace.

Apache Shindig (Apache Shindig) is an open source OpenSocial container and provides a reference implementation of the OpenSocial specification. Shindig processes JSON RPCs generated by gadgets, according to OpenSocial upper level API. For example, the following call retrieves information about all friends of a the participant with ID guid:

```
osapi.people.get({userId:'guid',groupId:'@friends'});
```

Such calls are processed by Handlers, implementing calls available to the social network developers. OpenSocial database is accessed by low-level calls, tightly depended on OpenSocial database schema. Shindig implements the corresponding class, which retrieves these elements through JPQL queries to the database.

For the implementation of the Unity platform, the Java version of Shindig was used and extended according to the academic community collaboration model. To do so, existing OpenSocial API calls had to be extended to support enhanced functionality.

4.3 OpenSocial Extensions

OpenSocial API was extended to accommodate different participant roles and relations, inter-gadget communication and an enhanced notification mechanism incorporating the concept of roles and specific participant notification (Nikolaidou et.al, 2012).

Extensions to OpenSocial include extensions both to the underlying database as well as to the corresponding API calls. Extensions in the lower level API, which is tightly depended on the database schema, are necessary to accommodate all database extensions. Some of them must also be propagated to the upper level API to support either additional parameters or parameter values of existing OpenSocial calls, used for gadget development (JSON-RPC interface) or to program the OpenSocial Container (REST interface).

Moreover, custom calls were implemented in Java, for functionality that is not defined through the OpenSocial API. Such functionality mainly concerns the creation of social network entities, such as users and connections, as this is a procedure not inherent to the management of the social network model, but specific to each implementation platform, while it is not related to gadget development.

4.4 Extending Unity Platform to Support e-Administration Services

In order to support e-administration services as collaborative tasks, the Unity platform was extended to incorporate the recommendation mechanism defined in section 3.2 and the gadget life-cycle presented in section 3.3, resulting in the architecture presented in Figure 2.

More specifically, the faded parts were supported in the framework presented in (Nikolaidou et al, 2012); while the bright parts are the necessary components added to support e-administration services.

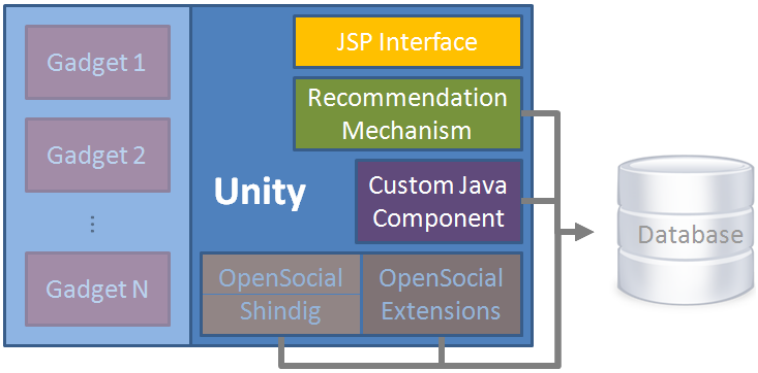

Fig. 2. Unity framework architecture

The *JSP Interface* was extended to accommodate gadget life-cycle. Participants may add gadgets in their profile based on their role in the academic community, while, when a gadget is added, corresponding AppData should be created for the specific participant. Furthermore, prior the execution of a gadget all necessary input data should be available. Such restrictions are managed by the supported JSP Interface, for all gadget in a unified fashion. To provide such functionality, the OpenSocial database is further extended to accommodate a Gadget Registry. Additional custom calls (not included in OpenSocial API) were created for this purpose, grouped in *Custom Java Component.*

The *Recommendation Mechanism* accommodates the provision of complex e-administration services by facilitating the combination of gadgets. It is invoked by the participants through the JSP interface, responsible to present them with the appropriate gadget compositions. The recommendation mechanism transforms the gadget composition problem to a planning problem and uses external planning systems (Hatzi et. al., 2010) to acquire solutions, i.e. plans that indicate how available gadgets can be composed to achieve enhanced functionality. In the same fashion, during gadget execution, the recommendation mechanism can indicate the prerequisites for specific gadgets, that is, the gadgets that should be executed and completed successfully before this gadget obtains all necessary inputs and is able to start its execution.

5 e-Administration Service Example

As an example of e-administration service consider the Thesis Assignment task. Students accomplish this task by filling out a corresponding Thesis Application Form, which is submitted to the corresponding professor. If he/she agrees, the form is signed and the supervising committee is indicated. If the request is denied, the student receives the form back. If the request is accepted, the professor forwards the form to the Student Admission Office to confirm the thesis assignment, taking into account other obligations the student

may have and properly notify both the student and the professor (preferable by e-mail). A BPMN diagram for the Thesis Assignment process is depicted in Figure 3. As indicated in the figure, corresponding data are filled by the student and the professor, if the student request is accepted. The first activity (Apply for Thesis) is performed by the student, the second and third by the corresponding professor, indicated in the Thesis Application Form, and confirmations by Admission Office personnel.

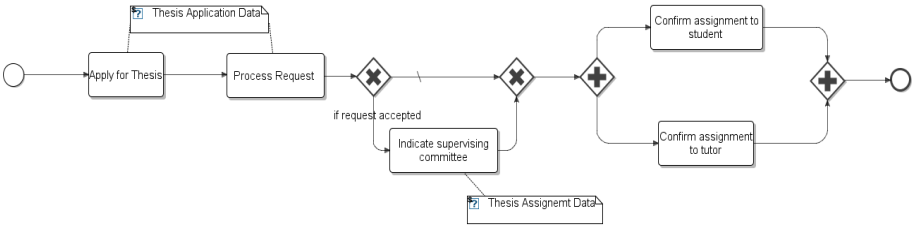

Fig. 3. Thesis assignment BPMN diagram

In the context of the academic social network, the student, the professor and admission staff must be able to perform the corresponding activities using gadgets installed and executed on their profiles.

It should be noted that the gadgets composing a specific task and the way gadgets are coordinated using specific application data fields are specified by the gadget developer, while Unity platform provides the necessary features to make this possible. Participant collaboration is possible through the proposed notification mechanism; each gadget can issue notifications targeted to a specific participant or participants having a specific role that need to take action next.

The process is initiated by the student, who selects the corresponding gadget, named "AssignThesis-Student", from the gadget drawer and installs it, as depicted in Figure 4 (left). If the student attempts to execute the gadget before any of thesis subjects have been announced, an informative message is displayed (Figure 4 – right).

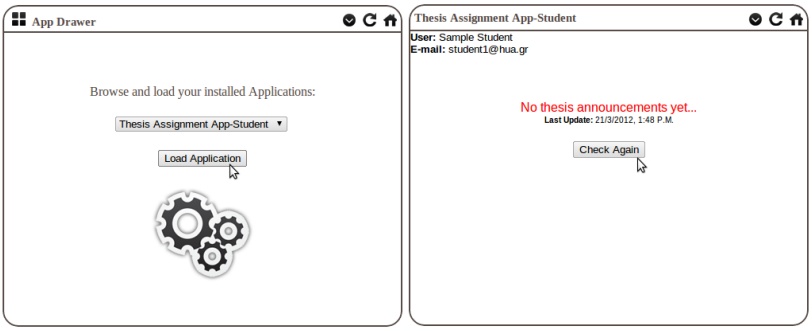

Fig. 4. Thesis Assignment task: Student installs and executes gadget

Upon installation, an AppData item called *thesis_status* is added in the application data table for the specific application instance for the specific user, "Sample Student".

Communication among the coordinating gadgets for the completion of the Thesis Assignment task is possible, since all of them are allowed to access and modify the AppData items created by collaborating gadgets on different profiles.

When thesis subjects are published by the teaching staff of the Department, the student is notified and the "AssignThesis-Student" gadget retrieves them and enables the student to select a subject and request the assignment, as depicted in Figure 5, changing the value of the *thesis_status* AppData item to *pending*.

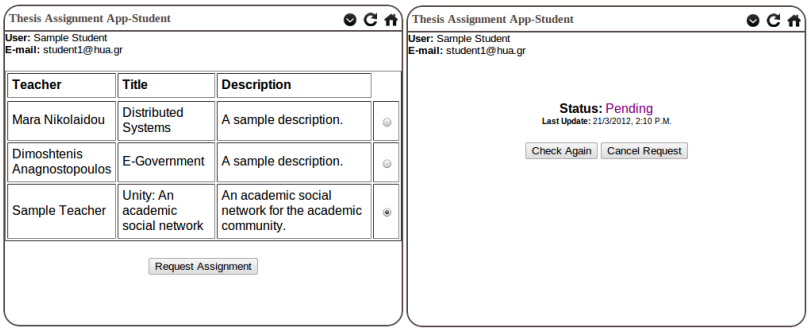

Fig. 5. Thesis Assignment task: Student requests assignment

The selected subject in this example is supervised by "Sample Teacher". The corresponding gadget checks whether "Sample Teacher" is a tutor of "Sample Student" and issues a notification targeted to the specific professor, as depicted in Figure 6, to let him know of the request and to inform him that he must be involved in the task by installing the corresponding gadget and taking some action.

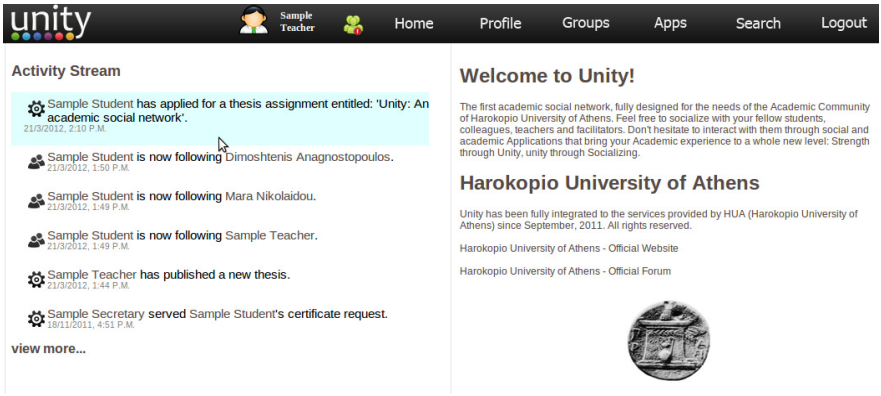

Fig. 6. Thesis Assignment task: Professor is notified to be involved in the task

After the Professor is notified of "Sample Student" request (Figure 5), he must install and execute the corresponding tutor gadget, named "AssignThesis-Teacher". Upon installation, the following appropriate AppData items are generated in the professor's

profile: *thesis_title, thesis_description, student, supervisors*. The student's gadget can access and modify these data, in order to achieve inter-gadget communication.

When executing the gadget, the professor views all pending requests, accepts the request of the specific student, indicates the supervising committee members as depicted in Figure 7.

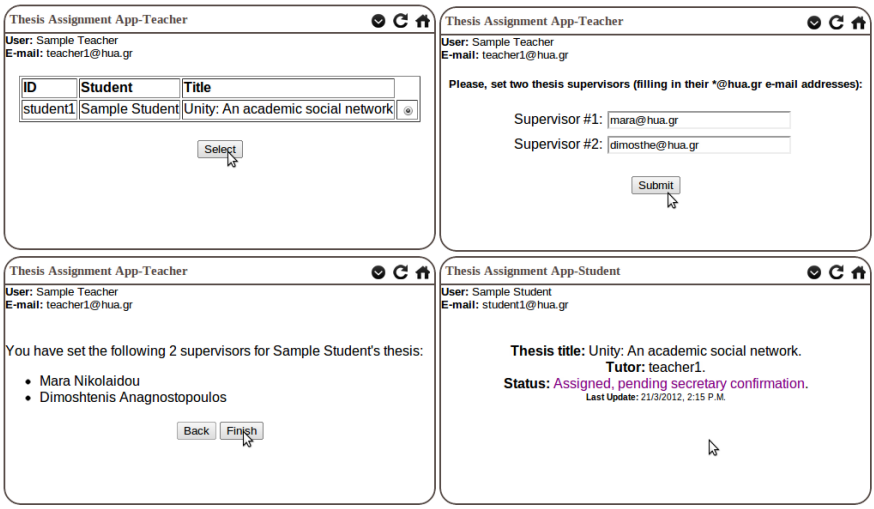

Fig. 7. Thesis Assignment task: Professor views pending requests, accepts and indicates supervisor committee

The corresponding AppData, some residing on the professor and some on the student profile, are updated. For example, the *thesis_status* item on the student profile is changed to *awaiting_conformation*. The student and Admission Office staff members are notified for his actions. The professor gadget notifies the student of the progress, and also notifies the Admission Office staff to be involved, by executing its own gadget. The Admission Office staff performs the necessary checks and confirms the assignment, thus completing the Thesis Assignment task, as depicted in Figure 8.

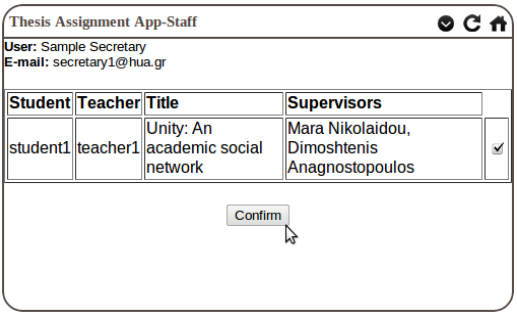

Fig. 8. Admission Office staff confirms thesis assignment

Upon task completion, the Admission Office gadget updates the AppData on the student profile, to indicate the status of the thesis as assigned, and confirmation notifications are sent to both the student and the professor, as depicted in Figure 9.

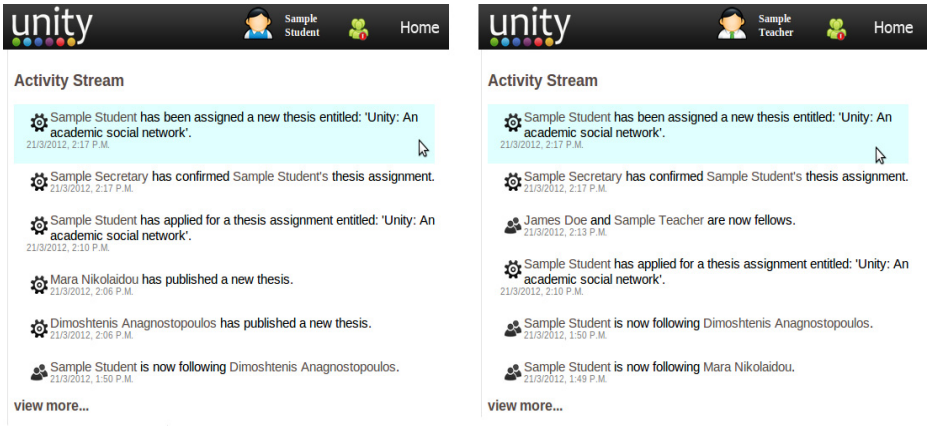

Fig. 9. Notifications on student and professor profiles

6 Conclusions and Future Work

This paper presented an approach supporting the provision of e-administration services through a novel collaboration model, employing social networking technology. Interactions between participants providing and requesting services were modeled as a social network community, featuring extended participant roles and relations. A specific predefined role was assigned to each participant, denoting their obligations and responsibilities in the community. Based on these roles, specific relations were defined, denoting the allowed interactions that can take place between participants. Service provision is performed through collaborating gadgets; each gadget can only be executed by specific participant roles. Collaboration in many cases requires matching between gadget inputs and outputs. A recommendation mechanism, using planning, is utilized to perform the matching and derive an execution plan to facilitate coordination.

The proposed e-service provision model was implemented within Unity academic social network, which already supported discrete participant roles and relation between them, enabling the assignment of specific activities to specific roles or participants. Unity framework was implemented by extending OpenSocial framework, based on Apache Shindig. To support the collaborative provision of e-administration services, the Unity framework was further extended to accommodate gadget lif-cycle and a recommendation mechanism.

Pilot e-administration services were developed and tested, such as Thesis Assignment, presented as an example, and Student Restaurant Card. Experience gained by supporting such e-administration services through collaborating tasks produced encouraging results. We continue developing and testing more complex services, which

require coordination not only with University authorities, but also with external authorities, for example taxation e-gov services.

The proposed extensions in social network collaboration model provides a social networking paradigm that can be utilized to serve e-administration purposes not only in the academic environment, as presented in this paper, but may also be applied to other collaborative communities featuring participant roles and complex relations between them, enabling task coordination and thus service provision based on these roles. The integration of the proposed interaction model with e-government services lies among our future goals.

References

1. Bermejo, J.A.A., Bravo, C.B., Mateos, M.J.R., Piera, J.R.: Social Networks in the Higher Education Framework - Understanding the University as an Organization: Inlumine, Our Study Case. In: Handbook of Research on Business Social Networking: Organizational, Managerial, and Technological Dimensions. IGI (2012)
2. Boulos, M.K., Wheeler, S.: The emerging Web 2.0 social software: an enabling suite of sociable technologies in health and health care education. Health Information & Libraries Journal 24(1), 2–23 (2007)
3. Bruno, G.: An Approach to Defining Social Processes Based on Social Networks. In: Handbook of Research on Business Social Networking: Organizational, Managerial, and Technological Dimensions. IGI (2012)
4. Bruno, G., Dengler, F., Jennings, B., Khalaf, R., Nurcan, S., Prilla, M., Sarini, M., Schmidt, R., Silva, R.: Key challenges for enabling agile BPM with social software. J. Softw. Maint. Evol.: Res. Pract. 23, 297–326 (2011)
5. Dais, A., Nikolaidou, M., Anagnostopoulos, D.: OpenSocialGov: A Web 2.0 Environment for Governmental E-Service Delivery. In: Andersen, K.N., Francesconi, E., Grönlund, Å., van Engers, T.M. (eds.) EGOVIS 2011. LNCS, vol. 6866, pp. 173–183. Springer, Heidelberg (2011)
6. DiMicco, J., Millen, D.R., Geyer, W., Dugan, C., Brownholtz, B., Muller, M.: Motivations for Social Networking at Work. In: CSCW 2008 Proceedings of the 2008 ACM Conference on Computer Supported Cooperative Work. ACM, New York (2008)
7. Elgg, Open Source Social Networking Engine, `http://elgg.org/` (accessed February 20, 2012)
8. Hatzi, O., Vrakas, D., Bassiliades, N., Anagnostopoulos, D., Vlahavas, I.: A Visual Programming System for Automated Problem Solving. Expert Systems With Applications 37(6), 4611–4625 (2010)
9. Fikes, R., Nilsson, N.J.: STRIPS: A new approach to the application of theorem proving to problem solving. Artificial Intelligence 2, 189–208 (1971)
10. Geyer, W., Dugan, C., DiMicco, J., Millen, D.R., Brownholtz, B., Muller, M.: Use and Reuse of Shared Lists as a Social Content Type. In: CHI 2008 Proceedings of the Twenty-Sixth Annual SIGCHI Conference on Human Factors in Computing Systems. ACM, New York (2008)
11. Hiltz, S.R.: Collaborative Learning in Asynchronous Learning Networks: Building Learning Communities. In: 3rd WebNet World Conference of the WWW, Internet, and Intranet Proceedings (1998)

12. Hoegg, R., Martignoni, R., Meckel, M., Stanoevska-Slabeva, K.: Overview of business models for Web 2.0 communities. In: Proc. Workshop Gemeinschaften in Neuen Medien GeNeMe Dresden, pp. 33–49. TUDPress, Dresden (2006)
13. Lewis, D.: What is web 2.0? ACM Crossroads 13(1), 3 (2006)
14. McLoughlin, C., Lee, M.J.: Social software and participatory learning: Pedagogical choices with technology affordances in the Web 2.0 era. In: Proceedings ASCILITE, Singapore (2007)
15. Nikolaidou, M., Hatzi, O., Katsivelis-Perakis, P., Hudhra, V., Anagnostopoulos, D.: Utilizing Social Network Technology to Support Collaborative Tasks. In: Computer Supported Cooperative Work. Springer (2012) (under review)
16. Oreilly, T.: What is Web 2.0: Design Patterns and Business Models for the Next Generation of Software. Communications & Strategies (1), 17 (2007)
17. Ploderer, B., Howard, S., Thomas, P.: Collaboration on Social Network Sites: Amateurs, Professionals and Celebrities. In: Computer Supported Cooperative Work (CSCW), vol. 19(5), pp. 419–455 (2010)
18. Richter, A., Riemer, K.: Corporate Social Networking Sites – Modes of Use and Appropriation through Co-Evolution. In: ACIS 2009 Proceedings (2009)
19. Shami, N.S., Muller, M.J., Millen, D.R.: Browse and discover: social file sharing in the enterprise. In: CSCW 2011 Proceedings of the ACM 2011 Conference on Computer Supported Cooperative Work, pp. 295–304 (2011)
20. Vossen, G., Hagemann, S.: Unleashing Web 2.0: From concepts to creativity. Ubiquity, Article 3 (December 2007)

Do Different Types of SNS Have Different Impacts on Participatory Social Capital?

Sangin Park, Yeontai Choi, Dukyun Hwang, and Miyon Paek

Seoul National University, San 56-1, Sillim-Dong, Gwanak-Gu, Seoul 151-742, Korea
{sanpark,mainder7}@snu.ac.kr, mooboolcyt@hanmail.net,
tinaback@naver.com

Abstract. As the rapid growth of social network sites (SNS) is taking up the role of traditional mass-media, more and more studies focus on the relation between SNS and social capital. These studies, however, typically deal with a specific site such as Facebook. In this study, we aim to so investigate whether different SNS with different characteristics have different impacts on participatory social capital. At least in Korea, SNS are categorized into five types (community, mini-homepage, blog, micro-blog, and profile-based service), and participatory social capital is specified by three types (such as off-line political participation, on-line political participation, civic engagement). Our regression analysis shows that SNS which are more open and focused on information sharing contribute more to participatory social capital.

Keywords: participatory social capital, Social Network Sites (SNS), Blog, Micro-blog, Mini-homepage, Profile-based service.

1 Introduction

Social Network Sites[1] (SNS) began to flourish rapidly in the world with the emergence of mobile-friendly environment and diverse information technology like Web 2.0, which focuses on bringing people together to interact and encouraging users to share personal information and ideas. It is evident that the rapid growth of Twitter and Facebook has come with the increased use of smart phones. Moreover, Social media represented by SNS is taking over the roles and influences of Mass media, functioning as a powerful tool for agenda setting and public opinion making. Thus, in a process of developing and transferring public opinion, SNS' influence in our society has been increasing.

SNS are not a simple and mere delivery channel of information. They create new relationship among the users by sharing information and communications. SNS provided 'a place of public opinions' in the U.S. presidential election in 2008 and the U.K. general election in 2010. Based on the Web 2.0 paradigm, SNS facilitate participation, sharing information, interactive communication, and continuity among communities. Public opinion making via SNS will continue to grow.

[1] In some countries such as Korea, SNS are also used as abbreviation of Social Network Services.

A. Kő et al. (Eds.): EGOVIS/EDEM 2012, LNCS 7452, pp. 231–241, 2012.

With these recent changes, several scholars of social science have given their attentions to SNS' political effects, especially on the social capital making [1-3]. These academic researchers have compared traditional media with SNS on several aspects, such as participation, sharing information, openness, communication, interactive relationship, and community. While traditional media relies on the broadcasting, which is a one-way communication for unspecified groups of audience, SNS can reach broader audience with specific interests. In addition, traditional media has relatively clear separation between content consumers and content producers whereas in SNS, the two participants are linked together in a way that they are interchangeable. As a result, it is not easy to separate the two and categorize each SNS' user type: SNS users can be contents consumers, content producers and content distributers at the same time. These multiple roles of SNS users make them a kind of collective and diverse members in social networks.

In terms of openness and communication, unlike anonymous Internet users in the past, the use of SNS requires participants to uncover their education, job, hobby, and friends. Typically, many SNS users interact by leaving comments and reviews in their social network. This openness reduces negative consequences such as digital populism and abusive and irresponsible communication. As a result, it creates a positive impact to support social capital developments based on trust and collaboration among people.

SNS also allow people to make their own communities. Thus, SNS helps people realize their desires for building, maintaining, and extending their relationships with others. Such linear communications among SNS users are their very characteristic, and create a substantial change from the expanded applications of digital media. A person can maintain or extent their social connections using SNS [1, 4, 5]. His investments on social networks can create more opportunities and information necessary to solve the collective social problems. Since the use of SNS requires participants to uncover their education, job, hobby, and friends, it enhances social capital which represents trust and reciprocal relations among people in a society[2, 3]. According to Putnam (2000), social capital can support an efficient democracy by inducing a strong civil society and increasing responsibilities of public sectors [7].

Faced with the rapid growth of SNS, recent studies focus on the relation between SNS and social capital. These studies, however, typically deal with a specific site such as Facebook. In this study, we aim to so investigate whether different SNS with different characteristics have different impacts on participatory social capital.

2 Basic Concepts

2.1 SNS Types and Attributes

We begin by explaining different types of SNS. SNS are a service that helps communications and sharing information through various human network tools on the Web. Crossing and combining networks of individual users, they share information and ideas. In a broader sense, SNS include social phenomenon of connectivity based on the web [8]. In

Korea, with a rapid evolution of information communications technologies (ICT), there are diverse types of SNS such as community, mini-homepage, blog, micro-blog, and profile-based service[2]. Table 1 below lists the five types of SNS and their attributes.

Table 1. Types of SNS

Type	Attributes
Community (internet café or club)	Group of Internet users who have common interests or similar hobbies to share information and to make relations with each other
Mini-homepi (mini-homepage)	Personal cyber space that the person can manage, invite others, and post personal contents primarily, like a homepage
Blog	Similar to mini-homepage, but more open to other users. Relatively specialized or objective contents are posted
Micro-blog	A kind of blog. People share thoughts and feelings using a short sentence, like Twitter.
Profile-based service	Services that people can make relations using a profile including open personal information and posted contents, like Facebook and Myspace.

2.2 SNS and Internet Collective Action

Mancur Olson (1971) explained the logic behind collective action, which is the famous theory in studies of public sector[10]. He pointed out that a motivation of collective action is in the center of his theory and understood that participants' motivation lies largely on their rational and economic consideration on benefits and costs in collective actions. When the benefit generated by a participant's activity is expected to be greater than the cost, then (s)he is more motivated to participate in. In cases of a grand scale collective action that benefits the society as a whole, there is a lack of motivation due to the probability of free riding. Thus, to decrease chances of free riding, Mancur Olson proposed the concept of a selective incentive, which can only be provided to participants.

Based on his logic, scholars have tried to study theoretical and practical possibility of Internet collective actions of recent political participations using digital equipment and networks on the Web. There are some benefits generated by Internet collective actions, like low transactional costs, bigger chances of voluntary association or community-construction and civic involvement. On the other hand there can be a danger from anonymity and irresponsibility.

In most SNS, including Micro-blogs, a person who wants to link with other users is required to disclose his identity to prevent irresponsible behaviors from anonymity. Moreover, most relationships in SNS are originated from friendships more than shared interests in specific issues; so relationships tend to last longer. In short, SNS are useful tools to solve the dilemma of collective actions when compared to the traditional ones; for example, it has decreased monitoring costs of free riders and has increased efficiency of grouping and stability of relationships.

[2] These categories are based on the annual survey from the Korea Internet Security Agency (KISA) which have investigated the Internet usage pattern of people in Korea.

2.3 Social Capital

Social capital is generated and acquired from social relations. Social capital grows as social trust, collaborative activity, reciprocity, and social norms are accumulated in social interactions[11-13]. Concerning that studies on social capital have focused on 'relations' or 'networks', it is advised to examine interpersonal communications in social capital accumulation. Development and expansion of digital media technology facilitate more flexible and horizontal communications and interactions among SNS users. Thus it is important to investigate the relationship between variation of communications method and social capital.

Studies, which use a network analysis method, put their emphases on 'individual.' Researchers have tried to understand how an individual pursues and maximizes his interest through networking. In this approach, social capital is a kind of outcome made from each individual's efforts to keep relationships within a network, and the social capital can be used as an instrument to maximize personal interests. Criticizing that there is confusion on trust, which has been used as a representative social capital by some scholars, and social norm, Lin et al.(2001) considers social capital as a resources which can be mobilized by people who expect a reward from investments to social relations[14]. On the other hand, other studies take collective action process to understand social capital accumulation. Putnam (1995) argued that social capital entails organizational characteristic, which facilitates coordination and cooperation for mutual interests[15]. Thus a function of social capital is not to simply maximize an individual interest but to promote common interests in a community.

2.4 SNS and Participative Social Capital

Earlier studies found a positive impact of Internet on social capital and focused on bridging social capital and weak ties [16]. In comparison with bonding social capital, bridging social capital is composed of weak ties among people from different social background. Many recent studies on social capital are treating SNS as significant instruments for building relationship among users and providing efficient communication functions which can contribute to greater social capital [1, 16-20]. SNS are useful in bridging weak ties, because it facilitates forming the extended network [18, 21, 22]. Empirically, prior studies found that some SNS, like Friendstar and Facebook, can encourage bridging social capital, and some scholar think a recommendation system like 'people you may know' in Facebook and follower list function in Twitter may have to do with bridging. [18, 23].

An individual with better understanding of social issues can participate in discussions and express own opinions on issues. Such deliberate activities are necessary to produce social capital. For example, twitter, which is very popular among young people, emerged recently as an important instrument of communication on social issues, and substantial political participations are often encouraged and led by heavy users. In addition, easy registration process and following-followers system help individuals spread their opinion quickly, form shared public opinions and promote active

political participations. Twitter users can send instant messages to their followers in anytime from anywhere. The messages spread through Twitter can have big political and social influence on audience. Hence, SNS, like twitter, play a significant role in generating social capital.

3 Literature Review

Even though a concrete theoretical base is not established, several empirical studies emerged like a trend. Before SNS become popular, Ellison et al. (2007) studied the impacts of Facebook on social capital by measuring students' usage of Facebook in the Michigan State University. They measured the number of users, the amount of time students spent, the number of Facebook friends, etc. They developed indexes to indicate Facebook usage levels and divide social capital into three groups: bridging type, bonding type, and maintained type. According to their result, the higher the Facebook usage level, the greater the social capital (especially bridging social capital) [16]. An interesting point is that students with lower self-esteem and daily satisfaction make better use of Facebook, and these results are closely related to bridging social capital.

Similar to Ellison et al. (2007), Steinfield et al. (2008) studied the relationship between social capital and Facebook usage. They used, however, different research framework; cross-lagged correlation analysis and lagged regression using two-year surveys[1]. The result of research was similar with that of Ellison et al. (2007), and they concluded that using Facebook was helpful to overcome some psychological disorders, which people who were more introverted or had low self-esteem may face when they feel a sense of disconnection from others.

Valenzuela et al. (2009) that examined the relationship between Facebook and social capital conducted a survey on students in Texas in 2007. They divided social capital into three categories: life satisfaction, social trust, and civil and political participation. They also found that there was a positive relationship between Facebook usage and the three types of social capital. The measured influence of Facebook usage, however, was not significant enough to say that Facebook was an effective instrument to increase social capital [2]. Nevertheless, their results contradict the time displacement hypothesis by Putnam (2001), which suggested cyber-pessimism and negative effect of television on social capital.

4 Research Framework

4.1 Data Collection and Sampling

This study uses data from Nielsen KoreanClick's web-based survey, 'Survey on behavior of Internet users on public sector'. The number of effective survey respondents is 1,593 out of 1,667. The survey was done under the quota sampling method that

considers gender and age of the Internet population. The survey includes questionnaires on personal identities, SNS usage level, political participation, and civic engagement.

4.2 Measurement

Dependent Variable. The dependent variable of this study is participatory social capital, which is composed of on-line civic engagement, on-line political participation, and off-line political participation. To measure the levels of on-line political participation and on-line civic engagement, the survey asked questions on a frequency of participations on stated activities through Internet in the past year, using a five-point scale: from '1' meaning 'never participate' to '5' meaning 'frequently participate'. Off-line political participation is measured through a question on experience and willingness to participation in future in stated political activities, using a three-point scale: '1' meaning 'I have an experience.'; '2' meaning 'no experience, but having intentions to participation in future.'; and '3' meaning 'neither'.

Table 2. Statements on questionnaires to measure dependent variables

Variable	Statements
On-line political participation (Cronbach's α : 0.81)	① participating in a public opinion poll or a vote on Internet ② participating in on-line discussion about social issues and policies ③ Participating in collective action for social problem solving or public interests (for example, banner for commemoration, campaigns, posting opinions, etc.)
On-line civic engagement (Cronbach's α: 0.79)	① Declaring obscene contents (for example, pornography, spam, abusive comments, illegal downloading, etc.) ② Posting valuable information on blogs, homepages, or communities, and answering to a posted question. ③ participating in voluntary activities from Internet ④ donation through Internet (for example, points, mileage, or money)
Off-line participation (Cronbach's α: 0.85)	① signing a petition ② participating in a boycott ③ participating in a sit-down ④ participating in a political demonstration ⑤ attempting to meet politicians or officers to express own opinion ⑥ participating in donation or fund-raising for a political purpose ⑦ visit or appear on the media

Independent Variables. This study has five types of independent variables: SNS usage level; personal identity; political and social participation; utilization of the media; digital literacy; socio-economic variables. The usage level is measured by a four-point scale; from 'one' meaning 'never use' to 'four' meaning 'use very frequently'.

Table 3. Research Framework and explanations on variables

Variable			Definition and Measurement
Dependent variable		Participatory social capital	On-line political participation / On-line civic engagement Five-point scale
			Off-line political participation Three-point scale
Independent variable		SNS usage level	Usage levels of SNS in the past year Four-point scale
Control variable	Political orientation	Supporting party	Dummy
		Political regime	Five-point scale
		Political interest	Five-point scale
		Internal political efficacy[3]	Five-point scale
		External political efficacy[4]	Five-point scale
		Public service motivation	Five-point scale
		Trust in public sectors	Do you trust in central government, local government, president, congressman, top officers Five-point scale
		Social trust	Score your trust level on the society out of 100
	Political·social participation behavior	Discussion on political issues	How often do you discuss with friends, colleagues, and family members government and political issues? Five-point scale
		Discussion on community issues	How often do you discuss with friends, colleagues, and family members local community issues? Five-point scale
		Participation in organizations	Five-point scale
		Voting at the 2010 local election	Dummy (not participate =0)

[3] Statements in the questionnaire are: ① I am ready to participate in politics ② I understand political issues enough ③ I think I can do a job of public services as others ④ I think I know about politics or government more than others.

[4] Statements in the questionnaire are: ① government officers do not reflect citizen's opinion ② congressman disregard citizens after being elected ③ political party are interested in only an election, not in citizen's opinions.

Table 3. (*continued*)

Variable			Definition and Measurement
Control variable	Media usage	Hours spent on Internet	
		Hours spent on TV watching	
	Digital literacy	Internet literacy	Four-point scale
		Usage level of public App.	The number of app used related to primary government departments
	Socio-economy variable	Gender	dummy(female=0)
		Age	Continuous variable
		education	Under high-school graduate, high-school graduate, undergraduate and graduate student, college graduate (baseline)
		Monthly income	Less than 671 EUR / 671 EUR ~ 2,013 EUR / 2,013 EUR~3,355 EUR / more than 3,355 EUR (baseline)
		Region	*Honam* area, middle area, *Youngnam* area, metropolitan area(baseline)
		Job	Jobless, housewife, student, blue-collar, white-collar, self-employed(=0)
		Marriage	Married, single(=0)
		religion	Buddhism, Protestantism, Catholicism, Confucianism, do not have (-0).

5 Analysis Result and Conclusion

Our regression results are reported in table 4. First of all, table 4 indicates that different types of SNS have differences in their impacts on participatory social capital. In the case of online civic participation and online political participation, 'Micro-blog' and 'Community' coefficients are larger than the other SNS types' coefficients.

Table 4. Regression Results

Variables	Online civic participation	Online political participation	Offline political participation
Community	0.4832*** (0.123)	0.2114*** (0.060)	0.2520** (0.101)
Mini-homepage	0.2387* (0.125)	0.0900 (0.060)	-0.1758* (0.102)
Blog	0.3734*** (0.131)	0.0696 (0.063)	0.1408 (0.107)
Micro-blog	0.4935*** (0.146)	0.2504*** (0.071)	0.0546 (0.119)
Profile-based service	0.1466 (0.135)	0.0168 (0.065)	-0.0555 (0.110)
Internet literacy	0.2191*** (0.031)	0.0916*** (0.015)	0.0794*** (0.025)
Public App. usage	0.6139*** (0.174)	0.2845*** (0.084)	0.4545*** (0.142)

Table 4. (*continued*)

Variables	Online civic participation	Online political participation	Offline political participation
Motivation to public voluntarism	0.2669*** (0.046)	0.1049*** (0.022)	0.0805** (0.037)
Internal political efficacy	0.1249*** (0.038)	0.0669*** (0.018)	0.1607*** (0.031)
External political efficacy	-0.0511 (0.041)	-0.0112 (0.020)	0.0728** (0.034)
Interest on politic	0.4557*** (0.133)	0.2688*** (0.064)	0.7138*** (0.107)
Discussion on government	0.3395** (0.142)	0.2151*** (0.069)	0.2265* (0.116)
Discussion on local problems	0.1814 (0.137)	0.0396 (0.066)	0.1269 (0.112)
Political orientation	-0.0270 (0.122)	-0.0148 (0.059)	-0.3238*** (0.099)
Off-line political participation	0.2659*** (0.031)	0.1345*** (0.015)	
Participation in organization	0.1158*** (0.027)	0.0436*** (0.013)	0.1721*** (0.022)
Voting experience	0.1931 (0.208)	0.1498 (0.100)	0.1906 (0.170)
Time spending on Internet	0.0010* (0.001)	0.0006** (0.000)	0.0003 (0.000)
Time spending on watching TV	0.0006 (0.001)	0.0003 (0.000)	-0.0011 (0.001)
Time spending on reading newspapers	0.0004 (0.001)	0.0001 (0.001)	0.0009 (0.001)
Trust on public sector	-0.0045 (0.032)	-0.0058 (0.015)	-0.0768*** (0.026)
Social trust	0.0007 (0.005)	-0.0002 (0.003)	-0.0022 (0.004)
Constant	-1.0927 (1.951)	-2.1350** (0.941)	1.1234 (1.593)
Observations	1,593	1,593	1,593
R-squared	0.513	0.487	0.366
Standard errors in parentheses			
*** p<0.01, ** p<0.05, * p<0.1			

The result that 'Micro-blog' has a strong relation with online participatory social capital may be due to its attributes: an open system to make relations, easy spreading through a re-twit function, the accessibility using mobile instruments, and the convenience from using short sentences. These attributes make it possible easy to produce networked community and to extend communication boundaries. Although the level of openness and ease of spread are relatively low, 'Community' typically has a strong tie between member users, and the strong tie may be a useful attribute which is

positively related to participatory social capital. In addition, 'Community' is sometimes formed to support the offline community. This unique attribute of 'Community' may explain a positively significant relation between the 'Community' usage level and the offline political participation.

On the other hand, 'Profile-based service', such as Facebook and Myspace, turns out to have insignificant impact on participatory social capital. This seems to be related to Profile-based service' attributes: relatively closed system with focus on making more personal relations. The case of 'Mini-homepi' shows similar results. 'Mini-homepi' has a relatively closed system, focusing on a relationship-making. Moreover, 'Mini-homepi' usage has a negative and significant coefficient on offline political participaption at the 10% significant level. This result may reflect that the majority of 'Mini-homepi' user is female.

The impacts of 'Blog' lie between those of 'Micro-blog' and 'Profile-based service'. 'Blog' has similar attributes of 'Micro-blog'. However, 'Micro-blog' is more convenient to have instant communications while 'Blog' is usually used to post more specialized contents.

This study used several control variables. Among them, the level of political interests, the public service motivation, and the internal political efficacy have positive and significant coefficients to all dependent variables. One interesting result is that the external political efficacy has negative and significant impacts on offline political participation. Indicators of the external political efficacy variable are composed of negative statements on politicians and government officers. Hence, offline political participations may be used a way to express resistance or distrust. Consistent with this interpretation, the public trust variable has a negative and significant coefficient on offline political participation.

Besides, the level of discussion on government issues has positive and significant coefficients on participatory social capital variables. The coefficient of the participation in political organization was positively significant to offline political participation. And the organizational participation is positively and significantly related to offline political participation. Lastly, the Internet literacy and the public App usage level are significant to all participatory social capital variables.

Note that our empirical results indicate not causality but correlations between SNS usage and participatory social capital. In order to control possible endogeneity problem, it is necessary to have appropriate instrument variables.

References

1. Steinfield, C., Ellison, N.B., Lampe, C.: Social capital, self-esteem, and use of online social network sites: A longitudinal analysis. Journal of Applied Developmental Psychology 29(6), 434–445 (2008)
2. Valenzuela, S., Park, N., Kee, K.F.: Is There Social Capital in a Social Network Site?: Facebook Use and College Students' Life Satisfaction, Trust, and Participation1. Journal of Computer Mediated Communication 14(4), 875–901 (2009)
3. Valenzuela, S., Kim, Y., de Zúñiga, H.G.: Social networks that matter: Exploring the role of political discussion for online political participation. International Journal of Public Opinion Research (2011)
4. Ellison, N.B.: Social network sites: Definition, history, and scholarship. Journal of Computer Mediated Communication 13(1), 210–230 (2007)

5. Joinson, A.N.: Looking at, looking up or keeping up with people?: motives and use of facebook. ACM (2008)
6. Granovetter, M.S.: The strength of weak ties. American Journal of Sociology, 1360–1380 (1973)
7. Putnam, R.D.: Bowling alone: The collapse and revival of American community. Simon and Schuster (2001)
8. Boyd, D.M., Ellison, N.B.: Social network sites: Definition, history, and scholarship. Journal of Computer-Mediated Communication 13(1) (2010)
9. Granovetter, M.: The strength of weak ties: A network theory revisited. Sociological Theory 1(1), 201–233 (1983)
10. Olson, M.: The logic of collective action: Public goods and the theory of groups, second printing with new preface and appendix (Harvard Economic Studies) (1971)
11. Coleman, J.S.: Foundations of Social Theory. Chs 8, 12 (1990, 1993)
12. Lin, N.: Building a network theory of social capital. Connections 22(1), 28–51 (1999)
13. Portes, A.: Social capital: Its origins and applications in modern sociology. Knowledge and Social Capital: Foundations and Applications, 43–67 (2000)
14. Lin, N., Cook, K.S., Burt, R.S.: Social capital: theory and research. Aldine de Gruyter (2001)
15. Putnam, R.D.: Bowling alone: America's declining social capital. The City Reader, 120–128 (1995)
16. Ellison, N.B., Steinfield, C., Lampe, C.: The benefits of Facebook "friends:" Social capital and college students' use of online social network sites. Journal of Computer Mediated Communication 12(4), 1143–1168 (2007)
17. Boase, J., et al.: The strength of internet ties. Pew Internet and American Life Project (2006), http://www.pewinternet.org/pdfs/PIP_internet_ties.pdf
18. Donath, J., Boyd, D.: Public displays of connection. BT Technology Journal 22(4), 71–82 (2004)
19. Ryberg, T., Larsen, M.C.: Networked identities: understanding relationships between strong and weak ties in networked environments. Journal of Computer Assisted Learning 24(2), 103–115 (2008)
20. Wellman, B.: Physical place and cyberplace: The rise of personalized networking. International Journal of Urban and Regional Research 25(2), 227–252 (2001)
21. Ellison, N., Heino, R., Gibbs, J.: Managing Impressions Online: Self‐Presentation Processes in the Online Dating Environment. Journal of Computer Mediated Communication 11(2), 415–441 (2006)
22. Parks, M.R., Floyd, K.: Meanings for closeness and intimacy in friendship. Journal of Social and Personal Relationships 13(1), 85–107 (1996)
23. Resnick, P.: Beyond bowling together: Sociotechnical capital. HCI in the New Millennium, 247–272 (2001)
24. Kim, T.: A Comparative Study on National Culture of SNS User-Comparison of Korea, China, and US. Journal of Information Technology Applications & Management 18(4), 131–148 (2011)
25. Kim, H., Han, K.H.: Unique Motivation for Using Global Social Network Site in Korea. In: HCI International 2011–Posters' Extended Abstracts, pp. 440–444 (2011)
26. Lee, G., Lee, J., Kwon, S.: Use of social-networking sites and subjective well-being: A study in South Korea. Cyberpsychology, Behavior, and Social Networking 14(3), 151–155 (2011)

Allowing Continuous Evaluation of Citizen Opinions through Social Networks

Francesco Buccafurri, Lidia Fotia, and Gianluca Lax

DIMET, University of Reggio Calabria
Via Graziella, Loc. Feo di Vito
89122 Reggio Calabria, Italy
{bucca,lidia.fotia,lax}@unirc.it

Abstract. Implementing concepts like e-governance and e-democracy requires to effectively allow the continuous participation of citizens in decisional processes of the community. In this context, a crucial aspect is the possibility of receiving the opinion of citizens in several situations. To do this, a massive adoption of existing e-voting systems is in fact unfeasible, but the guarantee that the basic security features are supported, is anyway necessary. In this paper, we propose a *lightweight* e-voting system relying on existing social networks which appears promising for the above applications. Indeed, our proposal solves the trade-off between security and complexity arising from the scenario of continuous opinion evaluation.

1 Introduction

E-democracy is one of the key factors of the transformation process of the city towards the future model of *smart city* [24,27,34]. Of course this process dramatically extends the task beyond the simple digitalization, by incorporating several dimensions that are not only technological (i.e., social, economics, political, etc.), but technical infrastructures represents a starting point allowing the success of the transformation. E-government must be able to address the basic questions allowing citizens to work and live in more intelligent ways, but the participation of citizens to the decision processes is a fundamental part of the project. Recall that the concept of smart city has to be intended in an extended way, thus not necessarily limiting the scope of e-services and the dynamics of the involved processes just to a city, but to an entire community which could be sometime really a city, sometimes a region, sometimes an entire Country. In this context, e-democracy relies on any ICT-based process allowing citizens to directly participate to the governance of the community, not only by expressing their preference in the political elections, but in many other situations where the opinion of citizens may drive the decisional process of the community. Consider for example the preliminary evaluation of a law or a reform, a political parties poll, a satisfaction survey, a primary election, just to mention a few. Currently, all the above situations are typically not faced by using the official electoral system, for evident reasons of economy and feasibility. But no cheap

A. Kő et al. (Eds.): EGOVIS/EDEM 2012, LNCS 7452, pp. 242–253, 2012.

system guaranteeing the basic voting properties, which are uniqueness, secreteness, verifiability, uncloneability, robustness and scalability, are in fact available. So that, either some of the above features are not guaranteed, or the continuous participation of citizens is not really implemented. When moving towards the e-democracy era, we have to find a way to implement all the above *light* forms of public elections, whose usage will be more and more important.

E-voting protocols are nowadays a consolidated reality in the scientific literature, so we could trivially use one of them. Anyway, the features providing e-voting systems [7,35] are in fact excessive with respect to the application we are considering, since some of these features have a high cost in terms of complexity of a real system implementation. Thus, we have to find some lighter method, guaranteeing the above basic security features, whose implementation does not require dedicated infrastructures and complex working, making the solution unproportionate with respect to the problem.

We propose a solution based on pre-existent social networks, allowing citizens to vote through their own profile. The technique presented in this paper takes inspiration from the approach proposed in [5], where the problem of anonymous resource evaluation in social networks is faced. The solution here presented, among the features typically satisfied in e-voting systems, guarantees uniqueness, secreteness, verifiability, uncloneability, robustness and scalability. Anyway, no complex overhead is required besides an electronic card to identify a citizen or any identity management system able to identify people (plausibly, we can consider this is for free in an e-government context), and owing a profile by each voter in one of the existing social networks. Concerning the last requirement, we observe that the penetration of social networks in the life of users is very high. As a consequence, assuming that a user has a profile in one of the most famous social networks like Facebook, Twitter, YouTube, Flickr, MySpace, etc. is realistic [28,31,11,38,16,6].

The paper is organized as follows. In the next section, we contextualize our paper in the scientific literature. In Section 3, we recall some background notions, and in Section 4, we give a brief overview of our proposal. Section 5 is devoted to the e-voting protocol which is the core of our proposal, in Section 6, the analysis of the security of this protocol is presented, by showing that all the desired features are guaranteed also against possible attacks. Finally, in Section 7, we draw our conclusions and sketch possible future work.

2 Related Work

Our paper is contextualized in the topic of e-voting, where there exists a wide literature. Chaum [10] introduced the notion of *mix-net* as a tool for achieving anonymity in e-mail and in electronic elections. A mix-net consists in a sequence of servers, called mixes. Each server receives a batch of input messages and produces as output the batch in permuted (mixed) order. Such mix-nets are sometimes called *mix cascades* or *shuffle networks*. When used for voting, the input messages are the ballots of the voters. An observer should not be able to tell

how the inputs correspond to the outputs. This property provides voter privacy in an electronic election. In Chaum's original proposal, before a message is sent through the mix-net, it is encrypted with the public keys of the mixes it will traverse in reverse order. Each mix then decrypts a message before sending it on to the next mix. A modified version of the protocol was published later by Chaum [9]. A new kind of receipt improves security by letting voters verify correctness of the election outcome, even though all election computers and records were to be compromised. The system preserves ballot secrecy, while improving access for voters, robustness, and adjudication, all at lower cost.

Sako et al. [36] propose another approach to e-voting based on *re-encryption mix-nets* [33] and on *proofs*, used by voters to prove to the authorities the correctness of the votes they sent. Proofs may be interactive (e.g., classical zero-knowledge proofs) or non-interactive and simply attached to the vote. All mixes in this system have a unique private key for the El-Gamal encryption scheme. There exists a public key for an anonymous channel. Mixes produce encrypted ballots with proofs for users. During the voting stage, the voters choose their votes using an untappable channel and send them via decryption networks. This vote will be counted only after the mix posts a proof of correct decryption. This scheme is based on an ad-hoc recruitment, like for example the use of untappable channels for the transmission of data, which makes it little practical [39].

Zwierko et al. [39] propose an agent-based scheme for secure electronic voting. The scheme is universal and can be implemented in a network of stationary and mobile electronic devices. The proposed system is based on an idea of an authentication protocol with revocable anonymity, which utilizes a combination of *Merkle's puzzles* [30] and a *secure secret sharing scheme* [35]. The Merkle's puzzles provide anonymity and a secure secret sharing scheme is a method of group authentication. Both methods can also be used for the e-voting scheme to protect voter's privacy and to create effective method of authorization.

The protocol, presented in [21], is designed for large scale elections. The counter and voters communicate through an anonymous channel, the administrator uses a blind signature scheme so that each voter has a different digital signature and uses the commitment scheme to compute the ballot. The election protocols based on homomorphic encryption are described in various papers [3,13,14].

In the system proposed by Cramer et al. [13] the authorities create a pair of shared private and public keys. Using these keys and the El-Gamal scheme, the voters can create their ballots: they encrypt their votes and produce a non-interactive proof of validity, with the zero-knowledge property. After checking the proofs from the voters, the coalition of honest authorities can combine all correct votes and utilize proofs to decrypt the product. In the result they obtain the final tally. The protocol proposed by Damgård et al. [15] utilizes the generalized Pallier's cryptosystem. A more effective method of decryption and computing the result is presented in [13].

Another system exploiting the homomorphic encryption scheme was proposed by Ogata et al. [32] and improved in [1,22,33]. During the initial stage the authority

publishes the shared public key. Then, the voters register, compute and post their votes on a public, broadcast communication channel with memory, called bulletin board [13]. All votes are then sent through a re-encryption mixnet. After being checked, the count is made. Some other approaches to electronic voting, also based on homomorphic encryptions, have been proposed in [3] and [26]. The system preserves the receipt-freeness property [29,17](and incoercibility, providing that the adversary does not have access to the registration phase), since a voter can generate a false receipt. Unfortunately, receipt-freeness and incoercibility have in the paper a high price in terms of verifiability and scalability. Also the usage of anonymous broadcast channel makes the scheme impractical, since it is hard to implement. All the above e-voting systems require complex mechanisms and ad-hoc infrastructures (eg., mix-nets), making them not suitable for our purpose.

3 Background

In this section, we briefly recall some notions representing the background necessary to the reader to understand the technical aspects of the paper. Such notions are *digital signature*, *blind* and *partially blind signature*.

The digital signature mechanism relies on public key infrastructure. Each user owns two keys, a private key and a public one. The private key is kept secret and the public one is made public. Guessing a private key is computationally unfeasible for enough large keys. The first step of the signature generation process is the computation of a cryptographic hash function [19,18] of the document to be signed. The result, called digest, can substitute the original document in the signature generation process since the probability of having two distinct documents producing the same digest is negligible. Moreover, the problem of finding a document with digest equal to that of another given document is unfeasible, so that an attacker cannot corrupt a signed document without the signature detects it. The digital signature is produced by encrypting the digest with the private key using an asymmetric cryptographic cipher, typically RSA. The verification of the signature is done by checking that the decryption of the signature done with the public key of the subscriber coincides with the (re-computed) digested of the document.

A blind signature [8] is a signature scheme in which the signer is not aware of the content of the message to sign. Denoted by (n, e) the public key of the signer S and by (n, d) his private key, the author (say A) of the message M generates a random number r such that it is relatively prime to N (i.e., the *greatest common divisor* $\gcd(r, n) = 1$) and calculates $M' = r^e M \mod n$. Then, S signs the blind message M' by $S' = (M')^d \mod n$ and sends it back to A, who computes the digital signature of the unblinded message $S = (S')r^{-1} \mod n = M^d$. Partially blind signatures [2] are a particular type of signature allowing the signer to explicitly include in unblinded form some pre-agreed information in the blind signature, like an expiry date, and are mainly used in the context of electronic cash (e-cash).

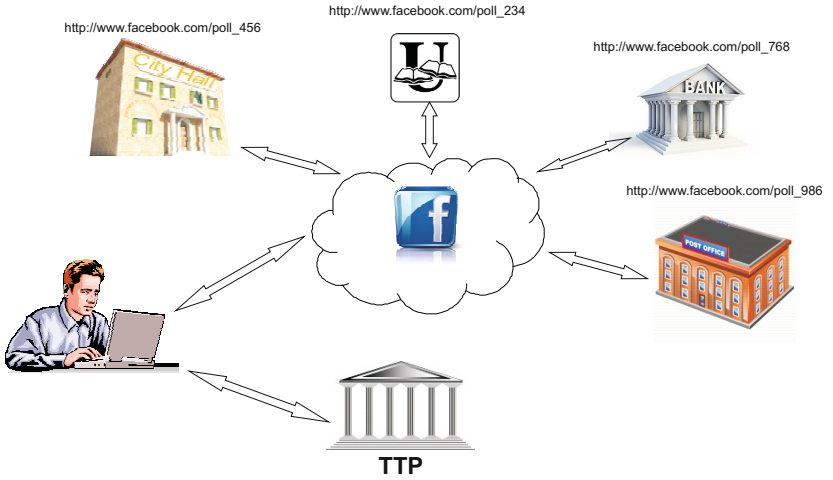

Fig. 1. The e-voting scenario

4 An Overview of the Proposal

In this section, we briefly describe the e-voting scenario we have designed in our proposal. The e-voting protocol will be described in the next section. We assume that the citizens may use a smart card embedding an X.509 certificate [4,12] for authentication (for example, an electronic identity card [37,25]), or, equivalently, we assume that an original secure identification of users is adopted in the social network they belong to. In principle, any other identity management system able to identify people over the social networks is sufficient. In sum, the assumption is that each user is identified by means of a unique ID.

The solution is based on the usage of existing social networks. Citizens vote by using their social network profile. The e-voting infrastructure is implemented by exploiting, for each existing social network (actually, for the most important ones) a (large) number of profiles whose `URL` is of the form: `http://www.socialnetwork.org/poll_Y`, where `Y` is a cardinal number. These profiles are managed by possibly different government entities. Each entity replicates its profile over the most common social networks. The only requirement we have for these *super* profiles is the service continuity. These profiles are called in our model *credential providers*, and play the role of granting credentials to voters they can spend in order to submit their vote to a Trusted Third Party (TTP), responsible of generating the ballots for each e-voting. It is worth remarking that each credential provider belongs typically to a different party, in the chosen set. Indeed, we can imagine that the domain of credential providers is built by collecting a large variety of subjects, like public sector offices, postal offices, universities, schools, military subjects and so on, in such a way that we can easily reach a relevant number. The scenario is summarized in Fig. 1. The voter selects a suitable number $\overline{t}$ (see Section 5 for its definition) of credential

providers on the basis of the value of her ID and asks them for the credentials relating with the e-voting. In the figure we have assumed that the voter belongs to the social network Facebook and, on the basis of her ID, she computes four values (i.e., $Y_1 = 456$, $Y_2 = 234$, $Y_3 = 768$, and $Y_4 = 986$) identifying the respective credential users. In this example, $\overline{t} = 4$. The Trusted Third Party collects votes, verifies that they are admissible, and generates the ballots for each e-voting. The protocol ensures that the credential providers, even though may identify voters cannot link them to their vote, while TTP cannot identify voters. A basic feature of the system is that both credential providers and TTP store data regarding e-voting sessions only locally, so that the security of the protocol does not rely on the trustworthiness of the social network providers. In other words, as far as e-voting information is concerned, the system is truly distributed. The only assumption we require (common in this context) is that no more than t credential providers collude, where t is a parameter of the system. Obviously, the number $\overline{t}$ of contacted credential providers per voter is directly related to t. The detail of the protocol is shown in the next section.

5 The E-Voting Protocol

In this section, we describe how the e-voting protocol works. Consider an e-voting session identified by ID_{vs}. For the sake of presentation, we assume that a preference is expressed by reporting the number i identifying the choice of the voter. For example, if a new law act is submitted for preliminary evaluation to citizens, rates from 0 to 10 could represent possible choices. Similarly, if the voting session regards the choice of a candidate among k ones in a primary election, then the choice of the voter could be represented by a number from 1 to k. However, extending our technique to the cases in which preferences are given in a difference way (for example, in the case of a primary election, by indicating the name of the candidate) is possible with no impact on the model.

The e-voting process involves the following basic entities:

- The *Voter* V. Observe that we describe how the protocol run for the voting done by one user. Clearly, the overall e-voting session involves many user, each running these steps.
- A set $\langle CP_1, \ldots, CP_{2^n} \rangle$ of 2^n special users, named *credential providers*, issuing the credential exploited by the voter to prove her authorization to vote[1].
- A Trusted Third Party, say TTP, responsible of generating the *certified ballots* for each e-voting.

Our technique is parametric with respect to a value t. It is chosen in such a way that the likelihood that t randomly selected users misbehave is negligible. This is a common assumption in this context [13,39,20,23].

Now, we describe how the e-voting process proceeds. It consists of the following steps:

[1] The reason for which we are assuming that the number of credential providers is a power of two will be clear after the description of the CPs Identification step.

1. *CPs Identification.* In the first step, the voter, identified by ID_V, has to select $\overline{t} = 2 \cdot t + 1$ among the 2^n credential providers that will generate the credentials. The i-th credential provider chosen by V, say CP_i^V, with $1 \leq i \leq \overline{t}$, is CP_j, with $j =$SHA-1$(ID_V||i)$ `mod` 2^n. Specifically, the first credential provider is obtained by applying the hash function SHA-1 to the concatenation between the voter identifier ID_V and the number 1 (i.e., $i = 1$), and then by mapping the result to one of the 2^n credential providers through the `mod` operation. Having 2^n credential providers simplifies the computation of the `mod` operator (which is obtained just as the last n bits of the digest computed by SHA-1), and, moreover, results in a uniform mapping between voters and credential providers. Observe that the application of SHA-1 returns a pseudo-random value depending from the voter (through her identifier) which allows us to assume that the credential providers selected by V can be considered randomly chosen. Moreover, note that the value j computed by SHA-1 corresponds to the number Y (discussed at the beginning of this section) completing the `URL` identifying the credential provider.
   Furthermore, recall that all data regarding the e-voting procedure received by credential providers are stored only locally. This avoids that the social network provider could link all the information and violate the security measures of the system. In other words, we do not require any trust property to the social network providers. On the other hand, this is the reason why we require that credential providers rely on a local 24-hours-on-line server. Even this assumption, considering the type of involved parties, is realistic.
2. *Credential Issue.* In this step, the voter starts a connection with each CP_i^V (among the $\overline{t}$ ones). CP_i^V verifies that it has been correctly contacted by recomputing the function SHA-1 as done by V at the previous step. If this is the case, then CP_i^V generates the credential C_i^V allowing V to participate to the e-voting session. Otherwise, the connection is terminated. The credential C_i^V consists in the blind signature of the pair $\langle ID_{vs}, r\rangle$, where the first element ID_{vs} is the identifier of the voting session and the second one r is a 128-bit random sequence generated by V used to detect the uniqueness and non reuse of the credential. The use of the blind signature allows V to hide the values r and ID_{vs} signed by CP_i^V. As a consequence, once such a credential signature is unblinded, it will be impossible to link the credential and the voter.
3. *Voting.* This step starts after the voter has collected one credential from each of the $\overline{t}$ credential providers. Such credentials are unblinded and presented to TTP. Observe that the communication between voter and TTP is not done through the social network, in order to avoid that the simple collusion between the social network provider and TTP might permit the identification of the voter by TTP. Now, TTP performs the following operations. First, it checks authenticity and integrity of each credential and that the voting reference (i.e., ID_{vs}) in each credential coincide. Moreover, it verifies that in the past, no user has presented credentials issued from the same credential providers as the current voter for the same voting session (otherwise, it means that the voter is trying to repeat her participation to the same voting). If the

above checks succeed, then the voter is authorized to vote and TTP generates the ballot. The ballot consists in the partially blind signature of the triple $\langle ID_{vs}, r', p\rangle$, where r', which is a fresh 128-bit random sequence, and p, which represents the preference specified by the voter, are blindly signed, whereas ID_{vs} is unblindly signed. Moreover, TTP stores the received credentials in order to detect a possible re-submission of the same credentials.

4. *Ballot Publication.* After the voter obtains the signed ballot, she unblinds it in order to obtain a new ballot still correctly signed by TTP but not linkable anymore to the voter. In order to prevent timing attacks, the voter introduces an unpredictable delay before sending the new ballot back to TTP. At the end of the e-voting session, TTP verifies the signature of all received ballots and publishes valid ones, along with the assignment of marks.

6 Security Analysis

In this section, we analyze the security of our protocol by assuming a realist attack model. The basic assumption is that at most t users misbehave during the whole evaluation process.

We start by showing that verifiability is guaranteed. Each user can verify that the vote is fair since it is published and it is identified by r' that has been generated in Step 3. It is worth noting that the probability that two voters generate the same r' is $p(u; D) \approx 1 - e^{-u^2/(2 \cdot D)}$ (birthday attack) where u is the number of users expressing her preference for a candidate and D is the domain of r. In our case, even hypothesizing an unrealistically high number of users, like $u = 10^{12}$, such a probability is negligible. Indeed, since r is a 128-bit sequence, $p(10^{12}; 2^{128}) < 10^{-15}$. The same result can be obtained also for the bit sequence r used to identify the credential. Also in this case we may state that the probability that two voters generate the same random number r is negligible. This allows TTP to discard credentials having the same r as a credential already burned, detecting this as a tentative of double credential submission.

We now consider uniqueness, which requires that each user can express a preference for a candidate only one time. Indeed, the attacker who wants to vote in an e-voting session for the second time cannot use the same credentials otherwise the double vote would be detected by TTP in Step 3 where a database of the utilized credentials is exploited. On the other hand, the attacker cannot use the certificate of another user since she could not be able to perform the authentication step with credential providers without the knowledge of the corresponding private key. Again, if the attacker requires a new pair of (X.509 certificated) private and public keys, they will be associated to the same user, so that the reference to the voter will be the same thus resulting in the detection of the attack. Moreover, observe that in principle it could occur that two different voters V_1 and V_2 in the same voting session are considered the same by TTP in the case that the two voters share set of credential providers due to the collision of the hash function SHA-1. This would result in improperly rejecting the latest vote erroneously detected as duplicated vote. However, the above event can be

considered impossible since its probability is negligible in a realistic scenario. For example, recalling that the number of possible different sets of credential providers is $\binom{2^n}{\overline{t}}$ and the birthday attack (see above), for the realistic values $\overline{t} = 20$, $2^n = 1024$, and even hypothesizing an unrealistically high number of users 10^{12} voters, we obtain that the probability of collisions is less than 10^{-15}.

Concerning the secretness property (i.e., the score given by each user must be secret) we note that TTP knows only the e-voting session (Step 3 of Section 5) but is not able to link the voter and the preference rate of her ballot, thanks to the use of the partially blind signature. Similarly, the credential providers know only the voter's public key and have no possibility to guess the e-voting session (as seen at the end of Step 2). Finally, the other users have even less information about the ballot. Clearly, the collusion between TTP and a credential provider allows them to know both the voter identity and the preference specified by the voter. However, also in this case, the probability to guess the preference score is b^{-1}, where b is the total amount of votes of the e-voting session. Indeed, the ballot is encrypted by the partially blind signature of TTP which hides the preference score.

Also uncloneability holds. This property ensures that generating a bogus ballot starting from a legal one must be detected. We observe that a valid ballot has been signed by TTP and thus it cannot be modified. Obviously, it cannot be duplicate thanks to the presence of the bit-sequence r identifying the ballot, according to the previous probability consideration.

Concerning robustness, we highlight that when at most t credential providers misbehave, their unfair behaviour is detected by TTP. Indeed, the voter has to provide $\overline{t} = 2 \cdot t + 1$ credentials and, thus, at least $t+1$ of them must be correct, due to the fact that the hash function SHA-1 returns randomly selected credential providers (recall the assumption in Section 5 concerning the probability of user misbehaving). As a consequence, fake credentials are detected since they are in the minority.

Besides security aspects, we finally observe that our approach presents a good scalability, since the number of users involved in the generation of a single ballot is independent of the overall number of users. In particular, the preference score involves a limited number $(2 \cdot t + 1)$ of other subjects (i.e., the credential providers).

7 Conclusion and Future Work

The participation of citizens to the governance of the community they belong to is one of the key factors of the development of e-democracy. An important role that citizens should have in this context is the possibility to express their opinion about public decisions, including here any case of expression of preferences not reaching the formality of official elections. But the main basic properties of an e-voting system are desired also in these more informal cases, in order to guarantee their significance. The solution here proposed seems suitable to the above purpose, since it does not require complex ad-hoc infrastructures, exploits

pervasive and user-accepted media (i.e., social networks), and, finally, guarantees an adequate level of security. As a future work we plan to investigate some implementation issues and to study possible variations of the protocol aimed at graduating the privacy level of the vote, thus allowing the citizen to reveal some non-identifying personal data during the vote, but taking care to ensure a given level of anonymity.

Acknowledgment. This work was partially funded by the Italian Ministry of Research through the PRIN Project EASE (Entity Aware Search Engines).

References

1. Abe, M.: Universally Verifiable Mix-Net with Verification Work Independent of the Number of Mix-Servers. In: Nyberg, K. (ed.) EUROCRYPT 1998. LNCS, vol. 1403, pp. 437–447. Springer, Heidelberg (1998)
2. Abe, M., Fujisaki, E.: How to Date Blind Signatures. In: Kim, K.-c., Matsumoto, T. (eds.) ASIACRYPT 1996. LNCS, vol. 1163, pp. 244–251. Springer, Heidelberg (1996)
3. Acquisti, A.: Receipt-free homomorphic elections and write-in ballots. Tech. Rep. 2004/105 (2004)
4. Adams, C., Farrell, S., Kause, T., Mononen, T.: Internet X. 509 public key infrastructure certificate management protocol (CMP). Request for Comments (RFC), 4210 (2005)
5. Buccafurri, F., Fotia, L., Lax, G.: Privacy-Preserving Resource Evaluation in Social Networks. In: Proc. of the International Conference on Privacy Security and Trust (PST 2012), Paris, France (forthcoming, 2012)
6. Buccafurri, F., Lax, G., Nocera, A., Ursino, D.: Crawling Social Internetworking Systems. In: Proc. of the International Conference on Advances in Social Analysis and Mining (ASONAM 2012), Istanbul, Turkey (forthcoming, 2012)
7. Burmester, M., Magkos, E.: Towards secure and practical e-elections in the new era. In: Secure Electronic Voting, pp. 63–76 (2003)
8. Chaum, D.: Blind signatures for untraceable payments. In: Advances in Cryptology: Proceedings of Crypto, vol. 82, pp. 199–203 (1983)
9. Chaum, D.: Elections with Unconditionally-Secret Ballots and Disruption Equivalent to Breaking RSA. In: Günther, C.G. (ed.) EUROCRYPT 1988. LNCS, vol. 330, pp. 177–182. Springer, Heidelberg (1988)
10. Chaum, D.L.: Untraceable electronic mail, return addresses, and digital pseudonyms. Communications of the ACM 24(2), 84–90 (1981)
11. Cheng, X., Dale, C., Liu, J.: Statistics and Social Network of Youtube Videos. In: Proc. of the International Workshop on Quality of Service (IWQoS 2008), Enschede, The Netherlands, pp. 229–238. IEEE (2008)
12. Cooper, D., Santesson, S., Farrell, S., Boeyen, S., Housley, R., Polk, W.: Internet X. 509 public key infrastructure certificate and certificate revocation list (CRL) profile. Technical report, RFC 5280 (May 2008)
13. Cramer, R., Gennaro, R., Schoenmakers, B.: A secure and optimally efficient multiauthority election scheme. European Transactions on Telecommunications 8(5), 481–490 (1997)

14. Damgard, I., Groth, J., Salomonsen, G.: The theory and implementation of an electronic voting system. In: Secure Electronic Voting, pp. 77–98 (2003)
15. Damgård, I., Jurik, M.: A Generalisation, a Simpli. Cation and Some Applications of Paillier's Probabilistic Public-key System. In: Kim, K.-c. (ed.) PKC 2001. LNCS, vol. 1992, pp. 119–136. Springer, Heidelberg (2001)
16. De Meo, P., Nocera, A., Terracina, G., Ursino, D.: Recommendation of similar users, resources and social networks in a Social Internetworking Scenario. Information Sciences 181(7), 1285–1305 (2011)
17. Delaune, S., Kremer, S., Ryan, M.: Coercion-resistance and receipt-freeness in electronic voting. In: 19th IEEE Computer Security Foundations Workshop, p. 12. IEEE (2006)
18. Dobbertin, H., Bosselaers, A., Preneel, B.: RIPEMD-160: A Strengthened Version of RIPEMD. In: Gollmann, D. (ed.) FSE 1996. LNCS, vol. 1039, pp. 71–82. Springer, Heidelberg (1996)
19. Eastlake, D., Jones, P.: US secure hash algorithm 1 (SHA1). Technical report, RFC 3174 (September 2001)
20. Fouque, P.-A., Poupard, G., Stern, J.: Sharing Decryption in the Context of Voting or Lotteries. In: Frankel, Y. (ed.) FC 2000. LNCS, vol. 1962, pp. 90–104. Springer, Heidelberg (2001)
21. Fujioka, A., Okamoto, T., Ohta, K.: A Practical Secret Voting Scheme for Large Scale Elections. In: Zheng, Y., Seberry, J. (eds.) AUSCRYPT 1992. LNCS, vol. 718, pp. 244–251. Springer, Heidelberg (1993)
22. Golle, P., Zhong, S., Boneh, D., Jakobsson, M., Juels, A.: Optimistic Mixing for Exit-Polls. In: Zheng, Y. (ed.) ASIACRYPT 2002. LNCS, vol. 2501, pp. 451–465. Springer, Heidelberg (2002)
23. Hirt, M., Sako, K.: Efficient Receipt-Free Voting Based on Homomorphic Encryption. In: Preneel, B. (ed.) EUROCRYPT 2000. LNCS, vol. 1807, pp. 539–556. Springer, Heidelberg (2000)
24. Hollands, R.G.: Will the real smart city please stand up? City 12(3), 303–320 (2008)
25. John, E.R., Prichep, L.S.: Electronic identity card, US Patent App. 12/665,000 (June 17, 2008)
26. Juels, A., Catalano, D., Jakobsson, M.: Coercion-resistant electronic elections. In: Proceedings of the 2005 ACM Workshop on Privacy in the Electronic Society, pp. 61–70. ACM (2005)
27. Karnouskos, S., De Holanda, T.N.: Simulation of a smart grid city with software agents. In: Third UKSim European Symposium on Computer Modeling and Simulation, EMS 2009, pp. 424–429. IEEE (2009)
28. Krishnamurthy, B., Gill, P., Arlitt, M.: A few chirps about Twitter. In: Proc. of the First Workshop on Online Social Networks, Seattle, Washington, USA, pp. 19–24 (2008)
29. Lee, B., Boyd, C., Dawson, E., Kim, K., Yang, J., Yoo, S.: Providing Receipt-Freeness in Mixnet-Based Voting Protocols. In: Lim, J.-I., Lee, D.-H. (eds.) ICISC 2003. LNCS, vol. 2971, pp. 245–258. Springer, Heidelberg (2004)
30. Merkle, R.C.: Secure communications over insecure channels. Communications of the ACM 21(4), 294–299 (1978)
31. Mislove, A., Koppula, H.S., Gummadi, K.P., Druschel, F., Bhattacharjee, B.: Growth of the Flickr Social Network. In: Proc. of the International Workshop on Online Social Networks (WOSN 2008), Seattle, Washington, USA, pp. 25–30. ACM (2008)

32. Ogata, W., Kurosawa, K., Sako, K., Takatani, K.: Fault tolerant anonymous channel. Information and Communications Security, 440–444 (1997)
33. Park, C., Itoh, K., Kurosawa, K.: Efficient Anonymous Channel and All/Nothing Election Scheme. In: Helleseth, T. (ed.) EUROCRYPT 1993. LNCS, vol. 765, pp. 248–259. Springer, Heidelberg (1994)
34. Paskaleva, K.A.: Enabling the smart city: The progress of city e-governance in europe. International Journal of Innovation and Regional Development 1(4), 405–422 (2009)
35. Pieprzyk, J., Hardjono, T., Seberry, J.: Fundamentals of computer security. Springer (2003)
36. Sako, K., Kilian, J.: Receipt-Free Mix-Type Voting Scheme. In: Guillou, L.C., Quisquater, J.-J. (eds.) EUROCRYPT 1995. LNCS, vol. 921, pp. 393–403. Springer, Heidelberg (1995)
37. Stalder, F., Lyon, D.: 4 electronic identity cards and social classification. Surveillance as Social Sorting: Privacy, Risk, and Digital Discrimination, 77 (2003)
38. Ye, S., Lang, J., Wu, F.: Crawling online social graphs. In: Proc. of the International Asia-Pacific Web Conference (APWeb 2010), Busan, Korea, pp. 236–242. IEEE (2010)
39. Zwierko, A., Kotulski, Z.: A light-weight e-voting system with distributed trust. Electronic Notes in Theoretical Computer Science 168, 109–126 (2007)

From E to O
Towards Open Participation as a Guiding Principle of Open Government

Michelle Anna Ruesch, Sebastian Basedow, and Jan-Henning Korte

Zebralog GmbH & Co KG, Berlin, Germany
{ruesch,basedow,korte}@zebralog.de

Abstract. In analogy to the semantic evolution from e-government to open government, the paper at hand introduces the term open participation as a further development of e-participation and highlights the role of open participation as a guiding principle of open government. It aims to counterbalance tendencies that reduce open government to open data and transparency, and stresses that these are necessary but not sufficient means to reach the goals of open government. Open participation, as a guiding principle of open government, accounts for the need to create spaces of interaction between the state and its citizens and to facilitate cross-media participation of citizens in political decision-making processes. Open participation goes beyond e-participation in that it puts openness at the heart of participation processes. Rather than an end in itself, e-participation is thus a valuable method to put into practice the goals of open participation. The paper identifies three different dimensions of openness – transparency, inclusiveness and receptiveness – which are key factors of successful open participation projects.

Keywords: open government, open participation, e-participation, e-government, transparency, civic engagement.

1 Introduction

The contemporary modern government is a "government that opens its doors to the world" (Tapscott, 2010, p. XVI). It is an *open government*, i.e. a government that makes its data openly available, encourages civic participation in decision-making processes and policy development, and allows for collaboration between non-governmental stakeholders and the state. In a recent survey among over 1000 Germans conducted by the Arbeitskreis Open Government Partnership Deutschland (2012) a striking 96 percent said they appreciate moves towards more open governments. Governments themselves also increasingly acknowledge that "governmental paternalism may have caused a lack of political interest, knowledge, and responsibility among the non-participating population" (Petrik, 2009, p. 2) and that increasing transparency, civic participation and collaboration may make government more responsive, accountable as well as smarter and more efficient. Not long after President Obama introduced an elaborate Open Government Directive, putting the US in the

A. Kő et al. (Eds.): EGOVIS/EDEM 2012, LNCS 7452, pp. 254–263, 2012.

lead regarding the movement towards open government, other countries, including Germany, are also starting to develop open government programs (Höchtl et al., n.d.; Klein, 2012). Hence, it seems that while the maxim of the early 2000s was e-government, focusing on efficacy and public services with the help of Information and Communication Technology (ICT), the dominant paradigm today is open government which goes beyond electronic service provision and encompasses the goal of increasing civic participation. The present paper aims to shed light on the evolution from e- to open government, draws attention to the fact that 'open' means more than just 'transparent' and introduces the term *open participation* as a further development of the term e-participation. In particular, each section of this paper develops one argument: First, it is argued that unlike the term e-government, open government embraces a normative, goal-oriented character towards more openness and thereby serves as a better guiding principle than e-government. Second, open government is often equated with transparent government, yet this neglects that transparency is only the prerequisite for the ultimate goals of open government, above all increasing participation and collaboration. Third, in analogy to e- and open government, the term open participation is introduced as a guiding principle of open government that does justice to the normative character of participation processes, which should be based upon transparency, inclusiveness and receptiveness.

2 From e-Government to Open Government

This section gives a short overview of the paradigmatic shift from e-government to open government, describes their differences, and establishes the argument that the former should be seen as just one aspect of the latter and that the latter in addition encompasses normative goals.

When governments started to take an interest in the idea of an electronically supported government, their subsequent e-government strategies were, at their core, about "using the tools and systems made possible by Information and Communication Technologies (ICTs) to provide better public services to citizens and businesses" (European Commission, n.d.). In other words, the explicit aim consisted in the enhancement of public services. It was about offering online services, such as renewing driver's licenses or ordering birth certificates on the Internet (Harrison, Guerrero, Burke & Cook, 2011). Shortly thereafter, a second benefit of ICTs was discovered: The potential to modernize administrative infrastructure and make it more efficient. Besides the amelioration of public services, internal efficiency was thus added as another goal of e-government strategies.

However, the public service perspective has increasingly widened up to include not only top-down practices from government for citizens but also as a guiding principle so as to make use of ICTs for more dialogical practices, notably civic engagement in politics. In its broader definition, e-government thus also encompasses a participatory, interactive component of ICTs for government, highlighting that "the movement to e-government, at its heart, is about changing the way people and business interact with government" (Cook et al., 2000, p. 6). Hence, besides the practical, rather descriptive components of ameliorating current public service routines and increasing efficiency,

a more normative component of how government ought to be – namely more interactive and open for civic participation – was added (Wind, 2011; Spitakis, Spiraki & Nikolopoulos, 2010). The problem with such a broad definition, however, is that the term itself does not accurately represent this normative understanding. It is a misnomer, since 'e' (electronic) does not necessarily imply 'o' (open).

The semantic dissonance and incoherence resulted in the emergence of a new paradigm: open government. In the US, this term is strongly associated with Obama's move away from Bush's e-government strategy towards an Open Government Directive (Gusteric, n.d.). Strongly influenced by this directive, the predominant definition of open government contains three major axes: transparency, participation and collaboration (Medimorec et al., 2010). European countries are also increasingly developing open government strategies (see e.g. Klein, 2012). Even though the term is still sometimes used merely as a synonym for e-government, as illustrated for example by Vienna's open government strategy (see Mittheisz, 2011), e-government should actually be seen as just one aspect of open government. More precisely, e-government is in fact a strategic method that helps governments to become more open, i.e. to reach their vision of an open government. Nevertheless, as Gustetic (n.d.) rightly observes, both e-government and open government are "part of the same E-Democracy maturity continuum",[1] even though this view neglects that 'open' in fact goes beyond 'electronic' and implies both online and offline measures, with ICTs being the central driving force. In sum, it is fair to say that open government is the new *Leitbild*, i.e. guiding principle of many governments and that it is more accurate as compared to e-government since it implies a normative component, i.e. a vision regarding the relationship between government and the governed.

3 Participation: Blind Spot of Open Government

Just as terms like "Government 2.0", open government is also often described as what O'Reilly (2010) calls "a cameleon, a white rabbit term, that seems to be used by people to mean whatever they want it to mean" (p. 11). Currently, the discourse around open government seems very much dominated by those who want it to mean 'open data' or transparency, as illustrated by definitions of open government that reduce the paradigm to "transparent governance" (Matzat, 2011). However, while the movement towards making government data publicly available is certainly an important step towards open government, open government goes far beyond that. As nicely illustrated in Lee and Kwak's (2011) Open Government Implementation Model, transparency (including open data) is just the first step in the pursuit of open government and sets the stage for participation and collaboration.[2] Moreover, as Figure 1 shows, in our conception of open government, 'collaboration' is a sub-form of participation rather than a distinct category. This conception is based on a definition by

[1] It would go beyond the scope of this paper to discuss the various definitions of e-democracy; a good introduction to the various views can be found on `http://www-e-demokratie.org/was-ist-e-demokratie` (in German).

[2] They even include a fourth stage, namely ubiquitous engagement, yet in our model we stick to the three conventional elements, as their last stage seems too indistinct to be reasonably operationalized.

Albrecht et al. (2008) who use participation as an umbrella term for all levels of involvement of citizens and non-governmental stakeholders in political and administrative decision-making processes that go beyond elections. Unlike Lee and Kwak's (2011) or Obama's definition (see Lathrop & Ruma, 2010), it is much more encompassing and covers forms of interaction like consultation and cooperation.[3]

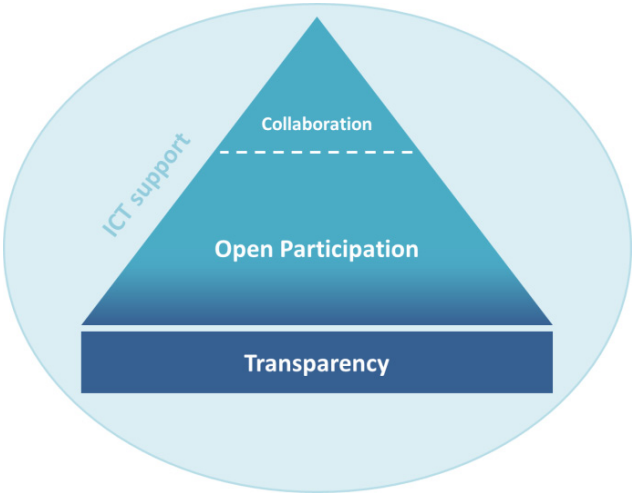

Fig. 1. Open Government

As Figure 1 illustrates, transparency is the basis for participation (including collaboration) which is the major normative goal of open government and thus must not be neglected. Just as electronic measures should not be introduced merely for the sake of 'being online', transparency should not be enhanced only for the sake of increasing transparency but for the sake of promoting civic participation.

Two major reasons can be identified for the focus on transparency and open data when talking about open government. First of all, transparency is seen as the first step and a prerequisite for the other components. As Parycek & Sachs (2010) state, "access to governmental information is the key to empower the public" (p. 5). The second reason for the focus on transparency is based on the widespread belief that free access to government data will automatically enable participation (Wind, 2011), i.e. that citizens can empower themselves by using government data in applications and fulfilling their role as critical watchdogs. What is omitted in such a conception of participation is that access does not imply action, and transparency does not imply participation; the former merely provide the prerequisites for the latter. In order to achieve civic participation, i.e. to involve citizens in decision-making and policy development, governments not only need to make data available but they also have to

[3] The difference in definition might partially stem from linguistic disparities. In German, participation is often translated as "Bürgerbeteiligung" which is used as a rather general term. "Beteiligung" in English, however, rather translates as "civic engagement" of which participation is seen as a subcategory.

provide spaces of interaction between state and civil society. To give an example, it is a big difference whether a budget is transparent or participatory. For example, based on Open Government Data, the website http://www.offenerhaushalt.de, a non-commercial and non-governmental project by ICT savvy citizens, visualizes the German federal budget in a very attractive well-arranged way and thereby contributes to increasingly informed citizens which, as we have established, is the first step towards participating citizens. Nevertheless, information and knowledge does not mean that the voice of citizens is being heard, even if they speak up. Acknowledging that transparency is necessary but not sufficient to give citizens a voice, participatory budgets have been gaining ground in the past couple of years. Such participatory budgets not make data and information publicly available, but they moreover allow citizens to submit their own proposals. With the help of online platforms, citizens can also rate and comment on administrative and other citizens' proposals.[4] Having established in this section that participation is a blind spot of open government and that transparency is necessary but not sufficient in order to open up government for civic participation, the next section proposes the term open participation as a guiding principle within the open government paradigm.

4 Open Participation: Guiding Principle of Open Government

When talking about participation in the context of open government, the dominant term currently used is e-participation (see e.g. Albrecht et al., 2008; Macintosh, 2008). As stated above, this is probably due to the fact that open government is very much associated with e-government. However, just as established in the first part of this paper regarding the terms e-government and open government, the problem with the term e-participation is that it does not comprise any normative goals. When using e-participation to describe an applied method, it is perfectly valid. Yet when using it to describe a larger vision or goal, it is only of limited value. After all, the quality of participation should not be assessed according to its format or degree of ICT-use but rather according to its openness. We therefore propose the term 'open participation' to describe the place and scope of participation within open government. This normative goal can be put into practice with various participatory methods, among which e-participation is certainly crucial since ICTs provide many of the requirements for open participation processes.

We understand open participation as a goal and guiding principle of open government, serving as vision for cross-media participation of citizens in political decision-making processes. The term open participation puts openness at the heart of participatory processes and thereby suggests the degree of openness to be a key success factor of participatory processes in the context of open government. Although Lee and Kwak (2011) have used the term 'open participation', their definition is not very helpful for our purposes. On the one hand they define participation as "public engagement in relatively simple interactive communications" and thereby do not see consultation processes as part of participation, which we do. On the other hand, they do not specify further what they

[4] An example is the participatory budget of Bonn, see `http://www.bonn-packts-an.de`. An overview of participatory budgets in Germany can be found on `http://www.buergerhaushalt.org`

mean by 'open' and what distinguishes mere participation from *open* participation. In the following, we will illustrate in more detail our conception of open participation. As illustrated in Figure 2, the 'open' in open participation relates to three different aspects: Transparency, inclusiveness, and receptiveness.

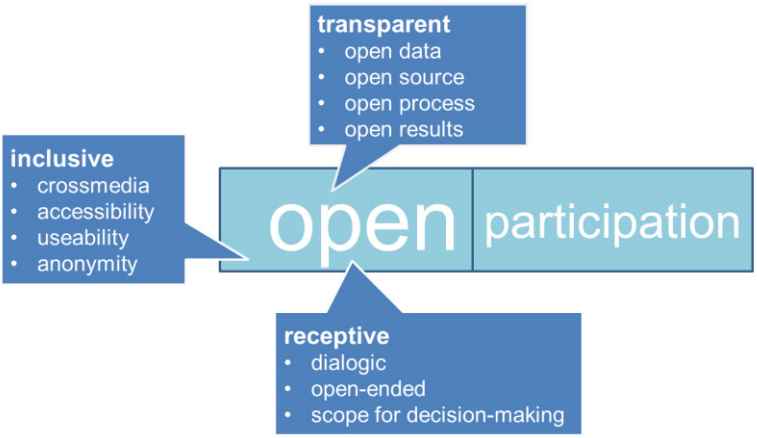

Fig. 2. Open Participation

Openness as Transparency

Open participation requires transparency with respect to the subject matter, the process, the results, as well as regarding the software or methodology. In this regard, ICT, notably the Internet, plays an essential role since online-platforms can concentrate information from different sources in one channel, and make them easily accessible. So while open participation certainly goes beyond e-participation, e-participation is crucial as a method to achieve open participation. In order for the participation process to be transparent, information regarding the subject matter must be freely available and accessible. ICTs can facilitate such transparency through open data. Moreover, clear and truthful information must be provided regarding the course of action, including prospects and limits of the consultation. The need for transparency concerns process and results alike. Lastly, openness in the sense of transparency and related to e-participation requires freely accessible technology or software.

In this regard, it is important to note the give-and-take basis of open participation (see Figure 3). Open participation not only concerns the inputs of a participatory process, but equally alludes to the outputs and the benefits generated for governments, citizens and developers alike. Next to the results of the consultation process, which should be made transparent in order to enable further use, new or enhanced open data is generated by the open participation process. For example, Application Programming Interfaces (API) can be provided that facilitate the extraction of raw data of the participation content, thereby empowering non-governmental stakeholders to use the data for their own purposes and to retrace decisions made by governments based on

these data. Moreover, in the context of e-participation, the use of open source software enables the further use of new or enhanced source codes and modules. Such disclosure allows for innovation regarding participatory processes.

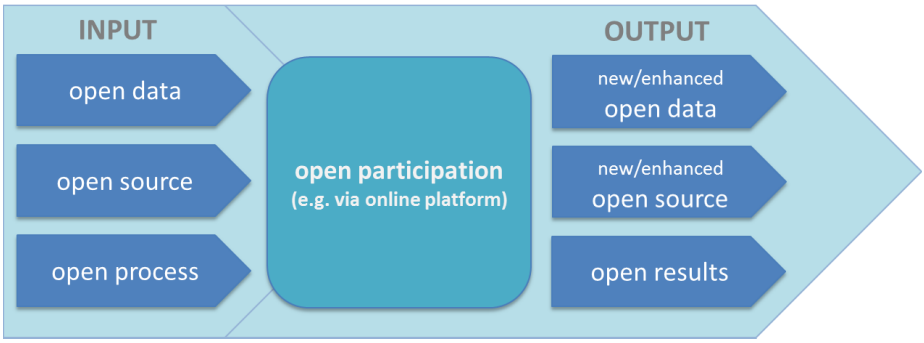

Fig. 3. Give-and-take basis of open participation

Openness as Inclusiveness

Besides transparency, open participation processes must feature high levels of inclusiveness. In other words, access must be open for everyone. This does not mean that everyone must participate, but rather that everyone must have the possibility to participate. A cross-media strategy that combines online and offline channels is essential in order to reach out to disadvantaged and underrepresented groups in society. As Kubicek, Lippa and Koop (2011) state, such a strategy should be applied to both meta and process communication, i.e. to mobilization and information as well as to the participation tools themselves. Another factor for a low barrier to participation is high useability such as easy to understand navigation in the case of online participation platforms, or the use of plain language and the avoidance of administrative sociolects in both on- and offline processes. Lastly, besides handicapped accessibility which should be guaranteed online and offline, the possibility to participate anonymously or with a pseudonym[5] rather than with one's real name is crucial. In their paper on real name policy in e-participation, Ruesch and Märker (2012) establish the 'open participation argument': "Anonymity and pseudonymity are seen to provide more open and equal participation as they do not reveal information such as gender and put the message rather than the person at the centre" (p. 4). In this respect, it is suggested to abstain to some degree from transparency for the sake of inclusiveness.

Openness as Receptiveness

Finally, besides transparency and inclusiveness, open participation also refers to receptive participation. First of all, the participation process must be dialogical, i.e. open in

[5] We understand pseudonymity as a form of anonymity, in the sense of not revealing one's real name or personal data.

both directions. Such two-way communication between citizens and the state implies that the participatory space – be it an online-platform or a round table – is accessible for both citizens and administrative and political representatives. Secondly, openness in the sense of receptiveness implies that the administrative or political stakeholder that organizes the participation process needs to be open minded regarding the results, i.e. even if the process does not produce the content that was hoped for, censorship is by no means accepted. Third, and closely connected to the second aspect, is the necessity for a scope of decision-making, i.e. some kind of open-endedness of the results. Conversely, if there is no openness regarding the subject matter, for example because of legal restrictions or expiration of a formal deadline, there is no point in consulting the public. It may even be counterproductive in that it can distance citizens from the political process and lead to apathy (Weber & Peixoto, 2012). An example of receptive participation is given by the City of Vancouver, BC with its city-wide consultation 'Talk green to us' (http://vancouver.uservoice.com/). Citizens were asked to hand in ideas on how to make Vancouver the 'greenest city' worldwide until 2020. Not only did the municipal administration directly respond to questions raised by citizens, but also the software allowed tracking the current status of the submitted proposals. Ideas could thus be labeled as either started, declined, under review, planned or completed.

5 Conclusion

The paper has suggested open participation as a goal and guiding principle for open government. It has argued that transparency is not an end in itself but that it is merely the first step towards opening up government for non-governmental engagement. Acknowledging that transparency is necessary but not sufficient, the paper has explored the different dimensions of open participation. It has established that open participation principally suggests that every phase of the participation process should be open in the sense of transparent, inclusive and receptive. However, questions remain as to how much openness is necessary or enough. Should we strive for maximum openness? For example, how conducive is it to the participation process to open up the conceptualization phase for civic engagement? Also, there are currently no generally accepted guidelines as to how open the evaluation process should be. Openness can range from publishing a report with all the results, over disclosing the evaluation raw data and methodology, to actively involving citizens in the evaluation process. On a more technical note, questions arise as to which methods are especially valuable for open participation, what role ICTs can play, and which standards need to be introduced in order for e-participation platforms and processes to be in accordance with the goals of open participation. These questions go beyond the scope of this paper, yet it has sought to provide an inspiration for debate in both theory and practice among the different stakeholders. Coming back to Tapscott's (2010) open door metaphor (see introduction), this paper has made clear that open government is more than open doors. Open doors, i.e. transparency, are only the prerequisites for citizens to enter, i.e. for open participation. The guiding principle of open participation highlights the need for governments to create spaces of interaction which citizens are actively encouraged to enter and which are transparent, inclusive and receptive.

References

1. Albrecht, S., Kohlrausch, N., Kubicek, H., Lippa, B., Märker, O., Trénel, M., Vorwerk, V., Westholm, H., Wiedwald, C.: eParticipation: Electronic Participation of Citizens and the Business Community in eGovernment. Study on Behalf of the Federal Ministry of the Interior, Division IT 1 (2008)
2. Arbeitskreis Open Government Partnership Deutschland: Open Government – Demokratie neu erleben. Ergebnisse und Analysen einer repräsentativen Befragung (2012)
3. Cook, M.E.: What citizens want from e-government. Albany: Center for Technology in Government (2000)
4. European Commission: Definition of E-Government (n.d.), http://ec.europa.eu/information_society/activities/egovernment/index_en.html (retrieved)
5. Gustetic, J.: E-Gov versus Open Gov: The Evolution of E-Democracy. Phase One Consulting Group (2010), http://www.phaseonecg.com/docs/egov-opengov-whitepaper.pdf
6. Harrison, T.M., Guerrero, S., Burke, G.B., Cook, M.: Open Government and E-Government: Democratic challenges from a public value perspective. Center for Technology in Government, Albany (2011)
7. Höchtl, J., Kaltenböck, M., Parycek, P., Schossböck, J., Thurner, T.: Open Government Data: Potentiale, Risiken und Hürden (o. J.)
8. Klein, M.: Bürgernah, transparent und wirtschaftsorientiert (2012), http://www.egovernment-computing.de/publicsector/bund/articles/355323/index3.html (retrieved)
9. Kubicek, H., Lippa, B., Koop, A.: Erfolgreich beteiligt? Nutzen und Faktoren internetgestützter Bürgerbeteiligung - Eine empirische Analyse von 12 Fallbeispielen. Bertelsmann Stiftung, Gütersloh (2011)
10. Lathrop, D., Ruma, L. (eds.): Open government: Collaboration, Transparency, and Participation in Practice. O'Reilly Media, Inc., Sebastopol (2010)
11. Lee, G., Kwak, Y.H.: An Open Government Implementation Model: Moving to increased public engagement. The IBM Center for The Business of Government, Washinton, DC (2011), http://www.businessofgovernment.org/sites/default/files/An%20Open%20Government%20Implementation%20Model.pdf (retrieved)
12. Macintosh, A.: E-Democracy and E-Participation Research in Europe. In: Chen, H., Brandt, L., Gregg, V., Traunmüller, R., Dawes, S., Hovy, E., Macintosh, A., Larsen, C.A. (eds.) Digital Government, vol. 17, pp. 85–102. Springer US, Bonston (2008)
13. Matzat, M.: Was für ein wohliger Begriff. Der Freitag, Nr. 50 (2011)
14. Medimorec, D., Sachs, M., Legat, R., Parycek, P.: Let the sunshine in – Open Government. eGovernment Review 6, 10–11 (2010)
15. Mittheisz, J.: Open Government in Wien. 11. E-Government-Wettbewerb für Bundes-, Landes- und Kommunalverwaltungen 2011 (2011), http://www.egovernmentwettbewerb.de/praesentationen/2011/1710_1107_MIT_Finalistentag_11eGovernment-Wettbewerb.pdf (retrieved)
16. O'Reilly, T.: Government as a platform. In: Lathrop, D., Ruma, L. (eds.) Open Government: Collaboration, Transparency, and Participation in Practice. O'Reilly Media, Inc., Sebastopol (2010)
17. Parycek, P., Sachs, M.: Open Government–Information Flow in Web 2.0. European Journal of ePractice 9, 1–12 (2010)

18. Petrik, K.: Participation and E-democracy: How to Utilize Web 2.0 for Policy Decision-Making. In: Chun, A.S., Sandoval, R., Regan, P. (eds.) Proceedings of the 10th Annual International Conference on Digital Government Research: Social Networks: Making Connections Between Citizens, Data and Government, pp. 254–263. Digital Government Society of North America, Puebla (2009)
19. Ruesch, M.A., Märker, O.: Real Name Policy in E-Participation. The Case of Gütersloh's second Participatory Budget. Paper Presented at CeDEM – International Conference on E-Democracy and Open Government 2012 (forthcoming, 2012)
20. Spirakis, G., Spiraki, C., Nikolopoulos, K.: The Impact of Electronic Government on Democracy: E-Democracy through E-Participation. Electronic Government, an International Journal 7(1), 75–88 (2010)
21. Tapscott, D.: Foreword. In: Lathrop, D., Ruma, L. (eds.) Open Government: Collaboration, Transparency, and Participation in Practice. O'Reilly Media, Inc., Sebastopol (2010)
22. Weber, B., Peixoto, T.: ICT Facilitates Citizen Engagement; Open Government Partnership Webinar. World Bank Institute, Open Government Cluster (2012)
23. Wind, M.: Die „Zentralität" im E-Government. Study conducted on behalf of Hans-Böckler-Stiftung. Institut für Informationsmanagement (ifib), Bremen (2011)

A Framework for Storing and Providing Aggregated Governmental Linked Open Data

Tomáš Knap[1,2], Martin Nečaský[1], and Martin Svoboda[1]

[1] Charles University in Prague, Dept. Software Engineering
Malostranské nám. 25, 118 00 Praha 1, Czech Republic
{tomas.knap,martin.necasky,martin.svoboda}@mff.cuni.cz
[2] University of Economics, Prague, Czech Republic

Abstract. The paradigm of publishing governmental data is shifting from data trapped in the private data silos to open data, or even linked open data, bringing the information consumers (citizens, companies) unrestricted access to the data and enabling the agile information aggregation, which has up to now not been possible. Such information aggregation comes with inherent problems, such as provision of poor quality, inaccurate, irrelevant or fraudulent information. As a part of the OpenData.cz initiative and LOD2 project, we are developing a framework which will enable creation, maintenance, and usage of the data infrastructure formed by the linked open data. In this paper, we briefly describe our ongoing work on the framework – the processes of (1) cleaning, linking, assessing the quality of data being stored and the processes of (2) providing aggregated views on the governmental linked open data.

1 Introduction

All over the world governments are connecting to the uprising trend of publishing governmental data as open data[1]; open data is original non-aggregated machine readable data which is freely available to everyone, anytime, and for whatever purpose. As a result, citizens paying the government are able to see and analyze the performance of the government by observing the raw data or using third-party applications visualizing the data; companies can use the data to run their business.

Cannot we do more than just opening the data to simplify their exploration and creation of applications on top of them? If global identifiers were used for resources (e.g., things, persons, abstract entities, etc.) in the form of HTTP URLs, data about the resources could be published on these URLs. Consumers could then use the current Web infrastructure to obtain relevant information about any resource by simply inserting its HTTP URL to the browser. Furthermore, if the open data was represented as RDF triples[2], we could link data (e.g. about a public contract) to other data (e.g. a supplier or public authority) and, thus,

[1] http://opendatahandbook.org/en/
[2] http://www.w3.org/TR/rdf-syntax/

A. Kő et al. (Eds.): EGOVIS/EDEM 2012, LNCS 7452, pp. 264–270, 2012.

create a huge web of interconnected data. The idea described is precisely the idea of *linked data* [2].

The linked data approach accelerates the evolution of the Web into an exponentially growing information space (linked open data cloud[3]), where the unprecedented volume of resources will offer to the information consumer a level of information integration and aggregation that has up to now not been possible. Indiscriminate addition of information can, however, come with inherent problems such as the provision of poor quality, inaccurate, irrelevant or fraudulent information. All will come with an associate cost of the data aggregation which will ultimately affect data consumer's decision making and linked data applications usage and uptake. To enable seamless data aggregation and to simplify the data consumer's judgement whether to trust the consumed data or not, we are working (as part of OpenData.cz initiative[4] and LOD2 project[5]) on several projects (modules) enabling creation, maintenance, and usage of the data infrastructure (see Figure 1).

Since there is not much linked open data in the Czech Republic so far, the *Data Acquisition* module (see Figure 1) will obtain Czech governmental data from various sources, such as (X)HTML pages or Excel spreadsheets, and convert it to RDF data. Currently, we are collecting data about public contracts, for which we also created an ontology[6] referred in the following text with the prefix `pc:`. In *Open Data Clean Store (ODCS)* module, the converted data will be cleaned, linked to other Czech governmental data and data in the linked open data cloud, the quality score of the data will be assessed and the data will be stored in a materialized view. To help information consumers and linked data application developers to aggregate data about a resource (e.g. a particular public contract or business entity) defined by various sources with various data qualities, and described by various data models, ODCS will provide aggregated views on the requested data. Furthermore, ODCS will accompany all the aggregated data with descriptive and provenance meta-data (e.g. the creation date, the process responsible for creating the data, the data license, source of the data) and information about the quality of the data to help consumers to decide which data are worth using. *Visualization and Analysis* module will simplify work of application developers and citizens by enabling them to define which linked data returned by ODCS should be visualized, how, and whether an analysis of the data should be conducted (e.g. computing average salary in a company).

In this paper, we briefly describe our ongoing work on the ODCS module (or shortly ODCS). We concentrate on the processes of (1) cleaning, linking, assessing the quality of data being stored and of (2) providing aggregated views on the governmental linked open data.

In Section 2, we will introduce the ODCS's interfaces and describe briefly how data are cleaned, linked, scored while being stored to the materialized view and

[3] `http://richard.cyganiak.de/2007/10/lod/`
[4] `http://www.opendata.cz`
[5] `http://lod2.eu`
[6] `http://code.google.com/p/public-contracts-ontology/`

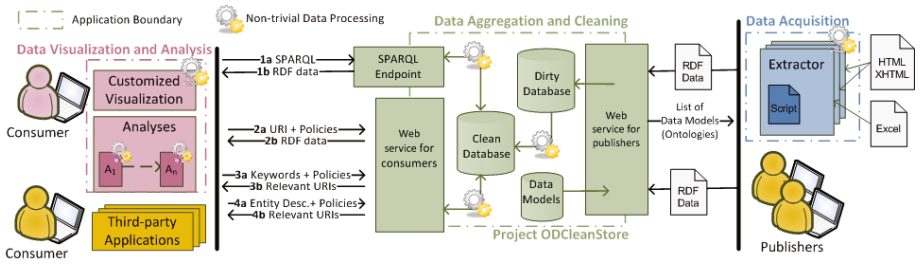

Fig. 1. Data Infrastructure

how the data are provided to the data consumers. Section 3 contains related work and the paper is concluded in Section 4.

2 ODCleanStore Project

ODCS works with data represented as RDF. In RDF, data are represented as typed statements, so called *triples*. A triple consists of a *subject*, *predicate* and *object*. The subject is a *resource* which represents an entity about which information needs to be published (e.g. a person or public contract). The predicate represents a property and it is also a resource (e.g. a name, colleague, price or description). The object is a value of that property. It might be a simple data value (e.g. a name of a particular person as a string value) or another resource (a person which is a colleague of another person). Resources are unambiguously identified by globally unique URIs.

An arbitrary set of triples forms a graph. It is useful to publish an information about such a graph. E.g. the date and time when the triples in that graph were published or the author of the triples. To enable this, graphs are handled as resources. They have their own identifying URIs and information about them is published in a form of RDF triples. They are usually called *named graphs*.

The architecture of ODCS is depicted in Figure 1. It provides a *web service for publishers* which allows to store RDF data in ODCS. This is useful in cases when data is already published in RDF on the Web. However, most of data are published in non-RDF sources, e.g., XML, HTML, Excel files, etc. For this, we offer the data acquisition module which allows to extract the data from these sources and convert them to RDF representation.

ODCS uses OpenLink Virtuoso[7] as a triple store. We use two instances of Virtuoso to store the data – dirty database (for newly incoming data, which contain potentially dirty and non-linked data) and clean database (for cleaned, linked and scored data available for data consumers).

RDF data stored in ODCS can be consumed in several ways (see Figure 1) using a *web service for consumers*; it can be consumed by the data visualization

[7] `http://virtuoso.openlinksw.com/`

and analysis module or by third-party applications. The first way to consume data is to send URI of a concept the consumer is interested in (Arrow 2a in Figure 1) and as a response she gets the description of the concept aggregated from available sources together with the aggregate quality of the data.

The method for data consumption described so far is useful when the consumer knows the URI of the concept she is looking for. If this is not the case, she may send a list of keywords as a part of the request (Arrow 3a) and receive (Arrow 3b) URIs of the top K relevant concepts – the relevance is based on the extent to which the given keywords appear in the description of the considered concept (e.g. in `rdfs:label`). Apart from a simple keywords search, we also enable consumers to specify in a detail all desired characteristics of the retrieved concepts (Arrow 4a) – a consumer can, e.g., specify that she is interested only in instances of the class `pc:Contract` (which models public contracts) having `pc:awardDate` and `pc:actualPrice` in certain value ranges; the returned URIs contain concepts satisfying the given conditions.

Last but not least, a consumer can query a *SPARQL endpoint* to get the data; this option is used for advanced users.

Optionally, a consumer can specify *conflict resolution policies* customizing the aggregation process described in Section 2.2 by specifying which aggregation methods should be used for which RDF properties.

2.1 Cleaning Data

When a new named graph g arrives to the dirty database, it is consequently cleaned, linked, scored and stored to the clean database. Before entering cleaners, we try to automatically find out whether the incoming graph g is a copy or update of an existing graph h; if yes, we use URIs of the resources in the graph h for the resources in graph g.

Cleaners. The goal of custom cleaners is to correct errors in the incoming named graph g. Cleaners are custom Java classes implementing a defined interface and having a named graph as their input and a named graph as their output. For example, a custom cleaner can check against the Business Register whether data about a `gr:BusinessEntity`[8] holds a valid identification number. Cleaners checking conformance of data with the used ontologies are automatically generated.

Linkers. Since data describing the same concepts (e.g. persons, public contracts) can be identified by various identifiers (URIs), the application will support specification of rules (scripts), which will apply to the named graph g and try to reveal whether the data in the graph g involves a new concept or a concept already involved in the clean database; in the latter case, the application will create a link (`owl:sameAs` predicate) specifying that the given two URIs are representing the same concept. Linkers will also support creation of other types

[8] `gr:` is a prefix for `http://purl.org/goodrelations/v1#`

of links between data. We use Silk engine [3] and its specification language[9] to specify policies driving the creation of links.

Quality Assessment. The ability to assess the *information quality* (*IQ*) of the consumed data presents one of the most important aspects of the information aggregation on the Web and will play a fundamental role in the continued adoption of Linked Data principles [7].

Quality assessment (QA) component will assesses the *quality score* of the RDF data residing in an incoming named graph g based on various information quality dimensions. Currently, it assesses the quality score by checking whether g satisfies custom *consistency policies*. Some sample consistency policies are: "The date held by the property `pc:awardDate` is later than the date held by the property `pc:publicationDate`", "The property `pc:referenceNumber` has value satisfying the given regular expression", "Property `pc:actualPrice` exists". Every policy r is associated with its weight; if the weight is positive (negative), the application of the policy to the graph g increases (decreases) the quality score of the graph. In the future, QA component will assesses the vector of quality scores, each score of the incoming graph g will be relevant for the particular IQ dimension.

After computing the quality score for the named graph g, the graph is stored to the clean database together with the score.

2.2 Data Aggregation

It is quite usual that data about one resource come from different sources. And, it may easily happen that two resources specify different values of the same properties of the the same resource. Then we have a conflict which needs to be resolved. We call the process of conflict resolution *data aggregation*.

The goal of ODCS is to provide aggregated views on the data in three steps:

1. Aligning the ontologies
2. Resolving instance level conflicts
3. Computing aggregate quality of the resulting data

ODCS maintains ontologies describing stored named graphs and enables to create mappings between them (e.g. to express that one property has the same meaning as another property) using Silk. Ontology mappings are taken into account during Step 1 of data aggregation – if the consumer requires certain property p of the subject s in the returned data and ODCS knows that property p has the same meaning as another property q and there exists triple (s, q, v), then the triple (s, p, v) is considered in further data aggregation.

Step 2 solves the instance level conflicts, which happen when predicates in the sources have inconsistent values [12]. Many papers solve instance level conflicts during design time (during filling up the clean database), e.g. [4,5], however, this approach is not suitable, because the worthiness of the data depends on the

[9] `http://goo.gl/GYuUx`

situation at the consumer's hand and, thus, cannot be aggregated in advance. The available aggregation methods are based on aggregations commonly used in database conflict resolution strategies [1], such as MAX, MIN, AVG, ANY, BEST meaning that maximum, minimum, average, any or value with the highest aggregate quality is used (see Step 3). We also support the aggregate function ALL meaning that all values are preserved (there is no aggregation at all) and returned to the information consumer.

In Step 3, we compute aggregate quality of the selected value or values returned to the information consumer and attach it to the returned values; the computation of aggregate quality $q(v)$ is based on three factors: quality scores of the source named graphs, the number of named graphs agreeing on the same value v, and the difference between value v and other (conflicting) values. Let us note that the purpose of this paper is just to give a brief overview of the capabilities of ODCS. Therefore, we do not describe the computation of $q(v)$ in a more detail.

3 Related Work

To the best of our knowledge, there is just one framework for cleaning, linking and aggregating RDF linked data – Linked Data Integration Framework (LDIF) [9], which "translates heterogeneous Linked Data from the Web into a clean, local target representation while keeping track of data provenance".[10]. The big difference between ODCS and LDIF is that LDIF, in particular Sieve module [6] of LDIF, aggregates data when being stored (not during execution of queries); this approach might be suitable for closed environment where queries are known in advance, however, not for open Web environments, where every consumer has different requirements on the data aggregation; in ODCS, different requirements for the data aggregation can be expressed by consumer's custom conflict resolution policies; in the future, we plan even more customization.

Our ongoing research effort is also focused on the area of linked data indexing and querying in general. Our work should result in a proposal of a new querying framework dealing with disadvantages of the existing approaches. In particular, we consider environments with local and distributed data, for which we would like to propose efficient indexing structures and query evaluation algorithms to support feasible querying using SPARQL [8]. The problem of the contemporary solutions is that they do not sufficiently master the size explosion of the open data cloud, data distribution and dynamicity aspects at once [10]. Preliminary ideas of the framework architecture were already presented in [11].

4 Conclusions

In this paper, we briefly described the framework for storing the data and providing aggregated linked open data. As the data are stored a set of cleaners and

[10] `http://www4.wiwiss.fu-berlin.de/bizer/ldif/`

linkers is applied to it, and the quality score is computed. During data aggregation, we solve conflicts among the data and compute aggregate quality estimate of the selected value or values. As compared with LDIF, ODCS provides indisputable benefits "by design", because the data is aggregated during query time.

Acknowledgment. The work presented in this article has been funded in part by GAUK 3110, GAUK 4105/2011, and EU ICT FP7 under No.257943 (LOD2 project).

References

1. Batini, C., Scannapieco, M.: Data Quality: Concepts, Methodologies and Techniques. Data-Centric Systems and Applications. Springer (2006)
2. Bizer, C., Heath, T., Berners-Lee, T.: Linked Data - The Story So Far. International Journal on Semantic Web and Information Systems 5(3), 1–22 (2009)
3. Bizer, C., Volz, J., Kobilarov, G., Gaedke, M.: Silk - a link discovery framework for the web of data. In: 18th International World Wide Web Conference (April 2009)
4. Dayal, U.: Query processing in a multidatabase system. In: Query Processing in Database Systems, pp. 81–108 (1985)
5. Demichiel, L.G.: Performing database operations over mismatched domains. PhD thesis, Stanford, CA, USA, UMI Order No: GAX89-25855 (1989)
6. Mendes, P.N., Mühleisen, H., Bizer, C.: Sieve: Linked Data Quality Assessment and Fusion. In: 1st International Workshop on Linked Web Data Management (LWDM 2011) at the 15th International Conference on Extending Database Technology, EDBT 2012 (March 2012)
7. Naumann, F., Rolker, C.: Assessment Methods for Information Quality Criteria. In: Proceedings of the International Conference on Information Quality, pp. 148–162 (2000)
8. Prud'hommeaux, E., Seaborne, A.: SPARQL Query Language for RDF (2008)
9. Schultz, A., Matteini, A., Isele, R., Bizer, C., Becker, C.: Ldif: Linked data integration framework (2011)
10. Svoboda, M., Mlýnková, I.: Linked Data Indexing Methods: A Survey. In: Meersman, R., Dillon, T., Herrero, P. (eds.) OTM-WS 2011. LNCS, vol. 7046, pp. 474–483. Springer, Heidelberg (2011)
11. Svoboda, M., Starka, J., Mlynkova, I.: On Distributed Querying of Linked Data. In: Proceedings of the 11th Workshop DATESO 2012, pp. 143–150. MATFYZPRESS publishing house - Charles University in Prague (2012)
12. Yan, L.L., Tamer, M.: Conflict tolerant queries in aurora. In: Proc. of CoopIS, p. 279. IEEE Computer Society Press (1999)

Exploring Data Integration Strategies for Public Sector Cloud Solutions

Alexander Breil, Patrik Hitzelberger, Paulo Da Silva Carvalho, and Fernand Feltz

Centre de Recherche Public – Gabriel Lippmann, Belvaux, Luxembourg
{breil,hitzelbe,dasilva,feltz}@lippmann.lu

Abstract. The emerging trend of using Business Intelligence (BI)-Applications in public organizations to support the decision makers belongs to the backend oriented e-government activities. A prerequisite for BI is data integration, which is still an expensive task. At the same time, public organizations are forced to save money, due to shrinking budgets. As cloud computing is marketed as key technology to gain higher efficiency and generate cost savings, we analyze in this paper its possible impact on data integration in the public sector. We describe first the conventional approaches of virtual and materialized data integration. Using technical and E-government specific criteria, the advantages and disadvantages of the two different approaches are shown. Afterwards, the paper scrutinizes the suitability of virtual and materialized data integration in the cloud by proposing and analyzing technical architectures that implement the two different methods. These architectural propositions are then discussed applying the criteria from the precedent chapter. Finally, we summarize our results and explain how we want to proceed with our further research.

Keywords: Data Integration, E-government, Cloud Computing.

1 Introduction

Most e-government definitions focus on the online delivery of government services to customers (citizens, enterprises, public organizations). Other authors consider also the backend-oriented support of the government management with IT to increase public sector efficiency [1].

In the business world, decision makers can draw upon a variety of Business Intelligence (BI) tools. Since a couple of years, there is a tendency to implement such businesslike management tool support in the government sector [2]. Examples for BI deployments in the public sector can be found in Germany, where a Data Warehouse supports the reporting process for the management of asylum applications [3], or in Brazil, where BI methods help to detect frauds in an electronic reverse auctions system [4]. Essential for the application of BI is the integration of the different data sources of the operational systems. Despite three decades of research in this domain (cf. e.g. [5]), data integration is still one of the most cost intensive tasks in enterprises [6]. For the public sector, given its shrinking budgets, these costs are a paramount obstacle for the implementation of BI applications. Cloud computing could be a key technology to solve this problem [7], allowing public agencies to benefit from the

A. Kő et al. (Eds.): EGOVIS/EDEM 2012, LNCS 7452, pp. 271–278, 2012.

advantages of BI. The US Department of Homeland Security, for example, is currently piloting a first version of a BI-Service deployed in a Private Cloud [8].

Concerning cloud computing, a variety of definitions exists. We follow Baars's and Kemper's [9] definition: a cloud is "a distributed, net-based architecture where resources can be dynamically rearranged".

The focus of this short paper is to explore the potential of cloud computing for different approaches of data integration. More specifically, we study data integration strategies for supporting BI applications in an e-government setting. The paper first takes a look at the current state of data integration approaches, differentiating between materialized and virtual data integration, and outlining the pros and cons of both approaches. The evaluation is based on general technical and specific e-government criteria. Afterwards, we scrutinize the suitability of these methods in the cloud by proposing and analyzing software architectures that implement the two different approaches. We compare the suggested architectures by the same criteria used in the precedent chapter. Finally, in the conclusion, we discuss necessary further research.

2 Data Integration Approaches

Data integration tries to create a single view on data from "distributed, heterogeneous, autonomous [and] evolving data sources". The main issue for data integration is the enormous (syntactic, semantic, etc.) heterogeneity of sources, combined with the autonomy and dynamicity of the related organizations [10].

There are two general approaches for data integration. *Materialized data integration* means that the data is integrated by fetching data from different sources, into one centralized database. *Virtual data integration* means that the data is integrated by creating a virtual view on the different data sources. These sources are queried at runtime in order to access and integrate their data [11].

2.1 Materialized Data Integration

Materialized data integration realizes the integration by fetching the relevant datasets from the target sources and persisting them physically elsewhere. An example is a data warehouse (DWH) in the context of BI-Applications (OLAP, Data mining, etc).

The data warehouse itself is a specialized database. The data integration process takes place in the ETL (Extract, Transform and Load) layer. It is responsible for extracting the operational data from their different sources, transforming it into the DWH-Schema, performing data cleansing actions and to finally load the transformed data into the DWH [12].

The ETL process is executed regularly (hourly, daily, etc.), based on the specific application requirements. As a consequence, between two updates, applications that depend on this data cannot be considered as being up-to-date. This is one of the main problems of DWHs. Operational Data Storages (ODS) tackle this, but are not without issues either [13].

2.2 Virtual Data Integration

Virtual data integration is based on lazy fetching. Data is retrieved from the sources in real-time during the query execution. There are several architectural designs for

realizing virtual data integration like *(Meta)-Search Engines*, *Federated Databases* and *Mediated Query Systems* [14]. Due to the limited scope of this paper we only discuss the Mediator-Wrapper-Approach as example.

The Mediator-Wrapper-Architecture was introduced almost 20 years ago [15]. It consists of the Mediator, Wrappers and Data-Source layers. The data source systems remain unchanged. The first integration steps are performed by the wrapper which is unique for each source. It transforms the source data into a wrapper schema and overcomes interface, technical and schematic heterogeneity. Afterwards, the mediator integrates the different wrapper schemas to a global schema. This schema can be queried by applications that require data from the integrated view.

Since the data is integrated on-demand it is ensured that the retrieved datasets are up-to-date. On the other hand, this architecture is not able to handle temporarily unreachable data sources. A hybrid architecture which combines materialized and virtual data integration can help to overcome this disadvantage [16].

2.3 Comparison of the Two Approaches

The comparison of both approaches is done according to the two architectures presented in the precedent paragraphs: Data Warehouse as an example for materialized and Mediator-Wrapper-Architecture as an example for virtual data integration. Choosing other architectures (like ODS) could yield different results.

We compare first both architectures using general technical criteria (Table 1). In a second step e-government specific criteria are applied.

Table 1. Comparison DWH and Mediator architecture by technical criteria

	Materialized (DWH)	Virtual (Mediator)
Integrated data being up-to-date [17]	Depends on update periods, costs and type of application.	Always, data is integrated on-demand.
Performance [18]	Higher, queries are executed locally.	Lower, limited by the performance of the slowest data source.
Query-Execution-Complexity [17]	Lower, queries executed locally in the DWH using the schema the DWH provides.	Higher, queries have to be split up and be executed in the different data sources to finally combine the single results to the end result matching the global schema.
Autonomy of the data sources	Lower, data sources become an integral part of the ETL process. Change in the source impacts the whole process [19].	Higher, change of one data source only affects the appropriate wrapper [14].

Table 1. (*continued*)

Read/Write	Both [20]	Read-only [14]
Storage requirements [19]	Higher, all data is central.	Lower, no centralization.
Cleansing [21]	Possible, as a step in the ETL process.	Barely possible, since data cleansing has to be done in real-time.

Considering the technical criteria, a DWH seems to offer more advantages and appears to be the better solution for data integration. The main disadvantages are that the data in the sources and the DWH are asynchronous and that the autonomy of the data sources decreases. Both points are actually strengths of the virtual approach. Nevertheless, there are situations where it makes sense or is even inevitable to use virtual data integration, e.g. if the data sources are not fully accessible and/or not under the control of the organization that wants to integrate them.

To rate the two approaches according to their suitability for e-government the following additional criteria are applied:

- Data Ownership: Especially for inter-organizational data integration the data ownership factor is important. Ownership changes might be forbidden by law [22];
- Access Control: Controlling the access to certain data is crucial - different users or applications must have different access rights [23];
- Misuse potential: Risk that the integrated data is misused. Large integrated views may allow analyses that the users are not entitled to do [23];
- Privacy: The public sector and thus the integration process must respect data protection and privacy and make data anonymous in certain cases [22];
- Trust: The acceptance by the population is important for e-government applications in general [24].

Table 2. Comparison DWH and Mediator architecture by e-government criteria

	Materialized (DWH)	Virtual (Mediator)
Data Ownership	Can move; depends if the integration is inter-organizational.	Remains, because the data is integrated on-demand.
Access Control	Possible, in several ways on source or DWH side.	Easily possible. Critical data does not get exported.
Misuse potential	Higher, all data is centralized and complex queries can be executed.	Lower, data is still decentralized and query structure is limited by the interfaces.
Privacy and data protection	Possible through data anonymization during the ETL process.	Possible through anonymization during the request.
Trust concerns	Higher, since data is saved centralized.	Lower, due to the remaining decentralization.

The result of the analysis of these criteria tends to a virtual solution. This is a contrast to the former result (technical criteria) that backs a materialized approach.

3 Migrating Data Integration Approaches to the Cloud

This chapter applies the criteria of chapter 2.3 in order to evaluate the introduced approaches for data integration using cloud computing. For accomplishing this, we present and analyze two "cloudified" architectures that realize the respective integration approaches.

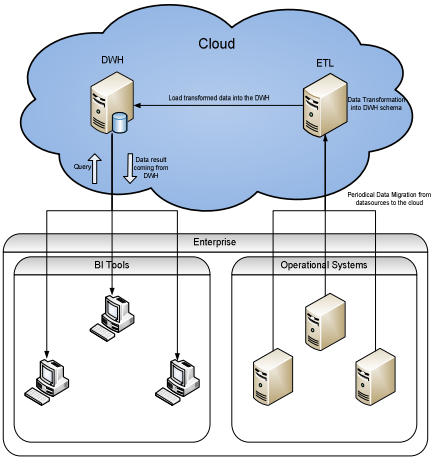

Fig. 1. Architecture for a DWH in the cloud (left)

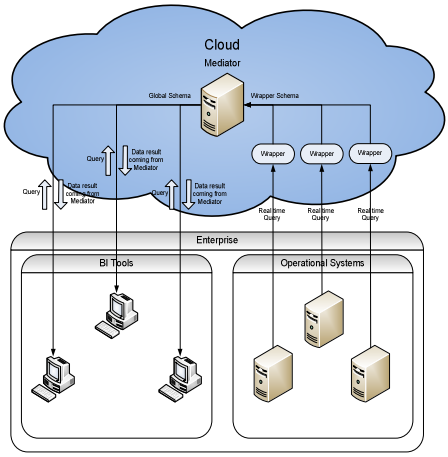

Fig. 2. Architecture for a Mediator-Wrapper based data integration in the cloud (right)

3.1 Architecture for Materialized DI in the Cloud

Figure 1 proposes an architecture for implementing a DWH in the cloud, whereas the operational systems and the BI tools remain on premise. The operational data is extracted regularly and uploaded to the cloud, following a strategy that has to balance the actuality requirements of the BI applications and the transfer related costs (performance impact, data volume and transfer times, etc.). The ETL process is executed in the cloud, because the processes for data integration and cleansing are computation intensive, typically causing peaks in terms of resource requirements. Executing this step in the cloud where resources are dynamically allocated is a typical cloud usage scenario. Data is as well stored in the cloud in this example.

This architecture realizes a Data as a Service (DaaS) cloud concept, which means that "data in various formats, from various sources, could be accessed via services to users on the network" [25]. BI-Applications can use these Daa-Services and execute their different analytical methods (OLAP, data mining, etc.).

The architecture could be adapted in various ways. For example it might also be advantageous to migrate the data sources of the operational systems to the cloud. This would reduce further the on-premise hardware and storage requirements.

3.2 Architectures for Virtual DI in the Cloud

A cloud computing adapted architecture for virtual data integration is shown in Figure 2. The mediator is hosted in the cloud and offers an integrated view on the data of the operational systems. So, the architecture follows as well a DaaS design, but no data is persisted in the cloud environment. The BI-Applications query the global schema of the mediator to retrieve data. Given the direct access to the sources, the data is always up-to-date. Nevertheless, there is a direct performance drawback on the data sources, as well as on the BI-side, that has to be managed. Data integration is achieved on-demand in the cloud, which means that the datasets from the several sources are fetched via their proprietary wrappers and transformed to the global schema. This is one advantage of hosting the mediator in the cloud. The dynamical reallocation of resources increases performance and more complex queries than in conventional solutions are possible. Again, only one of several possible architectures for a Mediator-Wrapper-Approach is shown. Like already mentioned in chapter 3.1, a migration of the operational data sources would also be possible.

3.3 Discussion of the Different Architectures

The migration to the cloud has an impact on the decision for a data integration approach. Data warehousing in the cloud seems to significantly profit from the flexibility and scalability that cloud computing provides. Since the complex ETL process is executed in an environment with dynamic resource allocation, the performance can be increased by providing on-demand computational resources. This also allows scheduling the extraction from the operational sources more often to guarantee a more up-to-date DWH. Due to the better resource availability during the ETL process, data cleansing also benefits from cloud computing. This offers organizations the possibility to use more complex algorithms to improve the quality of the datasets in the DWH. The typically high storage requirements of DWH are also easier to manage due to the on-demand flexibility of the cloud.

For the Mediator-Approach, we can observe improvements for the criteria *Performance* and *Query-Complexity*. Since querying the global schema results in complex calculations, the proposed architecture benefits from the scalability of the cloud environment. During load peaks, when many queries have to be planned and executed at the same time, the performance can be increased. Queries are executed faster, and new and more complex queries become possible.

In cases, where data accuracy is the main concern, and performance is not the first priority, virtual integration may be a better option.

Using cloud computing in the public sector increases the risk of losing trust in e-government solutions, due to privacy concerns. Germany has been experiencing this kind of problem when trying to establish a telematics infrastructure in its health sector [26]. For the other factors, the rating remains equal, except for data ownership in the case of a cloud based DWH. Here, the type of cloud, where the data is stored in,

matters. In a public cloud, data ownership will be lost for all sources, whereas in a private cloud the situation remains the same as for non-cloud solutions. In a community cloud the participating organizations keep the ownership of the data, since the cloud belongs to all of them and the infrastructure is shared.

4 Conclusion

In the precedent chapters we have compared materialized and virtual data integration, regarding technical and e-government specific criteria and the computing environment. In general, materialized data integration is preferable according to the technical criteria (see Table 1). In contrast to that, virtual data integration has significant advantages when the e-government specific criteria are taken into account (see Table 2). The migration to a cloud computing environment for realizing the data integration does not change this, but improves several technical aspects.

However, the public sector must react to the changing, conflicting environmental constraints: budgets are shrinking and the demand for efficient and modern services and service management is increasing. Cloud computing, using the advantages of economy of scale, is marketed as a universal instrument to deliver more efficient and less cost-intensive IT-solutions. Our analysis, examining if cloud computing can be handy in the public sector, could not falsify this statement. We have shown that cloud computing has potential to turn data integration in the public sector more efficient.

In the future, we will focus on the analysis and comparison of more aspects of the different emerging architectures and solutions suitable to deliver efficient backend infrastructure for the public sector in a cloud environment. The goal is to find the most suitable cloud model(s) for e-government.

References

1. Hu, G., Pan, W., Lu, M., Wang, J.: The widely shared definition of e-Government – An exploratory study. Electronic Library 27(6), 968–985 (2009)
2. Chappelet, J.L.: E-Government as an Enabler of Public Management Reform: The Case of Switzerland. In: Traunmüller, R. (ed.) EGOV 2004. LNCS, vol. 3183, pp. 283–288. Springer, Heidelberg (2004)
3. Bauer, A., Böhnlein, M.: Einsatz eines Data Warehouse im eGovernment-Bereich zur Asylsteuerung und Migrationsanalyse. In: Auf dem Weg zur Integration Factory (2005)
4. Souza, R., Pereira, A.: A Business Intelligence Methodology for E-government Reverse Auctions. In: IEEE Conference on Commerce and Enterprise Computing 2009 (2009)
5. Ziegler, P., Dittrich, K.: Three Decades of Data Integration – All Problems Solved? In: Jacquart, R. (ed.) Building the Information Society. IFIP, vol. 156, pp. 3–12. Springer, Boston (2004)
6. Bernstein, P.A., Haas, L.M.: Information Integration in the Enterprise. Communication of the ACM 51(9) (September 2008)
7. Goth, G.: Public Sector Clouds Beginning to Blossom: Efficiency, New Culture Trumping Security Fears. In: IEEE Internet Computing, pp. 7–9 (November-December 2011)

8. Department of Homeland Security (2011), Cloud Computing: What are the Security Implications?, http://www.dhs.gov/ynews/testimony/20111006-spires-cloud-computing.shtm (accessed February 16, 2012)
9. Baars, H., Kemper, H.G.: Business Intelligence in the cloud? In: AIS Electronic Library, PACIS 2010 (2010)
10. Bakhtouchi, A., Chakroun, C., Bellatreche, L., Aït-Ameur, Y.: Mediated Data Integration Systems Using Functional Dependencies Embedded in Ontologies. In: Recent Trends in Information Reuse and Integration 2012, pp. 227–256 (2011)
11. Haas, L.M., Miller, R.J., Kossmann, D., Hentschel, M.: A First Step Towards Integration Independence. In: Data Engineering Workshops (ICDEW). IEEE (2010)
12. Vassiliadis, P., Skiadopoulos, S.: Conceptual modeling for ETL Processes. In: Proceedings of the 5th ACM International Workshop on Data Warehousing and OLAP (2002)
13. Sherman, R.: ODS Redux, Part 1. DM Review 15(6), 52–53 (2005)
14. Domenig, R., Dittrich, K.R.: An overview and classification of mediated query systems. ACM SIGMOD Record 28(3) (September 1999)
15. Wiederhold, G.: Mediators in the architecture of future information systems. Computer 25(3.X) (1992)
16. Kermanshahani, S.: Semi-materialized framework: a hybrid approach to data integration. In: Proceedings of the 5th International Conference on Soft Computing as Transdisciplinary Science and Technology (2008)
17. Kermanshahani, S.: IXIA (IndeX-based Integration Approach) A Hybrid Approach to Data Integration. Doctor thesis, retrieved from http://tel.archives-ouvertes.fr/docs/00/40/75/75/PDF/these.pdf (accessed March 7, 2012)
18. Hull, R., Zhou, G.: Towards the Study of Performance Trade-offs Between Materialized and Virtual Integrated Views. In: Proc. VIEWS, pp. 91–102 (1996)
19. Hammer, J., Garcia-Molina, H., Widom, J., Labio, W., Zhuge, Y.: The Stanford Data Warehousing Project. IEEE Data Engineering Bulletin, Special Issue on Materialized Views and Date Warehousing 18(2), 41–48 (1995)
20. Widom, J.: Research Problems in Data Warehousing. In: Proceedings of the International Conference on Information and Knowledge Management, pp. 25–30 (1995)
21. Rahm, E., Do, H.: Data cleaning: Problems and current approaches. IEEE Data Engineering Bulletin 23(4), 1–11 (2000)
22. Lam, W.: Barriers to e-government integration. The Journal of Enterprise Information Management 18(5), 511–530 (2005)
23. Ebrahim, Z., Irani, Z.: E-government adoption - architecture and barriers. Business Process Management Journal 11(5), 589–611 (2005)
24. Wee Tan, C.W., Benbasat, I., Cenfetelli, R.T.: Building Citizen Trust towards E-Government Services - Do High Quality Websites Matter? In: Proceedings of the 41st Hawaii International Conference on System Sciences (2008)
25. Wang, L., Tao, J., Kunze, M., Canales Castellanos, A., Kramer, D., Karl, W.: Scientific Cloud Computing - Early Definition and Experience. In: 10th IEEE International Conference on High Performance Computing and Communications (2008)
26. Göres, U.: Nutzerakzeptanz – Herausforderung Telemedizin am Beispiel der elektronischen Gesundheitskarte. In: Telemedizinführer Deutschland Ausgabe 2009 (2009)

Author Index