

# Service oriented architectures for supporting environments in eGovernment applications

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**Abstract**— The introduction of eGovernment services and applications leads to major changes in the structure and operation of public administrations. In this paper we present current work in progress in Italian eGovernment projects aimed at the analysis, development, deployment and evaluation of tools and environments to support the people who design, develop, use and evaluate eServices to citizens.

**Index Terms**— eGovernment, eServices, Distributed Databases, Information Systems.

## I. INTRODUCTION

WHAT are the most appropriate information systems architectures to deal with the introduction of eServices in Public Administration? What are the most effective methodologies and strategies to provide concrete solutions to the complex change phenomena within the administrative structure of Public Administration involved in the new eGovernance policies? Are there guidelines for planning properly the design and the development of the Information Systems to support the delivery of web services in this context? These are the main questions we have addressed in our research in order to provide some contributions both in the theory and in the practice in this research field. In particular this paper illustrates some on-going research aimed at the definition of a coherent theoretical and architectural approach to assist the development of effective supporting environments capable to assist Public Administrations in the design and deployment of e-services to citizens and enterprises.

Public Administrations (PAs) all over the world are undergoing important innovation processes as a result of eGovernment projects such as provision of Web services to citizens [1,2,3]. In fact the arena of eGovernment is one of fast change as services are modernized and integrated. The most important dimension of change in the new concept of public service involves the breaking down of barriers between departments and units, the negotiation and implementation of multi-disciplinary and multi-agency networks and protocols and in more efficient and effective communication, transaction and co-ordination. This state of affairs will accompany the deployment of eGovernment programmes for

over a decade and it will be pervasive: the transformation activity will create analogous problems to managers, technicians and personnel throughout the different level of the public organization.

In the last decade, the work practice of complex organizations (Knowledge Intensive Organizations) have relied increasingly on their information systems [4,5]. As organizations are continuously evolving, there is a significant shift of importance from information-based systems, mainly dedicated to the management of operational data, towards new systems that are based on more aggregated information (e.g., data warehousing), and knowledge (e.g., knowledge management systems), necessary for monitoring and controlling business processes and for strategic decision making. The PAs can be considered as Knowledge Intensive Organization since they collect and process data and knowledge about citizens, companies and also PAs themselves.

Service oriented architectures, methodologies and tools, together with the conceptual and empirical framework of web services have a high potential to assist PAs in ongoing eGovernment innovation processes.

In the following we will first present a short description of eGovernment main open issues relevant to our cases. Then we will report some initial experiences from different projects in Italy in cooperation with the Public Administration of our local government in Trento. However, the research and development methodology has been developed for a joint EU application with Blekinge Institute of Technology and Ronneby municipality (Sweden), and Newcastle University and Newcastle municipality (United Kingdom). Our work in Trento is informed by ongoing research in all three sites in cooperation between the respective university and municipality. Finally some general reflections, based on our experience, will be discussed.

## II. EGOVERNMENT MATURITY MODEL

### A. A maturity model for eGovernment developments

Looking at the innovation processes that Public Administration are undergoing, a certain form of eGovernment maturity model is emerging [6, 7]: the first stages in the development of eGovernment applications and the exploitation

of new channels and media in the delivery of public and administrative services consists of little more than the creation of web sites which may inform about service availability and qualification but do not provide access. This, initial stage, however, soon generates issues of editorial control, maintenance and co-ordination. Furthermore, the issues of portals, which provide the electronic equivalent of a single point of access to information, emerge. Since such developments are often accompanied by the development of physical one-stop-shops, we often observe a parallel development on the intra-net of the call centre support functions with the internet and kiosk development of public access.

These, first generation applications generate a requirement to go beyond simple form handling and the introduction of electronic transactions. We see in these first instances of the introduction of the new channels and media a requirement for more fundamental change in administration processes and, indeed, the legal context in which they are delivered: electronic signatures and messages have, for example, to be acceptable as legal instruments. This leads to second generation eGovernment applications that provide integration and intermediation of service publicity together with support the transactions associated with service access and some aspects of delivery.

A characteristic of the first two generations of applications is that their technical provision and delivery can be achieved through quite conventional means: requirements can be defined, implementers can design and develop prototypes which can be deployed and evaluated in the field. This is because they represent the re-implementation of existing, well understood processes. However, such applications themselves start to create new demands and opportunities for restructuring the administration processes themselves. Our experience in the survey and analysis of eGovernment applications across Europe indicates that an important transition takes place at this stage and the conventional, waterfall oriented development lifecycle models become problematic. This is because the third generation applications are constructed in the context of significant changes at the organisational and policy levels and the full and effective participation of all stakeholders in these processes is critical for their success. It is at this stage that the need for new sorts of partnerships between different sorts of public and private organisation emerge in the development and delivery of eGovernment services through new channels

and media. Such participation requires appropriate technical means as well as the commitment of all the participants. Technologies such as work-flow and XML schema, as well as proprietary products (such as Lotus Domino, WebSphere, .NET, etc.), are being adapted and adopted to provide a concrete medium round which administration staff from different departments and functions can make their explorations and negotiations of new ways of working explicit.

#### A. *The state-of-the-art of local eGovernment developments*

The first stages of our research work has focused on an analysis of the state-of-the-art of local eGovernment developments and projects within the above framework. In order to fulfil this objective we have established, together with the local administration, a working group that includes representative of all stake-holders involved in the process: internal PA organizational and IT managers, internal users, representative bodies of external users, representative of IT consulting firms and the University of Trento.

Table I summarizes past and current local projects mapped in the maturity model proposed in the previous section. Different text styles correspond to finished projects (normal) and on-going projects (italic). From the table is quite clear that this snap-shot of the local state-of-the-art captures the involved PAs in the process of a significant effort to move from simple to complex services: most of the finished projects involve first generation applications, while the major focus of on-going projects is in the design of more complex services architectures and delivery.

### III. ON-GOING EGOVERNMENT PROJECTS

In this section we report first experiences from three on-going projects in Italy in cooperation with the Public Administration of Trento. The first two deals with the design of proper architectures and implementation of effective applications in the area of national distributed document repositories, as example of second generation applications. The last one deals with the design and development of a One Stop Shop (OSS) for services to enterprises and citizens in the Province of Trento, as an example of a complex, third generation, application and its main open issues.

TABLE I  
LOCAL PUBLIC ADMINISTRATION "MATURITY": STATE-OF-THE-ART

	Intranet	Extranet
<b>First Generation</b>	<ul style="list-style-type: none"> <li>▪ Electronic archives, databases, GIS</li> <li>▪ Distributed local document repositories</li> </ul>	<ul style="list-style-type: none"> <li>▪ Regional web site</li> <li>▪ Major municipalities Web sites</li> <li>▪ Local municipalities Web sites</li> </ul>
<b>Second Generation</b>	<ul style="list-style-type: none"> <li>▪ Tools to support navigation and editing/updating</li> <li>▪ <i>Tools to support collaborative work between units in associated services</i></li> <li>▪ <i>Extension to all back-office/front-office services</i></li> </ul>	<ul style="list-style-type: none"> <li>▪ Design of municipal OSS for selected procedures</li> <li>▪ <i>National distributed document repositories</i></li> <li>▪ <i>Design of regional OSS</i></li> <li>▪ <i>Electronic signature to support transactions</i></li> </ul>
<b>Third Generation</b>	<ul style="list-style-type: none"> <li>▪ <i>Back-office architectures supporting transactions</i></li> <li>▪ <i>Supporting environments for knowledge creation and sharing</i></li> </ul>	<ul style="list-style-type: none"> <li>▪ <i>Full deployment of OSS front-offices (physical and virtual)</i></li> <li>▪ <i>Supporting environments for OSS service delivery</i></li> </ul>

### A. LexBrowser Project

The focus of this project has been the planning and implementation of a web service, named LexBrowser, that allows the search and visualization of provincial norms and laws together with the possibility to translate the documents in a second language (German or Italian).

The service has been implemented within an Italian national project, named "NormeInRete" [8] that coordinates the activities of local PA in this field. "NormeInRete" is being realized through the incremental implementation of a national web portal capable of search functionalities on the various normative documents accessible on local web sites of the involved PA.

The overall plan is to create an information infrastructure that, based on the technologies currently available, can leverage each PA efforts in the pursue of transparency and accessibility of public content information. The efficacy of the architectural solution depends, among other issues, on the definition of appropriate standards of documents structuring and mark-up. To this end, the project adopts XML, as mark-up language, as well as of an URN (Uniform Resource Name), that concurs to identify every document through a unique name, depending on the nature and own identifiers of each document and completely independent on its physical location. These proposals are based on the adoption of emergent standards in the Internet, adapted from the ones defined within the Internet Engineering Task Force (IETF) and in the specific Working Group (URN Working group).

The practical problem that has been faced in the LexBrowser project has been the design and development of the local PA client architecture, as well as specific dedicated tools to prepare local documents for the national web service. The mark-up of the various documents has been performed following a set of rules encapsulated in a XML-schema [9], designed based on the structure of the local documents and on the standards of the national project. Open source development environments have been selected for the implementation. In particular:

- for the client level, Javascript 1.2 have been used to develop appropriate applets in the user interface; therefore Java™ Plug-in are needed for the correct visualization of the software
- for the middle tier level, the server applications have been based on Servlet Engine Jakarta Tomcat, Java™ Server Pages, Java™ Servlets and the JAXP package (API for XML). In particular two servlets application have been developed in order to implement full text search functionalities and visualization of XML documents
- for the data layer, the local database applications have been used in order to implement compatibility with legacy systems. In particular compatibility with SQL and Oracle database have been considered at this level.

### B. Shared national GIS metadata repository

This project has dealt with a similar problem of the

previous case study: the sharing of information within national administrations. Here the main objective has been to develop suitable architectures and tools to enable certified national agencies the access to both cartographical and associated data objects, collected and published electronically by local administrations.

The proposed and implemented solution is based on the automatic exporting of the metadata of the geographical objects through appropriate XML schema. In this way each local administration can maintain its own legacy database as well as proprietary Geographical Information System (GIS) tools for creating and maintaining its geographical databases, while providing access to its own repository to the certified national agencies. The project has included:

- an analysis of European and world standards for geographical metadata [10,11];
- the definition of a "road map" in order to implement the basic rules for the automatic translation of a local metadata descriptions to the national standard;
- the design and development of the application for exporting the metadata as well as of the client-server architecture for data publishing

The design of the system architecture has been discussed within the Italian working group for the National Cartographical Repository.

The final web application provides the following basic services:

- access management, with different profiles and security control;
- query interface for both geographical and alphanumeric data;
- automatic broadcasting of the query request to the associated local databases;
- common results visualization interface, both geographical and alphanumeric.

### C. The SPO.T. project

The local government Provincia Autonoma di Trento (PAT) wants to develop an integrated, one-stop approach to accessing public services from the user's perspective. Such One-Stop-Shops should provide a range of access mechanisms and channels that meet the requirements of citizens when, where and how they want it, and make financial and other key public transactions easier and more secure.

The implementation of the project, under the code name "SPORTello Trentino per le attività produttive" (SPO.T.), aims to a more effective use of information and resources, both internally within the PA and with partner organisations. To achieve this vision PAT is developing a broad band infrastructure network connecting its offices distributed in the region as well as users in remote and rural areas.

In the first phase of the project the provided services will address a subset of the most relevant administrative services identified at European and Italian level in the related eGovernment action plan [2,3]. They include procedures from all four Public Administration service categories identified at

European level [2]:

- License services to provide various kind of authorization (building licences, starting of new activities etc.);
- Registration services to provide registration and information data for administrative procedures (identity, residency, stay permit etc.);
- Health and Welfare services;
- Income services: all interactions and transactions that include financial fluxes between citizen /enterprises and local public administration.

PAT has established a working group that includes representative of all stake-holders involved in the process. The mission of this working group is:

- to provide an analysis of the state-of-the-art of eGovernment developments;
- to provide a feasibility study for the creation of physical and virtual One Stop Shop (OSS);
- to design and develop a first integrated software platform to support the people who plan, deliver services to citizens as well as the users of OSS services;
- to deploy the proposed platform in a subset of local administrations for a certain number of procedures (municipalities with more than 3000 residents)
- to monitor and analyze the results in order to support the growth and emergence of third generation eGovernment applications as well as to evolve the system to all municipalities and procedures.

In the first phase of the project the focus of the working group has been on the agreement of a shared methodological approach to be used. A consensus has been reached to first study the administrative procedure as they are performed at the present, to understand the difficulties and develop ideas how methodological elements from architectural discourse and use oriented and participative design, can support the project. Based on the experience with the deployment of these methodological elements, a first version of the tools will be developed and deployed within a set of selected pilot offices. The dynamic observation of this deployment will allow to improve the tools into subsequent phases of the project.

#### IV. SERVICE ORIENTED ARCHITECTURES: EMERGING ISSUES

In the present section the main ideas that are emerging from our projects and are shaping the definition of possible solution will be briefly presented. They comprise both architectural and IT issues.

##### A. *Intermediation and brokerage: the architectural idea*

The development of the first generations of eCommerce as well as eGovernment applications [12] has emphasised concepts such as the front and back office co-ordination with the call centre and the One-Stop-Shop as means of integration for users. In this environment concepts of intermediation and brokerage provide an extremely powerful abstraction for exploring changes in the way service relationships are understood. In a most general formulation a proposed intermediation and brokerage architecture [12] identifies four

(abstract) stages or epochs defined in terms of responsibilities and relationships. These should not be interpreted as a process sequence but as highly interacting and parallel. They are:

*Formation* where the set of available resources, capabilities and service offers are identified, recruited, assembled, organised and presented. Here we see the requirement for registration classification and validation resources and capabilities are co-ordinated around the generic concept of the catalogue.

*Rendezvous* where specific relationships between elements of supply and instances of demand are identified and selected. Here decision support and knowledge management resources are brought together with records and histories.

*Transaction* is concerned with the activation and supervision of delivery which may be distributed over both time and space. Case management resources and capabilities are present in this epoch of intermediation.

*Post-transaction and evaluation* closes the service loop providing the basis for quality management, failure analysis and recovery and the potential for organisational learning.

Such abstract architecture can provide in our opinion an useful tool to model the design of service oriented applications. This description of intermediation is, necessarily abstract. It can be used in the following ways: firstly, it provides a conceptual framework for service integration and delivery – the front office and the one-stop-shop are essentially brokerage environments. Secondly, it provides a framework for co-operative work and mutual support in communities of practice where public administration intermediate their own skills to each other in the construction of multi-disciplinary and cross department client and citizen oriented plans at both the individual level and as guides of policy and good practice. Finally, it provides the basis for a more flexible and responsive approach to service planning and management where the ever changing needs for information about performance, effectiveness, demand and opportunities are themselves satisfied through information intermediation and brokerage processes rather than by the redesign and implementation of specific management information systems with each new demand. Current approaches to this capability tend to assume monolithic organisation and rely on the concepts of the “data warehouse” and of “data mining”. While these have a place in some current eGovernment implementations, the more generalised solution of highly distributed and federal information environments emerge from the more generic notions of brokerage we are developing here.

As has been indicated in the definition of brokerage epochs, the abstract concepts map onto a number of IT tools and methods: these include the catalogues, client records and case management, decision support and guidelines, quality systems and knowledge management tools. At a level below, these user oriented applications concepts are a further set of quite well known platform or middle-ware concepts such as workflow and distributed transaction services, security services which provide authentication, signature, non-repudiation, audit and so on.

Thus, we propose to construct a cogent set of links ranging from a very abstract set of concepts to more concrete and specific ones. The generic concepts must be powerful enough to provide a useful conceptualisation of the organisational changes implied by third generation eGovernment applications across a wide range of political and cultural contexts. The concrete ones must be sufficiently accessible to provide a basis for the participative exploration and co-design of new administration processes and practices.

These implementation concepts are under consideration within our pilot environments.

### B. ITC Supporting environments

One of the objective of our on-going eGovernment applications is to develop a general platform for ICT supporting tools to eGovernment services, which may be adapted for use in an extended range of administration contexts and stages of the local eGovernment developments. This will also be achieved in the form of XML schema and service oriented computation models as a framework for the generic solution for supporting systems in eGovernment services. There could be many solutions which are acceptable to Public Administrations who intend to engage in eGovernment services: it will be a requirement on these schema and models that they exhibit a wide range of configurability and composability. The concept of service oriented computation model provide a powerful abstraction for exploring this solution space. An initial proposed configuration includes four major computational components each of which comprises a small number of sub-components. They are:

*Catalogue environment:* the organization and presentation in a catalogue of services and information within a Public Administration. This collection and organization of such information is also central to the concept of brokerage. Tools like Web sites, innovative portals and distributed databases lie within this domain.

*Transaction Environment:* the purpose of the transaction service is to ensure that, once a service is requested by a specific customer, all the required pre-conditions are met before commitment and that all post-conditions are achieved after commitment. Middle-ware concepts and tools such as workflow and distributed transaction services, security services populates this environment

*Decision Support Environment and Case Management Environment:* Public Administration face an ever-growing amount of information management to enable them to provide services to citizen and enterprises. Tools like Decision Support Systems and Case Management Repositories based also on the previous catalogue and transaction environments can supply a more comprehensive overview and enable more efficient access to the range of services provided across different parts of the organisation.

## V. CONCLUSION

In our research projects we believe that a participatory

approach together with the architectural discourse proposed in this paper will support the development of a platform in public service provision for enhanced co-operation, coordination and integration of services as well as the continued design in use of services and IT infrastructures.

## ACKNOWLEDGMENT

The research ideas and development methodology presented here are being developed in a joint European project with Blekinge Institute of Technology (Sweden), and Newcastle University (United Kingdom). M. Marchese thanks G. Jacucci of University of Trento, Y. Dittrich and S. Eriksén of Blekinge Institute of Technology and M. Martin and B. Wessels of University of Newcastle upon Tyne for the continuous exchange of ideas and information on ongoing research in all three sites. The three local projects described in the paper have also been the subject of internship projects of University of Trento students: M. Marchese thanks Alex Vettori, Lorenzino Vaccari and Ivan Trentinaglia for their effort and work in the projects.

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