SmartGov: A Governmental Knowledge-based Platform for Public Sector Online Services

E. Tambouris[1], G. Boukis[1], C. Vassilakis[2], G. Lepouras[2], S. Rouvas[2], R. Cañadas[3], S. Heredia[3], J. C. López Usero[3]

[1] *Archetypon S.A., 236 Sygrou Av., Athens, 176-72, Greece*

`{tambouris, gboukis}`@archetypon.gr

[2] *University of Athens, Ilissia, Athens, 157-84, Greece*

`{costas, glepoura, rouvas}@ di.uoa.gr`

[3] *Indra Sistemas S.A., Velásquez 132, 28006 Madrid, Spain*

`{rcanadas, sheredia, jclopez}`@indra.es

Abstract. *Public transaction services (such as e-forms), although perceived the future of e-government have not yet realised their full potential. E-forms have a significant role in e-government, as they are the basis for realising most of the twenty public services that all European Union member states have to provide to their citizens and businesses. The aim of this paper is to present a knowledge-based platform to assist public sector employees to generate online transaction services by simplifying their development, maintenance and integration with already installed IT systems.*

1. Introduction

According to the European Commission [1], transaction services (such as e-forms) although perceived the future of e-government have not yet realised their full potential. E-forms have a significant role in e-government, as they are the basis for realising most of the twenty public services [2] that all European Union member states have to provide to their citizens and businesses.

The development and the deployment of transaction services is a rather complex task, currently requiring the involvement of numerous roles, including domain experts, managers, IT staff, service administrators and end-users, which must act in a synchronised manner. Besides the large number of roles within a transaction services project, which is itself an impediment to its success, adoption of transaction services by public administration authorities is further hindered by the following issues:

❑ Complexity in creating e-forms and, most importantly, difficulty in *encapsulating domain expertise* in these forms. This if often resulting from the fact that knowledge is *implicit* within the organisation, rather than *explicit.*

❑ *Difficulty in interoperability* with existing IT systems within the organisation and with external IT systems of other organisations.

❑ Lack of *user-friendliness* for the end-user in the form of online help, domain specific information, external references, examples, support of multiple access devices etc.

❑ Lack of value-added, *domain-specific services* based on the data of e-forms that can be used at a strategic managerial level or to increase domain expertise.

❑ Lack of coherent *process models* for exploiting the use of public e-services within the public sector.

❑ *Organisational and cultural barriers,* such as public sector employees' fear of new technology and new methods of work in the public sector.

In this paper we present SMARTGOV, a knowledge-based platform that supports the whole transaction services lifecycle, tackling the various issues that impede the widespread of transaction services. Central to the SMARTGOV approach are a *knowledge repository,* which captures the domain knowledge in an explicit manner, and the isolation of information technology-related topics from operational and domain-specific issues, empowering thus public servants with domain expertise to undertake the development and maintenance of transaction services. The deployment of that platform should be supported by suitable process models that would enable process improvement and overcome organisational and cultural barriers.

The SMARTGOV platform is realised through the integration of diverse technological areas such as knowledge based systems, Internet and user-centric interfaces. The synthesis of these heterogeneous areas is achieved through extensive use of XML, which provides rich semantics and sufficient structure to deliver the necessary functionality.

The remaining of this paper is organised as follows. In Section 2, related work is reviewed. In Section 3, the actors involved in transactions service lifecycle within the SMARTGOV framework are listed. In Section 4, the SMARTGOV platform is outlined. In Section 5, the main functionality and benefits of the platform are given. Finally, in Section 6 the conclusions are drawn.

2. Related Work

Electronic government has received considerable attention during the last decade. An investigation on electronic government aspects is presented in [3]. The European Commission has also been continuously supporting research to promote

e-services in public administrations. Currently, research projects in this area are clustered around two main themes: tele-democracy and smart government [4]. Projects within "tele-democracy" cluster, such as EURO-CITI [5], are concerned with applications such as e-voting and tele-consultations. Projects within "smart government" cluster, such as eGOV [6], are focused to providing applications to the citizens e.g. one-stop government. However, there is currently a lack of projects addressing the problem of managing knowledge in the public sector.

Managing knowledge in the public sector cannot be realised and facilitated sufficiently only by tele-co-operation, shared databases and service applications. If Public Authorities (PAs) want to get a better understanding of who the recipients of their services are, who the providers are, and where there is room for improvement and quality control, an holistic view of the provision of e-services has to be addressed [7][8]. From an academic perspective, such a holistic view can be achieved through knowledge management. Unfortunately, for neither private businesses nor the public sector the problem of an effective and efficient organisation for Knowledge Management (KM) has been fully solved.

In the private business sector much research and development work has been conducted over the last 5 years into methodologies for KM. The ESPRIT and IST programmes support a number of projects that are developing innovative approaches to KM. Examples include: KnowNet (ESPRIT project 28928), COMMA (IST-1999-12217) and DÉCOR (IST-1999-13002). However there are significant differences in the way the public and private sector work. For example, in the public sector there is strong dependence on laws, regulations and jurisdiction; at the same time many stakeholders influence the administrative processes. A further major difference is *"trust"*. People dealing with commercial organisations are typically looking for financial integrity and confidentiality but when dealing with government agencies people expect not just integrity and confidentiality but also a level of transparency in the process that ensures trust in the service being provided. Businesses are providing services to their specific customers whereas government services are for the public at large. Government cannot choose its customers but rather has a duty to ensure access to all. E-business services are typically focussed around single events, e.g. buying a car, or opening a bank account, where buyers and suppliers work in an environment that is open to competition. E-government is much wider, however, encompassing a range of events, services and political processes that are by their nature open to contention.

Therefore the provision of public sector online services has to be regarded as a domain specific issue, which demands domain specific solutions.

From a technology perspective, a number of solutions on developing and deploying electronic services is available, including some commercial products. XMLForms™ by Schemantics [9], Accelio Capture™, Accelio Integrate™ and

Accelio Present™ by Accelio Worldwide [10] and Oracle E-Business Suite™ by Oracle Corporation [11] are examples of such platforms, whereas some open source products are available as well.

With regards to e-forms standards, a notable development is that of the *XForms* specification by the World Wide Web consortium (W3C) [12]. *XForms* is an XML-based standard for specifying Web forms, in a manner that separates "form purpose", "form presentation", and "form data", clearly defining the borders between content, structure and user input.

Finally, state-of-the-art in user interfaces suggests adopting a user-centred approach such as the one proposed by ISO 13407. Furthermore, recommendations such as the one proposed by the Web Accessibility Initiative by W3C are also considered as state-of-the-art in the area of design-for-all, which is essential when developing electronic public services.

3.   E-Services: Actors and Roles

According to the our approach the main stakeholders of e-services are:

- ❑ **Experts**: The public sector employees that have the required domain expertise on the processes that will be delivered through the e-forms system. These experts will be the main implementers of the *operational view* of the transaction services.
- ❑ **Managers**: The managers of the public sector who wish to obtain useful information (e.g. statistics, performance indexes etc.) from e-forms. Managers will complement the operational view of the transaction services, provided by experts, with the *strategic view*.
- ❑ **Supporting staff**: Implementing some features of the transaction service delivery platform (e.g. interaction with installed systems, database and operating system setup and administration) will require the involvement of IT staff. Moreover, user-interface specialists and/or web artists may be required to contribute, in order to enhance the quality of the delivered services. These support activities may be assigned to personnel of the public administration, or be outsourced.
- ❑ **End-users**: The end-users (either citizens and businesses or other public sector employees) that have to fill in e-forms.

4.   The SmartGov platform

Our proposal suggests that most of these problems can be alleviated or even eliminated by adopting an integrated approach for the introduction of e-forms in the public sector. Such an approach could be focused around two main themes:

- ❑ Integrating emerging standards with state-of-the-art technology and with advances in areas such as knowledge management, Web technologies, interoperability and accessibility.

❑ Introducing this technology in a systematic manner by adopting new process models, employing process re-engineering and process improving methods.

This paper focuses on the former, thus presents the platform from a technological only view. From this point of view, our approach identifies and addresses two key areas:

❑ The SMARTGOV knowledge-based core system.
❑ The SMARTGOV applications and services.

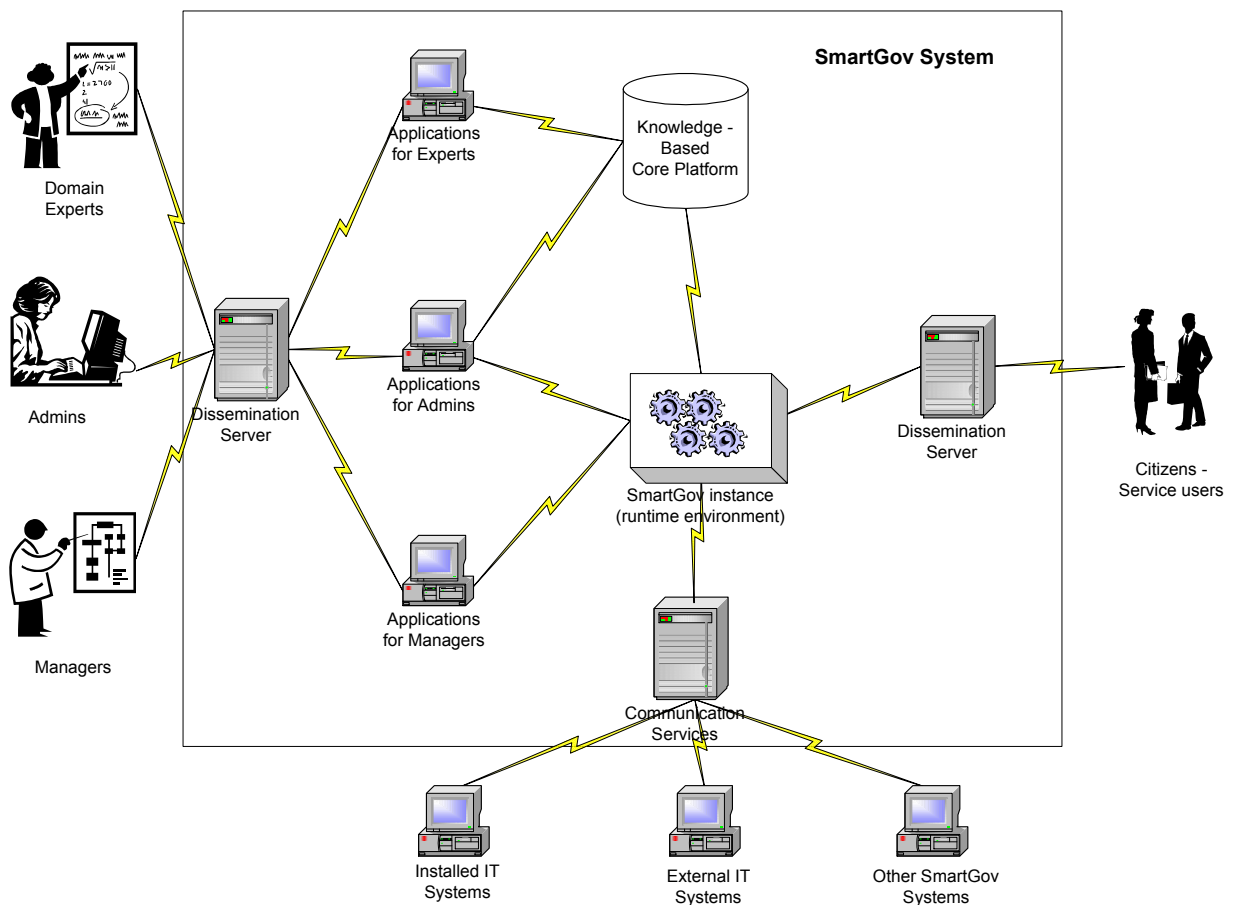An overview of the SMARTGOV platform is illustrated in Figure 1.

Figure 1 - *An overview of the SMARTGOV system*

4.1. The SMARTGOV Approach to Knowledge-based Core System

Presently, the domain knowledge used to develop e-services is provided either by means of extra documentation, or implicitly within the application or not at all. As a result, this implicit domain knowledge cannot be easily extracted, re-used for developing other services, or modified, when needed. Usually employees rather the organisation possess the critical assets: knowledge and insight. Therefore, the knowledge system must integrate these two assets, by means of encompassing the knowledge and insight that supports the development of electronic transactions.
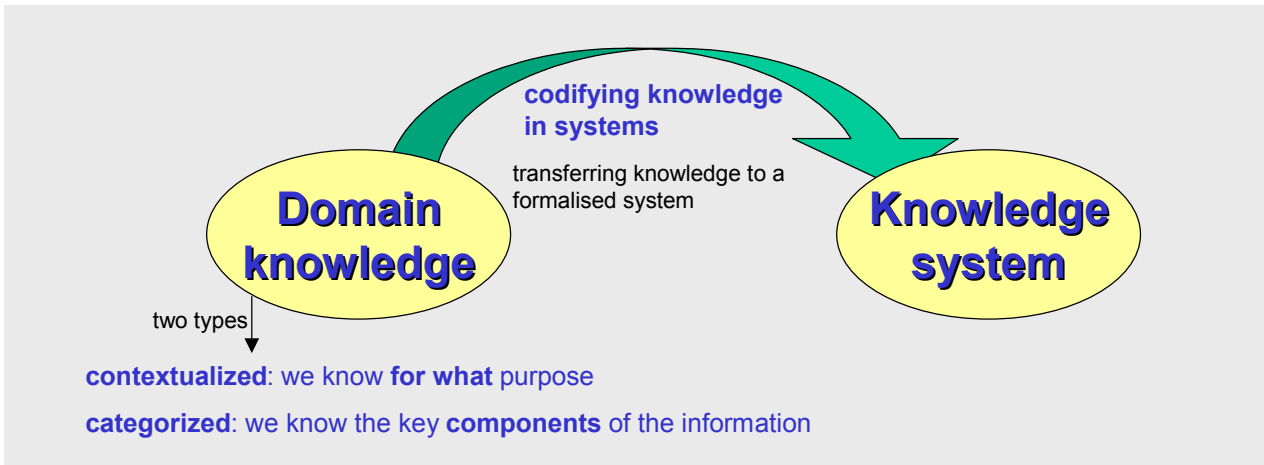
Figure 2 - *Transferring knowledge to a formalised system*

An important aspect of the problem to be resolved by the SMARTGOV platform is the transferring of the domain knowledge to a formalised system (i.e., DBs, e-forms). This process is illustrated in Figur 2 and includes:

- ➢ Knowledge audit
- ➢ Knowledge mapping
- ➢ Indexing of knowledge content
- ➢ Attribution of knowledge content.

In summary, this process aims to extract the knowledge imbedded into practices, data, culture, business model and process model, and record it explicitly and formally, in order to increase performance, leverage best practice and provide effective decision support. The formal process that accomplishes the tasks described above, is depicted in Figure 3.
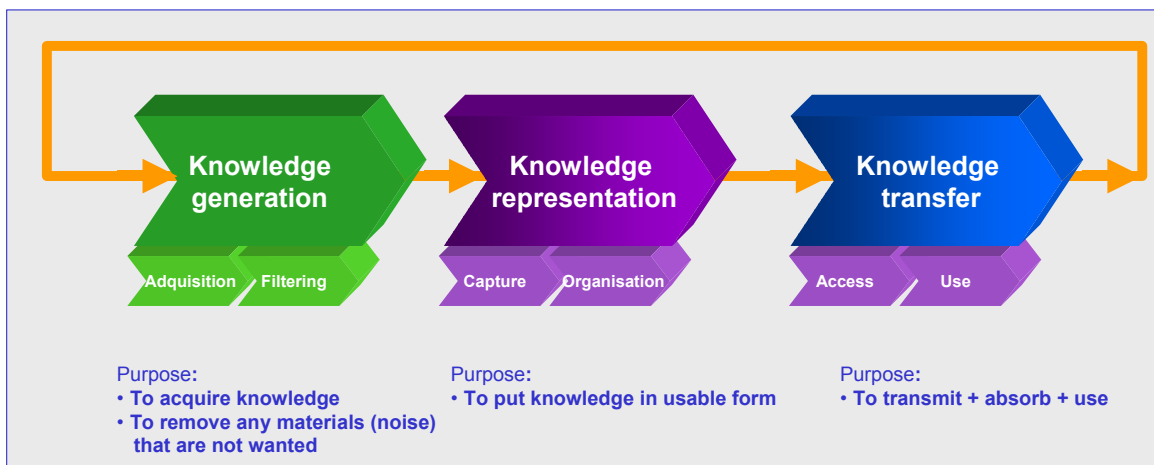

Figure 3 - *Knowledge generation, representation and transfer*

The SMARTGOV approach introduces and incorporates the key notion of the *transaction service element* (TSE), which is perceived as the main building block of transaction services. A TSE is the equivalent of a form field (such as the input space for a citizens id number or surname) but also contains metadata and domain knowledge that is attached by the form developer. Metadata may encompass the object's type, range of values, multilingual labels, on-line help, while domain knowledge includes information about the relation of the object to other elements, legislation information etc.

The SMARTGOV knowledge-based platform provides a *storage schema* that is capable of storing and handling the services and the associated e-forms as well as the corresponding knowledge. The schema will be expandable and allow for the adoption of new services. This schema will be *populated* with Transaction Service Elements, forming thus the Transaction Service Elements Knowledge database (TSEKDB), which includes the essential elements for developing transaction forms along with all relevant information and knowledge. The domain knowledge embedded in installed systems will be used for the development of the TSEKDB.

Public sector employees interact with the TSEKDB through a user-friendly front-end (administrative) tool, which enables both the retrieval of already existing knowledge, as well as maintenance activities, such as the addition new knowledge. The front-end tool allows for these tasks to be carried out in an intuitive and user-friendly manner.

4.2. The SMARTGOV Approach to Services and Applications

A Transaction Service (TS), within the SMARTGOV platform, is the equivalent of a form that contains a number of TSEs and some domain knowledge pertaining to the service as a whole. Under this scheme, development of a transaction service, consists of the following steps:

1. Selection of the appropriate TSEs to be included within the service.
2. Decision of the layout that will be used to present the service to its users. This layout may be selected from within a standard template library (which may then be customised); alternatively, any custom layout may be built from scratch.
3. Attachment of rules that govern the service, such as prerequisites for its usage, validation rules, triggering of other services etc.
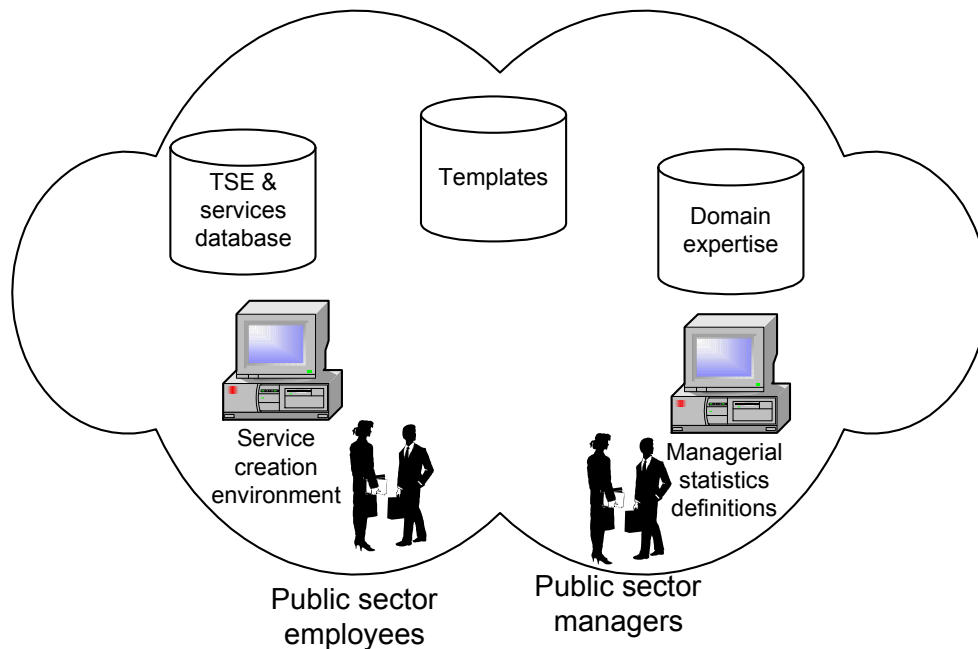4. Definition of MIS data and statistics to be captured for further processing.

Figure 4 *- SmartGov development environment*

When a transaction service has been developed, it may be deployed through *service instantiation*. This procedure generates automatically a *SMARTGOV instance*, comprising of all web pages, forms, information repositories and programs needed to operate the service within the Web environment, WAP channels or any other supported service deployment infrastructure. The generated elements are installed on the *Dissemination Server*, which handles the presentation layer i.e. all interfaces with the applications users. The overall operation of an instantiated service is illustrated in Figure 5.

A service that has been deployed to the public may need to interact with an installed IT system in order to exchange data with it. For instance, a service allowing for electronic submission of VAT declarations needs to contact the central taxation information repository to retrieve taxation data pertaining to the individual using the service, and to store the data entered by the user. All such communication is handled through the *communication services,* which include the *SMARTGOV agent* and the *Information Exchange Gateway.* The Information Exchange Gateway is attached to the installed IT system and publishes an *export schema,* which contains all the data items that need to be accessed by services running within the SMARTGOV framework. The SMARTGOV agent *imports* elements published within the Information Exchange Gateway's export schema within the SMARTGOV environment. Effectively, the Information Exchange Gateway encapsulates all peculiarities and idiosyncrasies of the installed IT systems, offering a uniform interface through which the SMARTGOV platform may communicate with virtually any IT system.
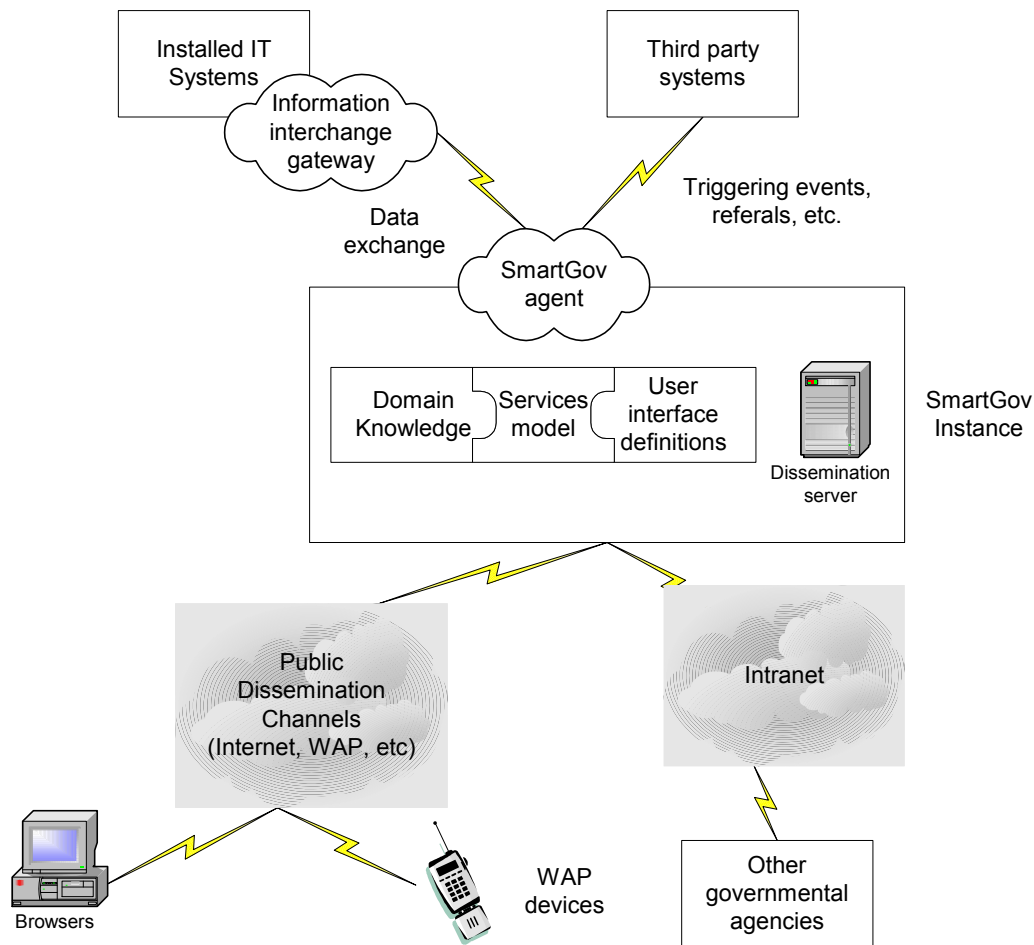
***Figure 5** – An Operational SmartGov Instance*

Besides providing the necessary link with the organisation's installed IT system, the SmartGov agent arranges for communication with third party systems the service should exchange data with, in order to access facilities that may complement or affect the running service. For instance, the SMARTGOV *agent* might provide linkage to document repositories where detailed instructions on form filling may be found, or support subscriptions to legislation databases, which emit alerts when legislation pertaining to the service operation is modified.

Service maintenance is also a major issue in operating transaction service environments that need to exchange data with installed IT systems. When a service undergoes modifications, for example due to legislation revisions, the electronic service published through the SMARTGOV *instance* must be 'in sync' with the organisation's private IT system, in order to carry out a full processing cycle for the service. In many cases, however, updating the private IT system may be quite cumbersome and time-consuming (e.g. when the private IT system is a legacy one, necessitating the need for program rewriting and data format migration), while the 'front-end' part of the service, such as declaration submission, must resume operation rapidly. The SMARTGOV framework caters for

these situations, by providing *submission spooling* mechanisms. These mechanisms allow for operating an electronic service and storing the submission data in a local information repository, until the organisation's back-end IT system is synchronised with the SMARTGOV *instance*. When the back-end IT system has been appropriately modified, the SMARTGOV *instance* may 'push' all collected submissions to the back-end, triggering thus the completion of the submission's processing cycle.

5.   Main Functionality and Benefits

The SMARTGOV *services and applications* comprise a coherent toolset for public services. These include:

- ❑ Applications for public sector employees to rapidly create and administrate e-services.
  From an operational point of view, these applications enable public sector employees with the required domain knowledge to easily create, deploy and maintain transaction services. The domain knowledge will be transformed into an explicit form and stored within the SmartGov platform, enabling thus its sharing among the authorised personnel of the organisation, whereas selected portions of this knowledge may be disseminated towards service users, making service usage more efficient and attractive. The deployed services will also be able to capture the user's behaviour, producing metrics, which can be used to improve various service aspects, ranging from presentation layouts to procedural issues.
  From a technological point of view, these applications enable integrating the emerging XForms standard by W3C with the SMARTGOV knowledge-based core repository. The technologies that could be used include Accessible Web interfaces, Java servlets, Java Beans, and XML.
- ❑ Applications for the public sector managers.
  These applications will allow public sector managers to obtain statistics and other information on e-forms instances that are running or have been completed. The relevant information may be specified in a high level of abstraction, with the SmartGov platform automatically performing the necessary mappings to system tasks, where appropriate. For that purpose, knowledge management methods such as OLAP tools and data mining processes will be provided.
- ❑ Services for the communication of the SMARTGOV system with installed IT systems and third party systems.
  The information exchange gateway complements the installed IT system encapsulating all processes required to export data to the SmartGov instance or import data from it, whereas the SmartGov agent handles all interactions between the deployed SmartGov instance and other IT

systems. These modules allow overcoming the fact that installed IT system are sometimes not built on top of a database, but are rather based on legacy technologies, such as COBOL programs or proprietary data formats, and even for the cases where databases are employed, these databases are not made available to web services, mainly due to security, legislation and policy considerations.

The information exchange gateway and the SmartGov agent will be based on an RDF vocabulary that will be developed within the SmartGov platform to provide interoperability of the SmartGov platform with installed IT systems and third party systems already in place. The extensive use of XML technologies is expected to ease the integration into the SmartGov Dissemination alternative communication channels such as WAP devices and PDAs.

Finally, it should be noted that the SMARTGOV applications provide significant functionality to address some very important aspects including:

- ❑ Integration with other IT systems

  The SmartGov platform includes extensive facilities to enable communication and integration with other IT systems, which affect the running service in an operational or supplementary dimension. Towards the communication with the organisation's installed IT system, the SmartGov platform provides the *Information Exchange Gateway*, the *SmartGov agent*, which arrange for seamless, high-level communication between the installed system and the SmartGov platform. When on-line communication is hindered, the spooling mechanism caters for *deferred mode* communication, storing information within the SmartGov platform and forwarding it to the IT system when on-line communication is possible.

  Integration with third party systems offers great added value to the transaction services: by collecting and linking information that could be useful to users of transaction services, the SmartGov platform provides a seamless portal to information repositories related to the offered services. Since these user interactions are performed through the SmartGov platform, they may be monitored and analysed, in order to determine the "most requested" information, and these metrics may be used to further improve the service. Moreover, by supporting event and trigger subscriptions, the SmartGov agent provides the means for ensuring that only up-to-date information and services are made available through the SmartGov instance, which is an issue of high importance.

- ❑ Minimisation of IT staff involvement.

  The SmartGov platform enables public servants having domain knowledge to design, develop, deploy and maintain electronic services. IT staff involvement will be limited to providing the necessary communication

links to the installed IT systems, and more specifically, the portion mapping SmartGov agent service requests to operations on the local IT system. Usage of templates, which may be developed once with the assistance of web designers, may provide a uniform look and feel for the services. At the same time, the required level of IT expertise is expected to fall significantly raising the acceptance of the SmartGov platform into PAs with pressing IT needs.

6.   Conclusions and Future Work

In this paper, a knowledge-based platform (namely SMARTGOV) for online public services was presented. This platform consists of the SMARTGOV knowledge-based core system and the SMARTGOV application and services. We believe that this platform provides a number of benefits to the different stakeholders within Public Authorities. Our next steps are to proceed with a detail specification, development, deployment and evaluation of this platform.

7.   Acknowledgements

8.   References

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