Development and implementation of the public electronic service for managing open competitions for government grants: Case study Autonomous Province of Vojvodina

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***Abstract*— Grants (non-repayable funds) are disbursed by provincial bodies in Autonomous Province Vojvodina to diverse recipients: local governments, vulnerable social groups, national communities, religious communities, nonprofit entities, educational institutions, churches, small and medium-sized businesses, or to individual citizens. Provincial administrative authorities grant funds for specific purposes by publishing calls for proposals. The purpose of this paper was to present results achieved and experiences gained in development and implementation of an electronic service facilitating non-repayable funds management process in a way to provide for horizontal integration of fund allocations in different sectors. Therefore, the paper presents the context of the development, the main functional and non-functional features, and deployment of the government grants management electronic service serving both the applicants and the provincial government institutions.**

I. INTRODUCTION

In this introductory part of the paper we present the context of the service development considering e-Government concept and basic aims, but also specifics of Autonomous Province of Vojvodina that affect development of the presented service.

A. The e-Government concept and basic aims

The concept of e-Government was defined variously by countries, academic institutions, international organizations, etc. Definition of e-Government depends also of the viewpoint (technical, social, economic development...) [5-8].

"Simply put, 'electronic' or e-Government is the systemic use of information and communication technologies (ICTs) to support the functions that a government performs for its constituents, typically the provision of information and services." [7].

Development of e-Government encompasses several stages or phases, from web presence to seamless or fully integrated web services [9-15].

So far, a variety of frameworks, approaches and recommendations to assist in overcoming challenges and pave the road for developing a successful e-Government are published [6-7, 16-18]. It can be concluded that interoperability and open standards are the necessary prerequisites for development of e-Government.

Many strategic documents paved the road for e-Government development in Europe [19-22].

The key components that should be considered in e-Government evaluation are [7, 24]: ICT and network infrastructure, enabling environment, information and communication ecology, organizational capacity, human capital, ICT prevalence of use, and web presence. The e-Government Index presents a more inclusive and less subjective measure of a country's e-Government environment. It incorporates a country's official online presence, evaluates its telecommunications infrastructure and assesses its human development capacity." [18].

B. Specifics of the Autonomous Province of Vojvodina

In this sub section we present very briefly social, legal and organizational aspects affecting development and deployment of the presented service.

Republic of Serbia exists from 2006, including two autonomous provinces: Vojvodina and Kosovo. Disintegration of former Yugoslavia and wars that took place in 90ties caused obvious and huge devastations in economy and all other areas in Serbia. Refugees, unemployment, poverty, illiteracy are only a few of many serious obstacles and challenges that hamper development in many areas, including e-Government.

Republic of Serbia, which is classified as a middle-income transition economy [1], is actively dedicated to economic development and substantial reforms in order to advance from transition economy to the developed status where e-Government development plays an important role. Development of e-Government in the Republic of Serbia and APV was enabled by adoption of many laws, regulations and strategic documents [23]. Following the governments worldwide that have been making significant attempts to improve the efficiency and effectiveness by making government services and information available on the Internet, Serbia, for only two year period (2010-2012), advanced 30 positions to arrive at 51st in the world rankings for implementing e-Government portal "eUprava" (eng. e-Government) in accordance with a "one-stop-shop" principle [25].

Autonomus Province of Vojvodina (APV) is one of the two autonomous provinces in Serbia characterized by an outstanding national and cultural diversity. In accordance with Serbian Constitution, the Statute of the APV guarantees national equality, multiculturalism and interculturalism.

The Government of the APV is the bearer of the executive powers in the Province and accounts to the Assembly for its work.

The Provincial administration is independent and performs affairs within its competencies in accordance with laws, the Statute and Provincial Assembly decisions and accounts for its work to the Provincial Government.

II. E-GOVERNMENT IMPLEMENTATION IN THE AUTONOMOUS PROVINCE OF VOJVODINA

Government of APV makes efforts to contribute to human, social and economic development in the Province by using ICT to improve government services in order to achieve effects of the use of ICT on various aspects of economic and all other kinds of development [2-4].

Following the example of other countries and available recommendations for e-Government development, but considering all specificities, obstacles and inheritance of the past, the Government of APV have adopted e-Government implementation plan. In Vojvodina, the developing of e-Government was partially conducted through the Program eVojvodina and partly through the implementation of the Strategy of eAdministration of Provincial Authorities Action Plan. The main goal of provincial level e-Government strategy in Vojvodina is to implement software support for activities of provincial bodies and to establish all relevant online public electronic services needed. Economic Development Program (Integrated Regional Development Program - IRDP) of APV for the period 2004-2008 was prepared with the support of the German organization Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ). One of the 14 priority IRDP projects adopted by the Assembly of APV in 2004 was the eVojvodina program, carried out by the Provincial Secretariat for Science and Technological Development. eVojvodina was a pilot of program budgeting. The global economic crisis has significantly affected the economy in Serbia, and for the implementation of the Program eVojvodina, as well as many other activities, there was not enough funding. Ending with 2012th year, budget funds allocated for the Program eVojvodina were almost three times smaller than initially planned amount. Funding and delivery of Program eVojvodina completed at the end of 2012. A number of strategic documents, infrastructure projects, software systems, electronic services and trainings in the field of information technology were carried out within the framework of eVojvodina, which has laid the foundations for the further development of e-Government and Information Society in the APV [26].

On the basis of decision on "Strategy of Provincial Administration Reform and Development" adopted by the Assembly of the APV, the Executive Council of the APV enacted decision on "Strategy of eAdministration of Provincial Authorities" in 2007. This strategic document is in accordance with republic and European standards. One of the basic goals of this document is to improve the quality and availability of information and services provided to users by provincial civil servants.

Office for Joint Affairs of Provincial Bodies is responsible for implementation, maintenance and development of e-Government projects according to "Strategy of eAdministration of Provincial Authorities" and Program eVojvodina. Sector for Information Technologies (IT Sector) is responsible for development and maintenance of common ICT infrastructure of provincial bodies, and for development of the e-Government projects at provincial level. Basic characteristics of implemented e-Government system at provincial level are: interoperability, safety, openness, flexibility and scalability [26]. Considering historical inheritance and economic obstacles, slow progress can be justified, but IT Sector gave maximum effort with respect to these circumstances.

III. ELECTRONIC SERVICE ECOMPETITIONS

A. Grants allocation in Autonomous Province Vojvodina

One of the main responsibilities and goals of provincial Government and administration is to plan, direct and foster development of the Province in all areas. Thus, on an annual basis, provincial bodies provide financial resources for disbursing grants (non-repayable funds) to diverse recipients.

Grants are disbursed by provincial bodies to diverse recipients: local self-governments, nonprofit entities, educational institutions, churches, religious communities, small and medium-sized businesses, or to individual citizens. Provincial administrative authorities grant funds for specific purposes by publishing requests for proposals. Applicants write and submit proposals. Usually, some level of compliance with competition terms is required. After evaluation and assessment of applications by previously defined criteria, reviewers make decision on the allocation of funds. The provincial body (grant maker - funder) signs contracts with selected applicants. Contract realization monitoring and auditing is based on report analysis. These procedures are very similar at different provincial bodies.

In order to improve the efficiency, effectiveness and transparency of the fund allocation process, it was necessary to establish a secure common multilingual electronic public service of the provincial government, which horizontally integrates funds allocations to citizens and business across different sectors.

Main goals and expected benefits of introducing electronic public service were:

- Reduction of the possibility of corruption;
- Transparency of the entire allocation process;
- Control of purposeful spending of allocated funds;
- Publishing of a "black list" (list of negative references) of applicants who have not submitted reports about spending of allocated funds (i.e. a list of applicants who did not meet the contractual obligations).

B. The project eCompetitions

Within the framework of the "Strategy of eAdministration of Provincial Authorities" Action Plan, Executive Council of the APV signed a contract with the Faculty of Technical Sciences (The University of Novi Sad) on the development of the project "Model of a software system for reporting and monitoring the competitions for grants provided by provincial authorities" [27]. The project was completed in September 2009.

Methodology used for project development relies on the following basic principles:

(1) Compliance with current standards that apply to design and implementation of complex software systems;
(2) Capability of seamless integration into e-Government system of APV and Republic of Serbia.

Project defined model of a software system includes the functional aspects, structural aspects, and behavioral aspects of the business process. Model building was carried out through the following activities:

- Surveying the current state;
- Determining the functional requirements;
- Determining of non-functional properties;
- Specification of model in UML.

Survey of the current state provides information on the computer and communication equipment and application software that were used as IT support for fund allocation processes by provincial bodies before the introduction of a software system eCompetitions. Data were collected from organizational units that implement the procedure of funds allocation through verbal interviews with employees and through predefined questionnaires. Survey encompassed also relevant organization structure, business processes and document architecture. The survey was conducted in all provincial bodies. On the basis on survey results, general assessment of the current situation was that the computer and communications equipment is sufficient for service implementation: each employee participating in the process of fund allocation has a computer with satisfactory characteristics, local computer network of provincial bodies and access to standard Internet services was already set up (in the framework of Program eVojvodina), and all administrative employees have attended the training and gained ECDL - European Computer Driving Licence certificate (in the framework of "Strategy of eAdministration of Provincial Authorities").

In order to specify functional requirements an analysis was performed that identifies, defines, systematically describes and unifies actors, activities and documents appearing in heterogeneous business processes aimed at reporting and monitoring competitions for grants that are carried out separately by provincial authorities. Core functional requirements were determined based on contract requirements and legislation relating to the allocation of funds. Detailed identification of requirements was carried out based on interviews with competent employees and paper forms used in relevant business processes in different organizational units.

The project also encompasses analysis of the following non-functional characteristics: interoperability, software architecture, data management, user interaction and security.

The standard language for object modeling - Unified Modeling Language (UML) was used. UML model is generated in Sybase PowerDesigner format.

The project has defined a software model (UML) for managing submissions, decision making, payment and reports in competitions for award of funds, implemented in practice by provincial administrative bodies and organizations. The model includes the functional aspects, structural aspects, and dynamic aspects of the business processes. The dynamic model was constructed to express and model the behavior of the system. The Use Case Models describe the proposed functionality of a new system. The project also defined communication schema between system components.

The project proposed implementation based on the open source software components. This project also specified detailed technical specifications for the procurement of a software system eCompetitions.

Project is based on fundamental principles (scalability, interoperability, use of open standards, etc.) and fully compliant with the latest ICT trends.

C. Implementation of the software system eCompetitions

Due to its complexity, the software system eCompetitions was implemented in two phases. Office for Joint Affairs of Provincial Bodies carried out open procurement procedure for the implementation of a software system based on eCompetitions project as an integral part of the tender requirements, at the end of 2009. The contract was signed with the company „PROZONE" (Novi Sad). The first phase of implementation was conducted during 2010th and the second phase was carried out in the 2011.

Software support for making the decision on competition announcement, the preparation and publication of the call for proposals and receiving and processing of applications was implemented in the first phase. Implementation comprises:

- model and CRUD (Create Read Update Delete) forms,
- process diagrams,
- module for user management and access control,
- module for announcement of open competition,
- module for submission to the open contest.

The second phase comprises implementation of the support for:

- evaluation of applications submitted for the competition,
- decision-making,
- contracting,
- monitoring of grant implementation.

Introduction, testing and adjustment of software system were realized in the first half of the 2011. Also in the second phase was implemented integration with existing software systems of provincial bodies. Training for users and administrators was carried out afterwards.

Verification (simulation of selected examples of business practices) was done by trained employees - provincial officials from the Provincial Secretariat for Education, Administration and National Communities.

D. Basic functional features

System eCompetitions provides software support for a secure common multilingual electronic public service of the provincial government.

Software system eCompetitions supports the entire life cycle of competition for funds in the provincial bodies: the entire process of preparing and publishing call for proposals, receiving, checking and replenishing the applications, processing of submitted documents, establishment of commissions (reviewer selection) and defining criteria for evaluation, automatic selection of the best bids, making bidding decisions, informing applicants, preparation and signing of grant contracts and electronic monitoring of contract execution, disbursement of funds, submission and control of periodic and final reports, archiving, as well as closing the competitions (for award of funds). In addition, system eCompetitions provides provincial bodies (grant makers - funders), with information about the competitions (calls for proposals) that particular applicant has applied so far, a list of

negative references and a list of applicants who did not meet the contractual obligations.

Software system eCompetitions, from the moment of public announcement of call for proposals, through all stages until the archiving, allows monitoring of the procedure status over the Internet. It provides electronic services aimed at information exchange with applicants, in particular assistance powered submissions, as well as application status tracking.

The system enables multilingual support, archiving, defining roles and right accesses for various users and creating of various reports. Digital signature feature guarantees signer authenticity and integrity of electronic documents. The system allows for electronic capture of documents, their electronic distribution, full monitoring of workflows defined in accordance with all relevant business rules, the verification and control of documents according to the rights of authorized users of the system, central archiving and efficient search of the archived documents.

So far the system eCompetitions is integrated with:

- Portal of public services of APV
- Joint post managing office of provincial bodies
- Software system of Provincial Secretariat of Finance (treasury payments)
- Internal PKI system of provincial bodies (electronic signature implementation)
- Web service of the National Bank of Serbia.

E. Software architecture and nonfunctional features

Software system eCompetitions consists of two applications: internal (back office), that is intended for the users employed in the provincial administration, and the external (front office) for applicants (citizens, small and medium enterprises, non-profit organizations, local governments, educational institutions, churches, religious communities, and the other institutions).

Software architecture and nonfunctional features are as follows:

- Multi-tier Web architecture;
- Multiplatform server-side (Windows and Unix);
- Database management system independence; runs on PostgreSQL, MySQL, Microsoft SQL Server and Oracle (current deployment is MS SQL Server);
- Multilingual user interface enabled by UTF8 encoding which allows use of scripts of all languages in official use in Vojvodina (Serbian – Cyrillic and Latin, Hungarian, Slovak, Romanian, Ruthenian and Croatian).
- Information security enabled by the secure client - server connection and data exchange through the HTTPS protocol, using SSL encryption; Web server certificate issued by the Serbian Post Certification Authority;
- Server and client side applications based on open-source technologies;
- Interoperability with other platforms enabled by open standards.

Both applications (back office and front office) are implemented as Java web applications based on multi-tier architecture and open source Java technologies. The middle tier (web and application server) integrates the user interface (client) with the data management (database) system. The Client tier is a web browser that processes and displays HTML resources, issues HTML requests, processes the responses and interacts with the web server using standard protocols.

System architecture (Figure 1) encompasses following components:

- Web server (IIS or Apache, in the demilitarized zone - DMZ) with module (Enhydra Conductor) for communication with application servers.
- Java application server (Enhydra Application Server, [28]) support for robust, multi-layered web applications.
- Client layer - HTML, displayed in a web browser.
- Application solution based on open source technologies supports document and business process management.
- Workflow Engine (Enhydra Shark, [29]) that fully complies the WfMC (Workflow Management Coalition, [30]) specifications and XPDL 1.0 standard (XML Process Definition Language [31]).
- Database server.
- Document repository (file) server - supports multiple protocols for handling documents (local file system, the Universal Naming Convention - UNC protocol).
- Tool for modeling business process definitions (Enhydra JaWE, [32]) - the graphical workflow editor which fully meets the WfMC specification.
- Tool Agents that automatically perform certain actions (sending e-mail, filling contents of the document, etc.).

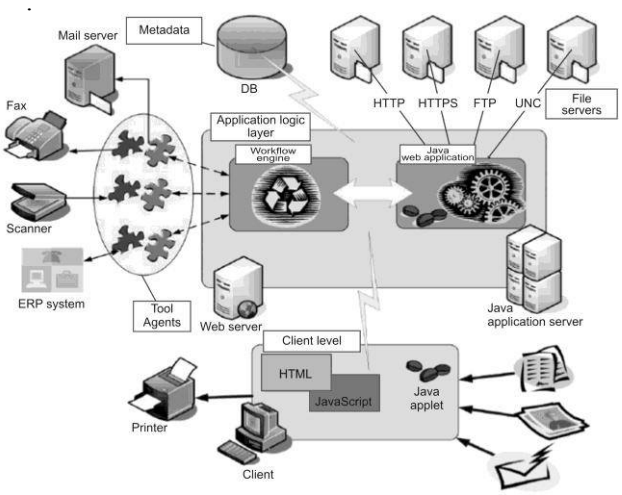

Figure 1. *eCompetitions: system architecture*

Integration of document management system and business process management system is done in two ways: by calling method in a Java library, as well as iFrame integration of document management module in the application, using WebDAV (Web-based Distributed Authoring and Versioning, [33]) and XML (Extensible Markup Language, [34]) standards.

Java standard for multilingual support i18n (Java Internationalization, [35]) is used for the implementation of this solution.

Database independence was accomplished using Enhydra DODS project (Professional Open Source Workflow, Groupware and Document Management, [36]), which allows working with different databases without changing the application source code (only with changes in the application configuration file).

Server and client side applications based on open-source technologies Enhydra Shark (workflow engine), Enhydra JaWE (graphical workflow editor), Spring, Hibernate, Enhydra DODS, WebDAV servlet, XMLC,

Jasper Reports, DWR, JOTM (Transaction Management), Log4J (logging), XMLBeans (working with XML documents), Apache Lucene, Enhydra Snapper (full text search), Enhydra application server (based on Apache Tomcat), Enhydra Director (module that allows working with a cluster of application servers).

Interoperability with other systems is achieved through open XML standards and web services. Web services and Simple Object Access Protocol (SOAP [37]) provide access to the document management functions and business processes management from external applications. Hence, it is possible to exchange data with other systems, import documents into the system, or to export the necessary information and documents from the system.

IV. DEPLOYMENT OF THE ECOMPETITIONS SERVICE

So far the eCompetitions service was deployed in two Provincial secretariats of the Autonomous Province Vojvodina, Provincial Secretariat for Education, Administration and National Communities and Provincial Secretariat for Urban Planning, Construction and Environmental Protection.

Since 2011, Provincial Secretariat for Education, Administration and National Communities carried out 15 open competitions for funds using the eCompetitions system. Provincial Secretariat for Urban Planning, Construction and Environmental Protection used eCompetitions system in 2012 to conduct four open competitions for funds.

Depending on the type of competition, the number of online submissions was between 30 and 1,000 per competition. At the present time (2013), the system eCompetitions encompasses 1459 registered legal entities and 88 authorized employees registered for online access.

Current deployment of the service in two Provincial secretariats has demonstrated its usability by showing that two administrative entities in charge with two quite diverse government sectors were able to carry out successfully their competitions in accordance with their local practice. In both secretariats significant improvements are reported concerning quality of the supporting documentation and decisions on funding allocations.

Full disaster recovery of server environment, which applies to all applications and public services within the information system of Government of APV, is applied to eCompetitions service. Implementation of the Information Security Management System (ISMS) in compliance with ISO 27001 Standard is in progress.

All provincial administrative bodies that carry out the allocation of funds (grants, subsidies, loans) are expected to start using the eCompetitions system during the 2013.

We find as appropriate to mention here that Office for joint affairs of provincial bodies received the prestigious international ICT award "Diskobolos 2011" in the category "Social activities" for the software system eCompetitions. System eCompetitions has also been nominated for the World Summit Award 2013 as the best e-Content example in e-Government & Open Data from Serbia (http://www.wsis-award.org).

V. CONCLUSIONS

The purpose of this paper was to present achieved results and experiences gained in implementation of an important and complex cross-sector multilingual electronic public service.

Based on the strategic recommendations related to ICT policy and standards and annual operating action plans for e-Government implementation in Vojvodina, contemporary methodologies accompanied with international and domestic good practices related to the development of electronic services were used for the project design and implementation of the multilingual provincial electronic public service eCompetitions.

System eCompetitions provides software support for a secure common multilingual electronic public service of the provincial government, which horizontally integrates different sector areas in the field of fund allocation. Improved efficiency in processing applications and in decision-making contribute to the more dedicated and purposeful allocation of funds. The system provides transparency of the work of provincial officials responsible for processing applications and allocation of funds and a list of negative references (i.e. a list of applicants who did not meet the contractual obligations).

The main general conclusion from our experience is that development process consisting of comprehensive project matching previously specified strategic framework for e-Government development and strict management of implementation action plans can result with development and deployment of the complex electronic service within reasonable time limits, even under severe financial constraints.

In addition, we opine that the system eCompetitions has a capacity to contribute significantly to government and public administration thrift by providing support for efficient monitoring of contractual obligations' fulfillments and funds' spendings.

Even though validation of the adoption, financial effects and benefits gained by the deployment of this electronic service have not been studied yet sufficiently, deployment of the electronic public service eCompetitions done so far indicates that this service can contribute significantly to the modernization of the provincial administration in the framework of information society development in the Republic of Serbia and APV.

Experiences gained will be used in the process of introduction of new electronic services in the APV within the framework "Strategy of eAdministration of Provincial Authorities with the Action Plan until 2015" which is "on the anvil".

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