

Online Support for Project Management Developed on Service-Oriented Architectures

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Abstract. Developing web interactive systems is a laborious work that requires the management of complex projects including data models, task models, and the user interface. In this paper are presented the main features of an *online* support system for project management, the system being intended to offer an extended functionality - by the means of a “cluster” of Web services - in handling complex information organized in arborescent structures. The main goal of the project is the implementation of a scalable project management system (within an organization or a consortium) relying on a service-oriented architecture (SOA) that offers compatibility/portability over heterogeneous platforms, Web engines and Database systems.

Keywords: SOA, WSDL, project management

1. Introduction

Developing web interactive systems is a laborious work that requires the integration of several activities in a complex project. The design of a usable system needs to take into account user models, task models, sophisticated data models as well as the user interface (Aquino et al., 2010). The project management is an important activity by itself and requires adequate support.

Over the years, several definitions were formulated for the term of project management. The Government of Romania stated in the "Manual of Project Management", developed in 1998, that project management consists in planning, organizing and managing (control) tasks and resources, aiming at achieving a certain goal, in the conditions of some constraints related to time, resources and costs (Gov, 1998).

Among modern methods used in project management, we recall the method known as critical chain (Critical Chain Project Management - CCPM). This is a method of planning and managing projects, focusing

mainly on the tasks of managing project resources. The critical chain is the sequence of terminal elements depending on the precedence relationships and resources, which prevents the completion in a shorter period of time for a project with limited resources. If resource availability is not a constraint, then the critical chain project is the same as the critical path (Critical Path Method -CPM) (Kelly & Morgan, 1959).

CCPM uses buffer management instead of Earned Value Management to assess the performance of a project. Some project managers consider that earned value management technique is misleading because it does not distinguish progress on the project constraints (e.g. : critical chain) to progress on non-constraints (e.g. : by other means). Event Chain Methodology can be used to determine project size, power and the resource buffers.

The CCPM method exceeded the limitations, focusing in particular on the human resources:

- A better estimate of the duration of project activities, avoiding multiple buffers and accelerating project implementation;
- Increases the capacity of project management, the project manager helps to lead the project daily, due to the global buffer zones;
- A lower vulnerability to various hazards and provide better response to deadlines, without undue stress.

For resources allocated to the project, CCPM is beneficial:

- Prevents conflicts over priorities among projects and project tasks;
- Reduces multi-tasking, lost time and frustration associated;
- The project manager no longer needs to perform a detailed monitoring, but only to focus on the project core tasks.

This material is organized as follows: first, we present the related work in the domain. In the next section we present the developed system. The article ends with the benefits brought by the system and the conclusions of the work.

2. Related work

Software solutions for project management make most of the activities to be automated. Current technology offers features such as project monitoring, site management tasks, workflow management and the analysis of support resources. Information technology is constantly moving, changing and adapting continuously to business challenges therefore it can provide a real

competitive advantage.

Dedicated software in project management (of which Primavera and Microsoft Project are the most commonly used) can do a number of re-planning and calculations with multiple dependencies towards a reference.

2.1 Primavera P6

A tool developed by Oracle, provides a solution of an integrated project portfolio management (PPM) which includes specific tools to meet the needs of every member of the team, responsibilities and authority. This solution uses standard Windows interfaces, client / server architecture, Web-enabled technologies, and stand-alone (SQL Server Express) or network-based (Oracle and Microsoft SQL Server) database. It can handle large-scale, highly sophisticated and multifaceted projects and can organize projects with up to 100,000 activities with unlimited resources.

2.2 Project Insight

Developed by Metafuse, is a cloud project and portfolio management software, designed for organizations that need a powerful solution for their project managers, with an easy interface for team members. Amongst the top features are personalized dashboards, resource and document management, workflows and project collaboration (Project Insight, *).

2.3 Microsoft Project 2016

Is a high performance application to effectively manage projects and resources. The product supports the possibility of collaboration and has a set of graphical tools to improve the planning of the project. The product allows monitoring of project progress at all stages, for better organization in order to complete projects at the right time, within the budget limits (Microsoft Project Standard, 2016).

2.4 Microsoft Project Server 2016

Together with its Cloud version - Project Online, is a flexible, on-premise solution for project portfolio management (PPM) and everyday work. Project Server enables team members, project participants, and business decision makers starting quickly, prioritizing the project portfolio

investments, and delivering the intended business value from virtually anywhere (Microsoft Project Server, 2016).

3. Integrated system for project management - ICISOAP

Considering the premises of project management concepts, it stands out that a project requires planning, activation, control design, detail design, implementation and project completion. This leads to the need of a data warehouse that contains the raw material to be used as a basis for management decisions. Not all the data is intended for full access for all users.

Users Groups

Users are individuals or organizations (e.g. : customers, sponsors, performing organizations or public) that are actively involved in the project or whose interests may be affected positively or negatively, by the performance or completion of the project.

Users/clients - persons or organizations who use Web interface for managing projects.

Project Managers - must manage the overall project, project planning at all levels and related components, handles communication with all stakeholders, particularly the project sponsor, project team and other stakeholders. The manager must provide accurate and timely reporting of project metrics and is responsible for identifying, monitoring, and responding to risks.

An important part of the responsibility of a project manager is to manage stakeholder expectations. The stakeholders may exert an influence on project results and on the project team members. The project management team must identify stakeholders on both internal and external levels, in order to determine project requirements and expectations of every stakeholder. The project manager must manage the influence of various stakeholders on the project requirements to ensure a successful outcome.

Project team - consists of project manager, project management team and other team members performing the work that have a set of specific skills for the project activities.

Operations managers - they have a management role over the entire project management system.

Database of the system

The database of the system, the central component of the portal, stores information related to project management. Based on the information stored,

the system provides timely information to users, a real time update of the information content that is only possible via the methods and procedures for collecting and ensuring compatibility of data from information sources.

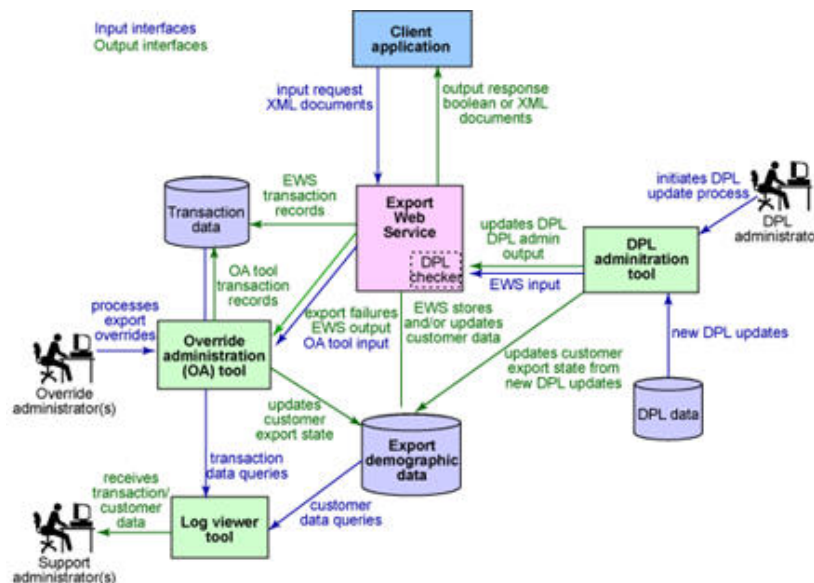


Figure 1. Simple SOA architecture

The database structure is planned around the following entities: - Project (with reference to the project details), Stage; Activity; Institutions; Web Services.

For synchronization between system data and the partners involved, in order to have a common knowledge base, a database was designed with minimal information to be transmitted to the project partners. Based on this database the Web services sends the information from the management.

3.1 Experimental Model based on SOA

The three roles of a service-oriented architecture have been designed (Figure 1):

- Web service provider - creates for each service description (service description - WSDL), which published in the Web service. The service provider may be regarded as server component of client-

server relationship;

- Web service consumer - finds service descriptions published in the register and uses them for the purpose of invoking these Web services. The consumer of services can be considered as part of a client-server client relationships.
- Registry - contains descriptions of the Web services intended for submission. This web service allows consumers to seek collection of descriptions, then, interaction on the Web service invocation is performed between the service consumer and the service provider.
- Our application has several roles, being at the same time Registry of services and Consumer of services. All partner institutions in a particular project represent Service providers. Each institution enrolled in the project management application makes publishing operation services. When a public institution publishes the description of the Web service in the registry, it provides details of the Web service, such as service location and the credentials for the service invoking.
- The consumer of services finds a list of descriptions for each institution services within the project management application.
- The experimental model uses the Web services of each partner to collect information about projects involving partner institutions, and through the application each user sees the updated information on projects. Project coordinators have all the financial data and progress reports of the project phases in one application that communicates through Web services with each partner institution in order to generate progress and final reports of the projects.

In Figure 2 is presented the app architecture based on SOA:

For an efficient exchange of data via the Web using XML, in addition to assigning meaningful XML tags and agreeing their structure, it is necessary to approve a protocol for XML document formatting. This protocol enables the recipient to understand which is the main part of the message and which part contains instructions or extra content. To this end, a simple protocol is used to access objects - SOAP. SOAP stands for **S**imple **O**bject **A**ccess **P**rotocol and it is an XML-based protocol used to exchange data in a distributed environment. SOAP provides a format for exchange of data between clients and services. The basic element of transmission is a SOAP message that consists of a compulsory SOAP envelope, an optional header and a mandatory body [7].

Through the application specific to Web services all institutions involved in project management (coordinator, partners, etc.) can insert information about service providers (partner institutions) and are able to access those services for providing current information to project management. Server-side services are available at each partner institution, through which it provides information on project management, thus offering updated information from each partner institution.

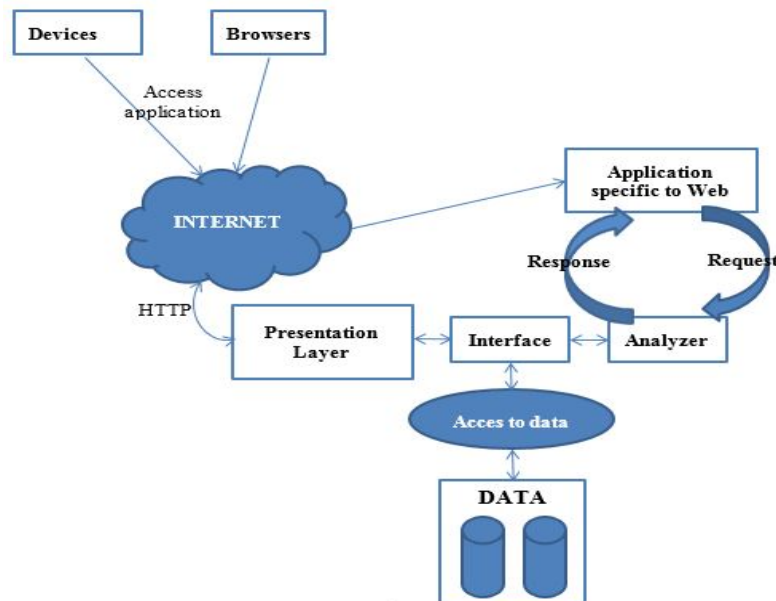


Figure 2. Application architecture based on SOA

An example of a SOAP message for financial return values for a phase by type of expenditure in the context of managing a project: the *<SOAP-ENV: Envelope>*, *<SOAP-ENV: Header>* and *<SOAP-ENV: Body>* mark the envelope, header and body parts that SOAP message.

When a request is sent to a service, information about the format that can be used by service consumer and information on the significance of the application are included in an XML document called WSDL - Web services description language - which contains a description of the Web service interface. The WSDL document defines, in an abstract manner, the actions performed by a Web service and data transmitted to these actions. A WSDL document contains information specified in the description language (Graham et al., 2003).

WSDL defines an XML schema for describing a Web service. The WSDL document defines, in an abstract manner, the actions performed by a Web service and data transmitted to these actions. The actions are represented by operations and data are represented by messages. A customer can call the service operations accordingly to the protocol and message format specified if locates and finds a WSDL document and network address for each port of related operations.

3.2 Specifications for developing client applications for data management

For the project management application, we have implemented and deployed a MySQL database. Development of the user interface was realized in PHP. The application relies on Apache Web server. As concerns the Web services instrument, they were developed in C#.net, catered by IIS and assisted by a Microsoft SQL Server database.



Fig3. Generating reports

In order to manage information, Web forms were built for the purpose of entering information specific to project management. Inserting information is permitted only after a successful authentication as administrator - the master user of the application – carrying full rights over the database. Web forms make possible that all necessary information be kept inside the project management database and monitor project's progress in time. Subsequently,

in order to generate complex reports, data gathered from applications through Web services from each partner institution is also available, in addition to the information already existing in the database.

As for the concrete implementation, only four categories of expenditure were considered in this prototype - *Direct expenses; Logistics; Travel costs; Indirect costs*. By using complex filters and combination of filters, a user can cover the entire range of reports that an institution might require for project management – (Figure 3).

The prototype is based on a service-oriented architecture (SOA). The Web services were developed in C# using Visual Studio.net and can be deployed not only on the servers of partner institutions, but on any machine using ASP.net engine. The application also plays the role of a registry service and allows the partner institutions to generate specific reports. By the means of the Web service system the coordinator can gather, process and transmit any information pertaining to a specific project (phases, activities) to each partner institution.

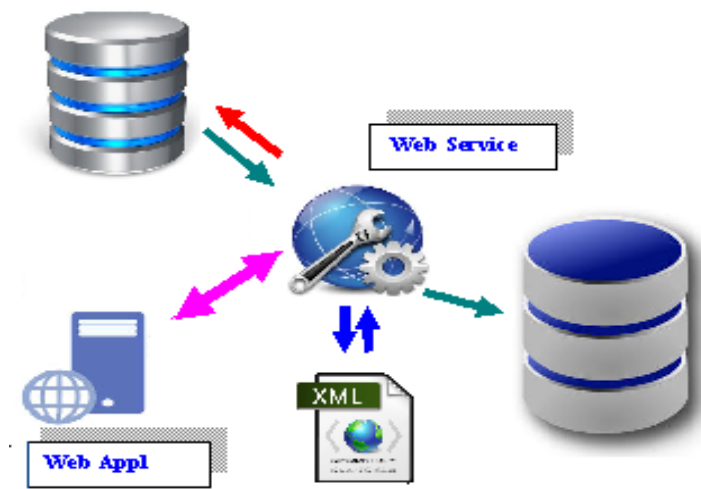


Figure 4. Web service for data exchange between institutions

To synchronize data between the Web application database (MySQL) and that of a partner institution (MS SQL Server), a Web service was designed to receive and traverse an XML file containing project specific information. This provides full compatibility (syntactic and semantic) between the coordinating institution and partner institutions (Fig. 4).

The coordinator can syndicate through web service information about the

project (phases, activities) for each partner institution. The method WriteXMLToDB is called in the web service, the specific location of the partner XML file is accepted as parameter, and the system updates the database of the partner institution with relevant information about the projects.

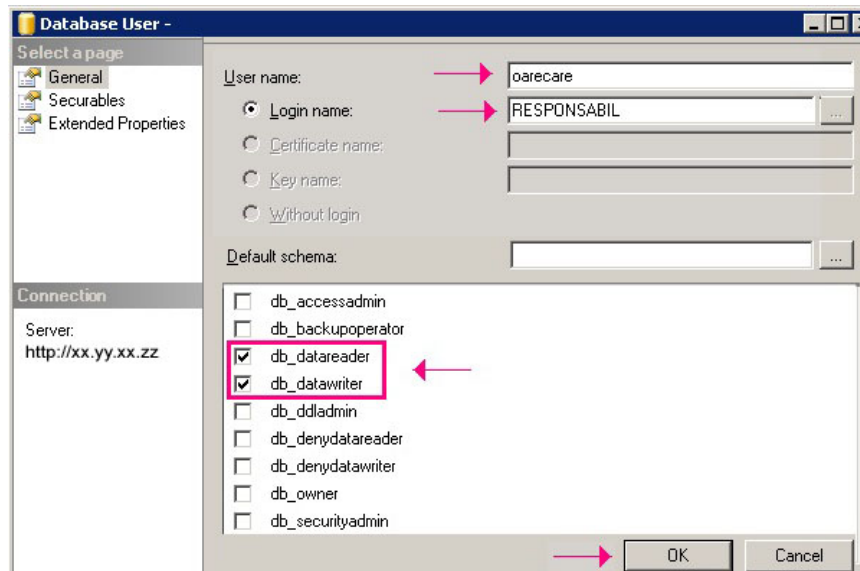


Figure 5. Web service for data exchange between institutions

To synchronize data between the web application database (MySQL), and data from the partner institution (MS SQL Server), a web service was designed to receive an XML file containing project specific information. This provides a common knowledge base and referencing on the easier steps and activities between the coordinating institution and partner institutions (Fig.5).

The XML file is generated specifically for each partner institution and contains projects in which the institution is involved, along with all the information necessary for referencing steps and activities.

4. Benefits offered by the application

The application herein offers the mechanisms to manage a remote collection of projects on which complex operations are performed. The interface is optimized to allow the end-user a neat and intuitive dialog with the server-

side, along with supplementary functionality such as report generation.

The application is versatile, as it includes a functional layer (everything is “translated” dynamically into XML) enabling coherent and consistent handling of data memorized within various Database Management Systems. Through this feature, data repositories belonging to external project management systems can be “plugged” into the application. Furthermore, the Web service engines can be used by other desktop clients or Web applications to perform specific management tasks.

In addition, the Web service functions are able to scan and convert data from NoSQL databases, thus enabling communication with data repositories located in Cloud and which have been designed for this new type of data management system.

The system is capable of smooth communication with potential similar applications written in Java, or Pearl, or Ruby running under their specific Web Engine.

For each SOAP message circulated by the Web services, an encrypted <authentication field> is injected along with a repeatedly changed encryption key, thus ensuring an additional level of security.

5. Conclusions

Project management involves applying specific tools and techniques meant for shaping the structure of a project (defining and connecting activities and resources, etc.) as well as for monitoring the progress thereof. Projects objectives, goals and requirements defined by time, cost, quality and performance parameters are considered important and appropriate activities for funding.

The prototype system has implemented a scalable and service-oriented architecture (SOA) to manage projects in a consortium with different computing equipment and heterogeneous platforms and information.

A Web Service is a *remote engine type* application, residing on a particular machine (*consumers* can access it through HTTP or HTTPS protocols) and *exposing functions* ready to process blocks of complex information sent through a Web request at a certain moment; subsequently, a function may also be instructed to return a value to the remote caller.

The two main components of the application consist of:

- The Web service provided by each partner institution - financial values of each partner are exposed in order to be integrated into the

project management process.

- Service consumer Web app - the team members can access information and generate reports.

We must point out that the application:

- Offers an easy to use interface to ensure the managing process as well as monitor the projects' progress;
- Enjoys fast, optimized algorithms for covering the arborescent structure of pieces of information organized according to the XML/JSON standard;
- Offers data compatibility across-database systems and platforms.
- Is suitable to integrate with other applications from the same functional family through the connection to a prospective Web services bus.
- Meets the security requirements, as in addition to secured protocol uses its own supplementary authentication mechanisms.

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