

# Collaborative Product Development - A Groupware System Based on SOA

Daniel do N. Melo<sup>(1)</sup>, Leonilde Varela<sup>(2)</sup>, S. Carmo-Silva<sup>(2)</sup>  
<sup>(1)</sup> Amazonian CERTI Institute, <sup>(2)</sup> Department of Production and Systems, University of Minho  
<sup>(1)</sup> Manaus, Amazon, Brazil, <sup>(2)</sup> 4710-057 Gualtar Campus, Portugal  
[daniel\\_nmelo@hotmail.com](mailto:daniel_nmelo@hotmail.com), [leonilde](mailto:leonilde@scarmo@dpi.uminho.pt), [scarmo@dpi.uminho.pt](mailto:scarmo@dpi.uminho.pt)

## ABSTRACT

Product Development (PD) can be enhanced through web-based collaboration of working teams. This collaboration enables professionals to work simultaneously on a same project, e.g. the development of a new product. Collaborative PD requires networking resources, and applications needed by collaborating teams in the design and management of product development projects. Using this collaborative approach to PD can bring benefits on cost and speed of development, and also on ideas, all important factors contributing for increased competitiveness of companies and industrial regions worldwide. This is an important objective of the Industrial District of Manaus, Brazil, where the results of the research work reported in this paper are intended to be firstly applied. This work explores two dimensions of the web based PD problem, namely the PD collaboration platform and the PD tasks and information management dimensions. An investigation was carried out into groupware applications and technology and also into tools for managing product development projects. This led to the proposal of a model of a collaborative system for new product development based on both the Service Oriented Architecture and the SCRUM project management framework. This paper describes the specification of software and hardware requirements for the proposed model and the collaborative tools to be used.

## INTRODUCTION

Product development can benefit from internet based collaborative environments. These favour interaction between PD stakeholders worldwide and ideas generation. Such environment can also enhance the product development cycle and achieve levels of speed and quality of product innovation never possible before.

Having into account that product innovation is nowadays probably the major factor of success of companies, investment on the development of suitable collaborative environments for improving new product development process and shortening its cycle is bound to be worthwhile. This work gives a contribution to this area. It proposes a groupware model for a collaborative product development (CPD) system, base on web services and the SCRUM project management tool and methodology [1]. The aims are to help to structure, improve and speed up the whole PD process, from start to end, in the sector of electronics consumer goods and related software. For this, in addition to the communication enhancement, web services and updated information on every PD task or version can be made readily available and accessible to PD stakeholders by this CPD system.

The CPD is based on a PD management structure organized into five phases. These are borrowed from PMBOK [2] published by the Project Management Institute, which describes the nature of the processes of project management in terms of integration between processes, the interactions within them and the objectives they serve. These processes are aggregated into five groups, defined as groups of processes of project management: 1) Initiation processes; 2) Planning processes; 3) Process implementation; 4) Process monitoring and control; and 5) Closing Process.

Thus, the groupware model of the CPD system includes functionalities that follow these process groups of the PD cycle.

In addition to this introduction the paper is organized as follows: First a simplified view of the framework for collaborative work through the web is presented. Then the nature and kind of components for constructing the web based CPD system are described. Before the conclusion we present first a simple view of the system architecture and then a brief description its functional features. The conclusion puts in perspective objectives, achievements and the intended use of the CPD system in the Industrial Manaus District (PIM) of Brazil, and refers the planned near future work

## **THE WEB APPROACH TO COLLABORATIVE WORK**

The term groupware was introduced in 1978 by Johnson and Lenz, as referred in [3], and defined as software components that help professionals in a local-area network to organize their activities to support the implementation of group activities. With the evolution of computer communications and Internet, the concept of groupware evolved. Nowadays, it is identified with collaborative networks and Computer Supported Cooperative Work (CSCW). This is a domain of computer science that studies the use of groupware technology. According to Rama [4] the term collaborative networks are networks based on web technology aimed at increasing the productivity of human resources and running group activities, local or remotely.

Web service technology is used in order to provide tangible benefits to users in the network, allowing them to access and perform their work efficient and quickly through the Internet.

Web services are software applications' components that can be accessed over the Internet for reuse in other applications or to easy interoperability between different application and platforms allowing easy exchange of data between them.

As defined by W3C (World Wide Web Consortium) [5] web services are essentially based on the following standard open source tools or technologies:

- XML (Extensible Markup Language);
- SOAP (Simple Object Access Protocol);
- UDDI (Universal Description, Discovery and Integration);
- WSDL (Web Services Description Language).

Using open standards provides the web service Interoperability between solutions from different vendors, allowing companies to establish partnerships and working groups to collaborate in a more flexible and dynamic way. Moreover, web services enable to combine two ubiquitous technologies: XML, the language of universal data description, and the HTTP transport protocol most widely used by web browsers and servers. These are important features for collaborative environments.

Due to the importance of using web services for CPD the proposed collaborative system explores the Service Oriented Architecture (SOA) technology [6].

Web service specifications are completely independent of programming language, operating system and hardware. This independence facilitates the use of web services on the Internet, through easy access by users and easy release by web service providers.

Figure 1 illustrates a typical web service structure, describing its main functionalities, represented through stages occurring between the web service publication and its utilization by the user. In this cycle a few tasks need to be carried out for a web service to be used: 1 – the web service provider publishes the service in a universal registry, i.e. the UDDI; 2 – (2a and 2b) the user looks for, requests and obtains information about the service and service access; 3 – (3a and 3b) After access request and authorization the service is provided and used.

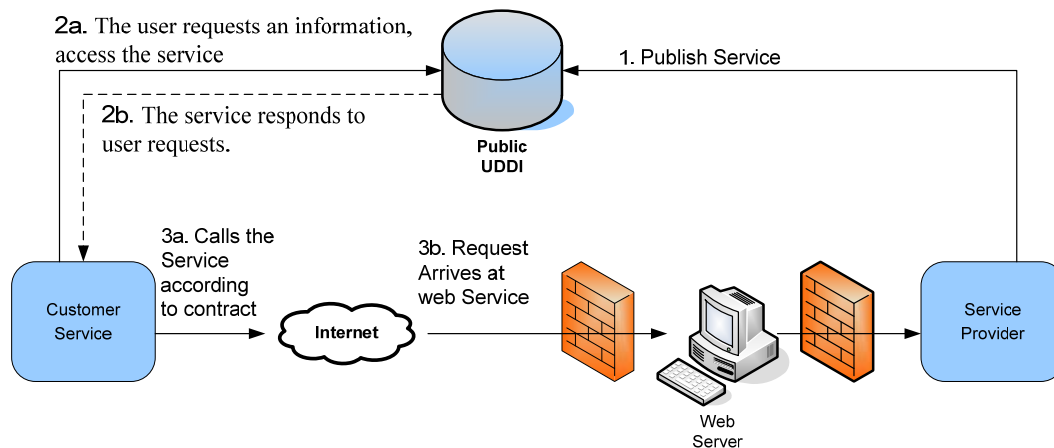


Figure 1: Web Service structure (Adapted from Luo et al. [9]).

According to Papazoglau [7] Service Oriented Computing (SOC) is a paradigm that uses web services as main elements for developing applications, including groupware applications. The author lists the following main characteristics and advantages of SOC:

- Support the development of rapid and low cost distributed applications, enabling massive interoperability;
- Represent platform-independent entities that can be described, published and flexibly integrated with other systems;
- Carry out simple tasks, such as elementary data request um to complex ones, namely, related to highly hierarchical business processes;
- Provide information distribution across independent platforms.

To favour the implementation of groupware requirements, Huhns [8] considers some additional requirements:

- Neutral features concerning technology used, i.e., the access and communication should be based on open standards, such as, protocols, descriptors and discovery mechanisms;
- Weak coupling, i.e., the systems should operate independently. Considering that coupling can occur at different levels, it is important that: only the interfaces provided by the service are used in the services engine, and registration and discovery mechanism decouples the use of the service location, using a transport protocol independent of the platform. Moreover, coupling by the style of invocation can be controlled by the use of asynchronous messages;
- Transparent location, by defining the location of a service through a repository accessible to multiple clients, independently of their location;
- Ability of service composition for the formation of another service;
- Ubiquity of services. Enabling services' access through the Internet anywhere and anytime, worldwide.

The characteristics described above are required for performing collaborative work through web services in secure and agile environments, also enabling effective communication between different data bases, contributing to better PD processes. In this context, Luo [9], reports a web service technology based application of SOC, widely used under the scope of collaborative work. The wide spread use of web services through SOC is due to their capability for enabling integration of heterogeneous and distributed applications over the Internet.

The SOA is a distributed computing paradigm that enables an integrated use of distributed data bases, which are under control by different proprietary domains [10]. Moreover, the use of SOA enables to reuse existing software components and promotes the interaction between different actors involved in the product development process, belonging to different organizations [11].

SOA [12] is an architecture oriented to business applications that include specific

individual processes,. In this context, through the implementation of SOA it is possible to define an architecture that enables integration of different web service systems' components in a flexible and agile way [13].

The choice of SCRUM tool and methodology was based on its suitability for project management agility and for speeding-up the CPD process. This methodology has been intensively used for PD, particularly in the management of software development projects.

## **COLLABORATIVE PRODUCT DEVELOPMENT SYSTEM COMPONENTS**

In terms of implementation, the CPD system is based on the following key requirements:

- Open source software components: related to selected operating system, programming language and database structure that implements the best solution based on open source technology;
- Hardware components: infrastructure for the capture, transmission and distribution of information;
- Collaborative tools: tools, systems or software applications to be integrated into the collaborative system;
- User Interface: graphical interface through which the users are able to access the contents available on the collaborative software.

An important component of the groupware model of the CPD environment is its collaborative system's user interface. The usability of this interface is expressed in terms of the way information can be stored, how easily and appropriately it can be accessed and shared, in order to enable a good CPD system.

A few tools were selected and briefly described. They are considered a coherent and complementary set of tools suitable for integration within the proposed architecture. This is mainly because interoperability among these tools is guaranteed, at a high level. A great contribution for this interoperability is the standard and open source nature of most of the tools and software.

### **Open source software**

Code reuse is a common practice in software development, especially when using programming languages that are already designed for enabling it, as occurs with JAVA programming. This allows faster system development. Moreover, frequently software components already tested are freely available and used. Thus, the CPD system is developed from open source software components that, among other pieces, incorporate:

- An open source operating system, preferably stable and incorporation constantly updated packages;
- An open source web server, which include authentication modules, and several important features for developing collaborative systems, such as, https and tls. This components must be stable, and incorporate constantly updated packages for Windows and Linux environments;
- A default operating system for Mail Servers, although, not always preventing from the existence of other mail servers;
- A programming language for developing the core of the system, GUI (Graphical User Interface), integration with collaboration tools and other software components. Such programming languages typically may include combinations of the following: PHP (Hypertext Preprocessor), Java, Javascript, CSS (Cascading Style Sheets) and XML.

The implementation of the proposed groupware collaborative system adopts the following software components and development tools:

- Linux operating system, which may be chosen from Debian, Ubuntu, Suse or Red Hat, among others;
- Apache Web Server;

- Development of the core of the system by using PHP programming language;
- Development of the system's GUI, by using Javascript and CSS;
- Development of middleware components, by using XML programming language. This middleware layer includes some important components which are important for the communication between the collaborative system itself and the client software SAGLI [14].

## Collaborative tools

The focus of the proposed collaborative system is on providing features and functionalities for improving new product development processes and management. Therefore, open source collaborative tools for project management were studied for incorporating in the CPD system. Among the tools studied, dotProject [15] uses a set of features and characteristics that make it suitable for aiding project management within collaborative environments. In the CPD system the version of this tool developed in PHP is integrated with two other tools, namely Eventum tool [16], which registers and manages the testing functions of software and hardware development. Another tool is Subversion, which produces versions of documents and source codes [17].

These tools will be customized to improve their usability in the context of the CPD system as a whole.

For enhancing the CPD process and meeting the regulations of the Manaus District, where the collaborative system is initially to be applied, the development of the following additional components are scheduled:

- eSCRUM: a software component for information parameterization, namely: schedule, milestones and dates, which enables to perform the automatic project management based on the SCRUM methodology;
- eSAGLI: a software component software (middleware) responsible for the transferring of data from the collaborative system to SAGLI through XML. This feature is necessary for implementing the Law of Computing Developed in Manaus, Brazil.

## Hardware components

In terms of hardware we consider two important components: the physical environment, including equipment and the data link component needed for processing and storing data, as well as for implementing data security features throughout the collaborative system.

In order to provide Internet access to the services available, through the collaborative system, a server with storage and processing capacities is required. This enhances efficiency and speed of running the services accessed.

Figure 2 represents the minimum infrastructure components required for the operation of the collaborative model system. In this configuration the collaborative system is embedded in a server, which is accessed through the Internet by some user and corresponding validating data.

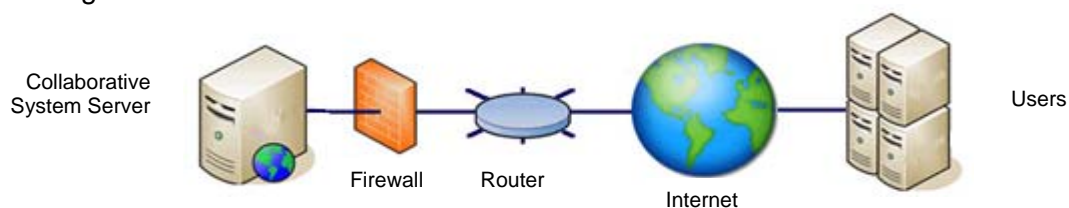


Figure 2: Infrastructure for collaborative model system.

Regarding the security aspect of information contained in the collaborative system, we identified the following software technologies necessary to implement:

- HTTPS (Hypertext Transfer Protocol Secure): an application that aims to ensure security for data transmissions over the Internet;
- SSL (Secure Sockets Layer): a layer to implement privacy and reliability between two application programs that communicate with each other. It runs through various application programs and platforms, based on different operating systems, and enables to establish a process of negotiation and job functions for mutual authentication, as well as data encryption and integrity checking for secure transactions establishment between applications on the Internet.

## ARCHITECTURE OF THE COLLABORATIVE SYSTEM

The proposed collaborative system is based on SOA, as previously referred, and the access to services is performed through the Enterprise Service Bus (ESB). Therefore, each service performs its functions and provides, through the bus, data and information to be used by other services. In this system the JBossESB [18] implementation is also used.

The use of different programming languages between modules can cause a major impact on the integration of the proposed system with other applications. Thus, the implementation of ESB allows all services offered by the collaborative system to be accessed through a common language. Moreover, this makes each service independent, which is also an important feature in this context of a collaborative system.

Figure 3 gives a simple view of the main architecture of the proposed collaborative system. The system that uses ESB is called eSCRUM and uses XML to communicate between system components. An important aspect of this is that the system remains open to possible improvements and insertions of new components with new features for the collaborative system. The eSCRUM enables a language-independence development of the system by providing communication between diverse languages such as PHP, XML, SQL, and HTTP. Additionally, this component will automatically collect information from the collaborative tools, such as dotProject, eventum and Subversion, showing it through a user interface.

The collaborative system's database management application uses the same standards as defined in the ESB reference.

According to Thomas [19], the services are offered by service providers, which provide a distributed computing infrastructure, enabling application integration within and outside of a Internet domain. Client of these services can also be applications that are or not in the field. Thus, there are components in the proposed system's architecture for clients and service providers.

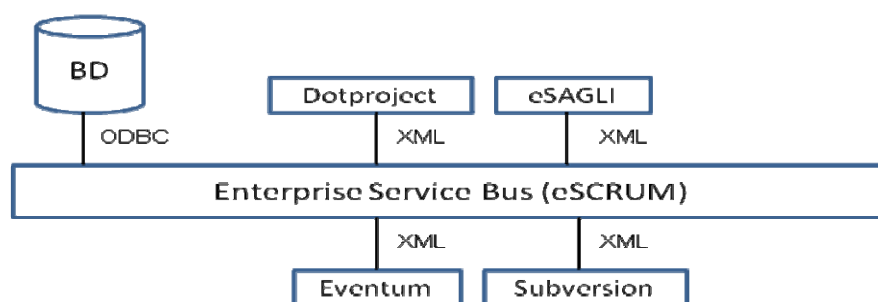


Figure 3: A synthetic view of the CPD system's architecture.

## FUNCTIONAL FEATURES OF THE CPD ENVIRONMENT

The use of the CPD system, including services provided, require the user to perform a number of tasks related with the functional features of the system. These include:

- Authentication password: to create a password for the user, through which the

- collaborative system can be accessed;
- Registration of a company or institution: it allows the integration of cadastral data of the company through a predetermined form;
- Registration of project team: enables integration of data from its users that compose a team through a pre-defined form;
- Registration of the project: it allows the integration of cadastral data of the company through a predetermined form;
- Visualization of projects: the planned projects activities. After the user loges in into the collaborative network, it will enable information about its status in the projects involved, and their activities at that time;
- Configuration of the communication system: allows registering the dates of the project deliverables, types and dates of meetings, with their frequency and duration, among other relevant information, based on the SCRUM methodology. Through this project management features some important functionalities can be made available in an automatic way through several different kind of alerts and generation of graphs and distinct indicators. These eSCRUM components enable:
  - Integration with the open source tool dotProject;
  - Integration with the open source tool Eventum;
  - Integration with the open source tool Subversion;
  - Integration with the client application SAGLI, through a component called eSAGLI.

Figure 4 below shows an use-case diagram [20] for illustrating the main features of collaborative system.

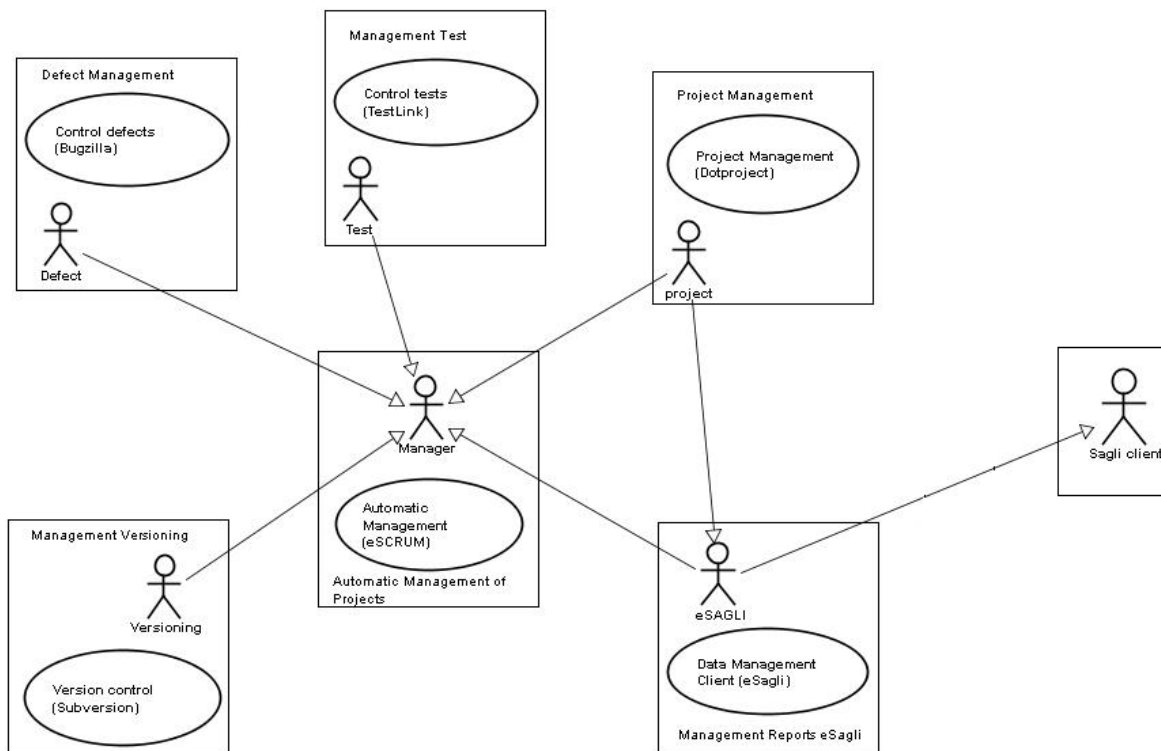


Figure 4: User case of collaborative system.

## CONCLUSION

One important objective of the Industrial District of Manaus (PIM), Brazil, is to increase the quality and the rate of new product development projects as a means of improving

economical and social sustainability and increase competitiveness of the industrial sector of the Amazon region. We are essentially talking about a strategy anchored on product innovation

Product innovation, being nowadays a major factor of success to companies, requires agility and an environment to promote creativity, ideas and improve the management and the speed of execution of new product development projects.

The opportunities put forward by the information and communication technologies together with the tools favouring collaborative work are discussed and explored in this paper as a means to contribute for the PIM stated strategy and objective. Thus, a study was carried out for creation of a collaborative environment for new product development towards improving and speeding management and the whole product development cycle.

This study puts together web and web based project management tools to arrive to what we call a groupware based Collaborative Product Development system. Web services, are used and organized in a Service Oriented Architecture. The components for management of project as a whole and their activities are based on the SCRUM methodology and web tools such as eSCRUM and eSAGALI. This is a tool necessary for, during project management, handling and integrating of data in specific databases, e.g. government and company databases.

Time, costs and development cycle of new PD projects are expected to be greatly reduced through the use of the collaborative system being designed.

At the moment the system is in advanced state of development and it is expected in the near future to test it with one or a few product development projects.

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