ENTERPRISE MASHUPS: A NEW APPROACH FOR BUSINESS SOLUTIONS

EMPRESA MASHUP: UN NUEVO ENFOQUE PARA SOLUCIONES DE NEGOCIO

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Abstract. A mashup is a Web application that integrates content from different providers in order to create a new service which is not offered by the content provider. The development of this kind of applications involves activities such as accessing heterogeneous sources, combining data from different data sources and building graphical interfaces. This factor limits non-experienced computer users to develop these applications. However, nowadays there are enterprise-oriented tools that allow non-experienced user for building mashups in order to respond business needs in an easy and rapid way. Due to this, the enterprise mashup approach has been widely adopted by a large number of enterprises. This paper presents an overview of the enterprise mashup approach, as well as a review of four enterprise-oriented tools which provide a set of features that allows non-expertise users developing mashups into an enterprise. Finally, we present the challenges to be addressed by enterprise-oriented mashup tools in order to provide an easier and faster way of developing mashups.

Keywords: Enterprise Mashups, Web applications.

Resumen. Un mashup es una aplicación web que integra el contenido desde diferentes proveedores con el fin de crear un nuevo servicio que no es ofrecido por el proveedor de contenido. El desarrollo de estas aplicaciones incluye actividades tales como el acceso a fuentes heterogéneas, combinación de datos procedentes de diversas fuentes y la creación de interfaces gráficas. Este factor limita a los usuarios no experimentados en el desarrollado de aplicaciones con en el uso de computadores. Sin embargo, hoy en día hay empresas orientadas a crear herramientas que permiten a los usuarios sin experiencia la creación de mashups para responder a las necesidades de negocio de una forma fácil y rápida. Debido a esto, el enfoque de mashup empresarial ha sido ampliamente adoptado por un gran número de empresas. Este artículo presenta una visión general del enfoque de mashup empresarial, así como una revisión de cuatro empresas orientadas a la producción de herramientas que ofrecen un conjunto de características que permite a los usuarios sin experiencia el desarrollo de mashups en una empresa. Por último, se presentan los desafíos que han de tenerse en cuenta por las empresas orientadas a la creación de herramientas de mashup empresarial con el fin de proporcionar una manera más fácil y más rápida de desarrollo de mashups.

Palabras clave: Empresas massups; Aplicaciones Web.

1. INTRODUCTION

In recent years, the adoption of Web technologies has been incremented, one of the goals of these technologies is to make easier tasks such as create, use, describe, share, and reuse resources on the Web. Due to this, a new approach for Web development called Mashup has emerged. Magazinius et al. [1] define a Web mashup as a Web application that integrates content from different providers to create a new service which is not offered by the content providers. Mashups are gaining popularity and they are applied in a large number of domains, they can be used from normal internet users to professionals or applications developers. This has spurred interest of using these technologies to empower enterprise employees to build applications that provides support to business processes. Mashups approach opens new and broader opportunities for data and service consumers, however, mashup development requires knowledge on three main tasks which are: 1) accessing to heterogeneous data sources such as Web Services, databases, RSS/Atom feeds, HTML pages, to mention but a few; 2) combining data from different sources and 3) building graphical interfaces. Nowadays, there are many research works and industrial tools which aim facilitating the mashup development, in particular to users which do not have programming knowledge allowing them respond to a personal or business needs.

This paper presents an overview of the enterprise mashup approach, as well as an overview of four enterprise-oriented mashup tools. This work is structured as follows. Section 2 presents related works of enterprise-oriented mashup development. Section 3 provides an enterprise-oriented mashup classification. Section 4 presents an overview of enterprise-oriented mashup tools. In section 5, the challenges on enterprise-oriented mashups tools are presented. Finally, we present our conclusions and emphasize our contribution.

2. RELATED WORKS

Nowadays, there are research efforts which aim to help enterprise employees develop applications that integrate data from heterogeneous data sources in order to solve business needs. Some of these efforts are focused for providing a mashup architecture. Chudnovskyy et al. [2] present an approach to support business processes integration and execution using services that provide communication and collaboration support and Web mashup techniques; also, they define a mashup reference architecture and derive a dedicated mashup execution platform. Soriano et al. [3] present EzWeb, a reference architecture and implementation of an Enterprise 2.0 Collaboration Platform that allows users co-produce and share instant applications. Maraikar et al. [4] present a service composition platform called SABRE. This platform provides tools to combine, filter, and transform Web services and data sources in order to build situational applications for business.

Other efforts addressed to develop enterprise-oriented mashup tools have been reported in the literature. López et al. [5] present the design of an enterprise-oriented mashup tool that provides components for accessing heterogeneous sources, a component to combine data from different sources and component for building the graphical interface. Altinel et al. [6] present a lightweight enterprise data integration service called Damia, this service allows users creating and cataloging high value data feeds for consumption by situational applications into an enterprise. Huang et al. [7] propose a system called SituMash which includes context representation, situation reasoning, workflow planning and mashup optimization. This system provides support for the automatic composition of widgets in response to situation changes without user manual selection. Abiteboul et al. [8] present MatchUp, a system that supports rapid, on-demand, and intuitive development of mashups, based on an autocompleting mechanism. MatchUp predicts, given a user's partial mashup specification, what are the most likely potential completions for the specification.

Hoyer et al. [9] propose a reference model for Enterprise Mashups that provides a foundation to develop and analyze grassroots Enterprise Mashups environments from a managerial and collaborative perspective. Xu et al. [10] propose a lightweight process modeling approach for process enterprise mashup applications; this approach pretends support collaboration among users with different levels of modeling skills and expertise in a virtual enterprise environment.

In table 1, a comparison of the aforementioned works is presented; these works represent a great effort in order to involve all enterprise users on the development of applications. However, these works have several drawbacks, such as: a) a vast amount of technologies and Web data sources are not included, b) lack of usage for advanced capabilities of rich Internet application technologies, and c) Web development experience required. These deficiencies can be solved by extending the capabilities of integration with other technologies and data sources, and using graphical and friendly interfaces, which are necessary in order to improve the non-expert user's experience. In the following section, an enterprise-oriented mashup classification is presented.

TABLE 1. An overview of enterprise mashup development

Proposal	Approach	Drawbacks
Chudnovsky et al [2]	Business processes integration and execution	The architecture is focused in using an specific telecommunications service (Telco)
Soriano et al. [3]	Knowledge workers as co-producers of software services and applications	Few data sources are considered and there is little support for building graphical interfaces
Maraikar et al [4]	Combine, filter and transform Web services and RSS and Atom feeds	Reo language knowledge is required, few data sources are supported
López et al. [5]	Enterprise mashup tool to build graphically mashup applications	It has support limited for building graphical and friendly interfaces
Altinel et al. [6]	Data integration service for business users	It has not support for building graphical interfaces and few data sources are considered
Huang et al. [7]	Automatic composition of mashups in response to situation changes	Few data sources are considered.
Abiteboul et al. [8]	System for mashup development based on an autocompletion mechanism	Friendly and intuitive graphical interfaces are not provided.
Hoyer et al. [9]	A reference model for Enterprise mashups from a managerial and collaborative perspective	Narrow application of the reference model in other areas and its verification in an iterative design cycle
Xu et al. [10]	Process modeling for process enterprise mashup applications	Process modeling skills and BPMN (Business Process Modeling Notation) Knowledge required

3. ENTERPRISE MASHUPS

Mashup is a new approach which has emerged in recent years and its use in enterprise environments increases every day. Vrieze et al. [11] identify four kinds of Enterprise mashups which are described next.

Business process mashups. These mashups coordinate different orchestration events, allowing a user to automate tasks that involves getting information from different data sources, aggregating, filtering, and shaping it, and then sending the result to several destinations. These kinds of mashups allow users specifying this execution himself, which will be executed as if the tasks were manually performed by the user.

Front-end mashups. These mashups aim monitoring business process in order to help technical leads in lines of business. They perform business intelligence tasks by retrieving information from different data sources, processing this, and then visualizing the results. An example of this kind of mashup is the overlay sales data on a map.

User interface mashups. Many business process tasks require the entry, editing, and approval data; this kind of mashups help the aforementioned tasks, due they function as user interfaces for data entry.

Knowledge mashups. These mashups are used on management of knowledge within an enterprise. Knowledge mashups allow users collaborating among

them. They provide social features allowing that members of different departments know what others departments are doing, the data synchronization among them, to mention a few tasks.

4. ENTERPRISE-ORIENTED MASHUP TOOLS

The enterprise-oriented tools have been primarily focused on creating an architecture that supports common processes and store data. According to Hoyer and Stanoevska-Slabeva [12], from an architectural perspective the enterprise mashup stack consists of three layers, which are described below.

Resources. It is the lowest layer and contains data or application functionality which represents the core building blocks of Enterprise Mashups. These sources are primarily accessed through APIs.

Widgets. Widgets provide applications on domain functions or data specific functions. They provide graphics, simple and efficient user interaction mechanism. They have been focused on consumption and customization in order to ensure flexiblility and reusability. However, software vendors such as Microsoft©, IBM©, or Google© define their own widget model.

Mashup. The users are able to define behavior according to their needs through assembling and composing a set of widgets. Also, by aggregation and linking of widgets in a visual and intuitive way, users can solve heterogeneous business problems.

In addition to the architecture layers aforementioned, the user needs of collaborative mechanisms, since collaboration is becoming in an essential element for improving productivity and accelerating innovation at the enterprise. The emergence of Web 2.0 has opened up new ways of collaboration. An environment in which workers are considered as co-producers of software services and applications through which take competitive advantages and meet business needs without involving IT departments.

Enterprise collaboration has obtained benefits from the emergence of a new approach called Enterprise 2.0 [13]. This approach provides to enterprises with models and tools for collaboration and co-creation. Some examples of enterprise collaboration tools are social linking and tagging tools such as social networking, social bookmarking and social search. These tools offer support for comments and voting, content management platforms such as wikis and forums, and information distribution tools such as RSS/Atom feeds. Nowadays many enterprises have deployed collaboration platforms, which provide collaborative services for knowledge workers. Besides, another fundamental element that have been provided to the enterprise employees is the chance of remixing and integrating already available services through enterprise mashups and collaborative resource repositories. A set of enterprise-oriented mashup tool that provides some of the features aforementioned are presented below.

Apatar©. It is a Java-based open source data integration software package which provides support to work with data of several data sources and formats [14]. Apatar© have a robust, scalable architecture which allows carrying out tasks such as extraction, transformation and data load for warehousing, as well as the migration, synchronization, and application integration. Apatar provides solutions form Application Integration, Salesforce and QuickBooks Synchronization, Mashup Data Integration, Data Warehousing and Analytics, Operational Integration, and Embedded Data Integration. This tool provides Enterprise 2.0-class middleware which allows developers accessing data both on a local network, an on-demand applications and Cloud systems such as SalesForce.com and SugarCRM. On Apatar, the mappings and transformation rules are graphically defined through a drag-and-drop interface, this feature allows non-developers developing data mashups. Apatar provides support for operating systems such as Windows, Linux RedHat, SUSE Linux, and MacOS, besides, it provides three different deployment options, which are: 1) desktop application, 2) server engine on JVM (Java Virtual Machine) and 3) embedded into third parties software.

IBM Mashup Center. It is an enterprise-oriented mashup platform that allows creating, sharing, and discovering reusable application building blocks such as widgets, feeds, services or mashup applications, these blocks can be assembled into new applications or leveraged within existing applications *[15]*. IBM Mashup Center provides the next main components: (a) Mashup Builder is a widget-based browser interface that allows creating, assembling, configuring and designing widgets, gadgets, mashup pages, and spaces, besides it allows searching widgets and add them into mashup pages; (b) Widget builder is a browser-based tool that allows both business users and Web developers creating widgets and sharing with the community; (c) Catalog is a repository that allows sharing, reusing and discovering widgets, it includes features such as ratings, tagging, and commenting; (d) Feed generator is a wizard-based interface that allows creating consumable feeds from enterprise data sources; and (e) Data mashup builder is a browser-based tool which allows mixing, merging, grouping, filtering, sorting and transforming feeds, with the aim of provide a single view of disparate sets of

information. IBM Mashup Center provides support for operating systems such as Microsoft Windows, AIX (Advanced Interactive Executive) and Linux.

JackBe Presto. It is an enterprise-oriented mashup platform that allows developing enterprise applications which integrate data from live information data sources *[16]*. Also, this tool enables users to visually assemble applications for business. The applications developed with Presto can be used in portals, Sharepoint, desktop, spreadsheets, Web sites and mobile devices. JackBe Presto provides a set of tools that allows carrying out the aforementioned tasks, these tools are: (a) Presto Wires allows developing data mashups, its interface is completely drag-and-drop and it provides virtual representation of data sources regardless of their type (RSS, REST, SOAP, XML, HTML); (b) Mashup Maker is a Web-based editor that allows defining applications using EMML (Enterprise Mashup Markup Language); (c) Presto Mashup Studio is a plugin for Eclipse IDE which allows designing, testing, debugging and deploying mashups, besides, this tool allows creating mashups from scratch, anhancing mashups created by Presto Wires, and reusing applications developed by other users; (d) Presto App Maker allows analysts creating visually-rich applications from mashups without developer assistance; (e) Presto Mashboard allows business users select apps and drop them onto a WYSIWYG dashboard canvas with the aim of covering requirements related to report and data-viewing; and (f)

Presto App Depot is a self-service in-house store that allows finding, using and sharing applications across an organization.

WaveMaker. It is a development platform form Web and Cloud applications, it provides visual and drag-and-drop tools which allows building Java-based mashups *[17]*. WaveMaker Studio allows building applications which can be extended by expert developers using a Java IDE. WaveMaker provides security, data access and scalability through Java-based components. Furthermore, it provides support for Web application servers such as Tomcat, JBoss, GlassFish, WebSphere and WebLogic, and for databases such as MySQL, PostgreSQL, HSQLDB, Microsoft SQL Server and DB2.

The data sources supported for an enterprise-oriented mashup is a fundamental factor to consider when a tool is elected for its implementation into an enterprise. In Table 2, a comparison of the aforementioned tools is provided; this comparison is carried out through the technology and data sources supported.

The enterprise-oriented mashup tools reviewed provide a great support for a great number of data sources; also they allow integrating other technologies. Furthermore, these tools provides a great support for building the graphical interface, all this turning them in powerful tools that allows even non-expert users developing mashups that point to business problems or needs.

TABLE 2. Enterprise-oriented mashup tools comparison

Mashup tool	Technology	Data sources supported
Apatar	Java	Salesforce.com, Centric CRM, Databases (MySQL, Dbase, Oracle, PostgreSQL), Structured/ Unstructured files (XML, CSV, TXT, MS Excel, EditGrid), Web destinations (Flickr, Amazon S3)
IBM Mashup Center	IBM WebSphere Application Server, Derby	Sharepoint, MW, Filenet, spreadsheets, Atom, RSS, JSON, XML, Databases, Google gadgets
JackBe Presto	Java, HSQL database, Apache's Tomcat Servlet Container, EMML	Sharepoint, portal platforms (IBM, JBoss, LifeRay), Oracle 9i/10g/11g, Oracle Fusion SOAs, Oracle Applications, Excel
WaveMaker	Java, JavaScript	REST Web Services, SOAP Web Services, MySQL, PostgreSQL, HSQLDB, Oracle, Microsoft SQL Server, IBM DB2

5. ENTERPRISE MASHUPS TOOLS CHALLENGES

The mashup developed with any enterprise-oriented tool can contain valuable enterprise data, so these tools have provided good security mechanisms such as authentication and authorization, besides, the applications developed are shared between employees across an organization as well as external customers, partners, and suppliers, so the security must be provided regardless of where the applications is being accessed.

The popularity of mobile devices grows daily; due to this an important challenge of enterprise-oriented mashup tools is the use of lightweight Web services that allows the mobile collaboration, as well as the development of intuitive and easy mobile applications that do not represent an obstacle for non-expert users.

The support to build graphical interfaces provided by the enterprise-oriented mashup tools is still limited; so it is important include RIAs (Rich Internet Applications) features in order to provide a better user experience. Also, sometimes the applications developed require the input of data from users, so, is necessary provides validation mechanism for the input data, taking into account that such applications will be developed by non-expert users.

Other important factor to be considered by these tools is the opportunity of providing recommendation mechanism that allows users get potential mashups allowing reusing these components in order to respond to a business need in a faster way.

It is important to take into account the aforementioned challenges, because this allows enterprise get an environment where all its employees collaborate with the solution to business problem or needs, and thereby improve the enterprise productivity.

6. CONCLUSIONS

Enterprises take advantages of mashup approach because it allows employees respond to a business need in a collaborative, easier and faster way. Day-to-day new development tools, languages, methodologies and initiatives emerge with the aim of facilitating the enterprise mashup development. This works introduces the mashup approach and provides a perspective of some of the most mature enterprise-oriented mashup tools. These tools widely vary in terms of services and features provided, and the knowledge about them helps developers and IT consulters to select a tool for its implementation into an organization in order to improve the enterprise productivity. Despite the advantages provided by these tools, they represent a great financial investment; which limits small organization to acquire such tools. Also, it is very important allow both expert and non-expert users collaborating between them with the aim of getting a feedback about the strengths and weaknesses of these tools with the aim of improving these tools allowing respond to the constant changes that can occur in the enterprise area.

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