Exploiting Mashup Architecture in Business Use Cases

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Abstract— **Evolution of Service Oriented Architecture has changed the outlook of business models. The business processes and services are not limited at organizational level any more, but they can also be used by external partners. Modern business solutions may be composed of many services that are provided and supported by physically distributed business partners. On the other hand customization and personalization of services are not the first priority of service providers which has made the application of services by end users more difficult. By the emergence of Web 2.0, business processes can benefit from more efficient communication methods. The shift away from traditional Web 1.0, is forced by the growing need for more efficient information sharing, collaboration and business processes. Mashup Architecture is one of the outcomes of Web 2.0 paradigm that has been widely accepted and used for user-centric information processing. At the moment mashups are mainly used for less fundamental tasks such as customized queries and map-based visualizations; however it has the potential to be used for more fundamental, complex and sophisticated tasks too. In this paper the latter aspect of Mashup architecture will be discussed in more details and the role it can play in business processes will be tailored with some specific use cases.**

Keywords- Mashup; SOA; Web 2.0; Semantic Web; Ontology; Business Process; Business Intelligence

I. INTRODUCTION

Back in 1960s, Doug Engelbart coined the collective IQ of organizations and of society as a grand challenge [1][2] and the Web 2.0 is an attempt to come a step closer to this vision. It is believed that central principle behind the success of the giants born in the Web 1.0 era who have survived to lead the Web 2.0 era appears to be this, that they have embraced the power of the web to harness collective intelligence [3].

The Web 2.0 has set a new trend in Rich Internet Application (RIA) world. It makes better use of the client machine's processing power and at the same time pushes the SOA paradigm to its limits. In this context, Internet will play the role of a global operating system that hosts the web services. In other words, the Web 2.0 fosters the global cloud computing idea where business services are presented on Internet and developers should select and weave them together to create new compound services. The most "Web 2.0"-oriented, exist only on the Internet, deriving their effectiveness from the inter human connections and from the network effects that Web 2.0 makes possible, and growing in effectiveness in proportion as people make more use of them [4].

Thus Web 2.0 is much more than adding a nice facade to old web applications rather it is a new way of thinking about software architecture of RIAs. In comparison to traditional web applications, the application logic of modern Web 2.0 applications tends to push the interactive user interface tasks to the client side. The client components on the other hand negotiate with remote services that deal with user events.

A set of six key business applications are motivating overall RIA spending, consisting of enhancement of existing web applications, high-transaction and event-driven Internet applications, next-generation portals, enhanced business intelligence solutions, application modernization, and peer-to-peer or mashup solutions. Market analyzers expect spending on each of these areas to increase rapidly over the next three years, exceeding $500 million by 2011 [5].

At the moment most SOAs are locked in small trusted network of organization applications and big companies have a complex stack of technologies to realize SOA-based scenarios. Thus, despite the advantages of Web Services, utilization of SOA services is not easy enough and requires deep understanding of underlying technologies and programming specifications. As a matter of fact the most corporations, implementing a successful SOA will require the service-enablement of their existing applications [33]. Mashup is an emerging technology that aims to bridge this gap by providing a user-driven micro-integration of web-accessible data [6]. The term mashup is originating from music industry where a song or composition is created by blending two or more songs, usually by overlaying the vocal track of one song seamlessly over the music track of another [7]. Mashups owes its popularity and fast improvements to its two basic blocks namely Web 2.0 and SOA. Mashup envisions building effective and light-weight information processing solutions based on the exposed web services of organizations. Such web services may range from simple web services such as RSS [8] and REST [9] based services to complex BPEL services for more serious use cases; however the Mashups benefits in the latter use cases is not yet known to IT decision makers. According to market research reports, this situation is going to change quickly in the coming years. Mashups are identified among top 10 strategic technologies for 2009 [10] and it is expected that by 2012, one-third of analytic applications applied to business processes will be

delivered through coarse-grained application mashups" [11]. The power of mashups is also being examined in real world information management scenarios and has attracted many attentions. For instance recently the Sunlight Labs [16] together with Google, O'Reilly Media, and TechWeb have announced a special contest called "Apps for America 2" [17] to create useful mashup of the Data.gov data resources. Data.gov is a high value, machine readable dataset generated by the Executive Branch of the U.S. Federal Government [18]. The challenge aims to demonstrate that when government makes data available, it makes itself more accountable and creates more trust and opportunity in its actions [17].

Mashups can be applied to a broad spectrum of use cases ranging from simple data widgets to more complex use cases such as task automation and system integration. The mashup applications can be roughly categorized under the following groups:

- Consumer Mashups (Presentation Mashups): are the simplest group of Mashups that are used to facilitate the creation of information portals from different resources for presentation purposes. This group of mashups have the lowest degree of customization and are usually implemented as pre-built widgets that can be added to user interfaces. A well-known example of consumer Mashups is iGoogle [12] that is a personal web portal with capability of adding web feeds and Google Gadgets such as email, scratch pad, news, weather, etc.
- Data Mashups: which are used to integrate the data and services from different resources such as Web Services, RESTful APIs, Web Extractors, RSS Feeds, etc. These kind of mashups aim to facilitate the data access and cross-referencing between resources. They may also benefit from presentation gadgets or visualization APIs to deliver the results. Nowadays a handful of mushable resources are available on the web and plenty of useful Mashups has been created using them. A good example of data mashups is geo-based Mashups that map information from different resources on web-based maps such as Google Maps [13] or Yahoo Maps [14]. Fig. 1 shows the top APIs for Mashups and their percentage of utilizations in community created mashups [19].
- Enterprise Mashups (Logic Mashups): always involving programming and therefore they are the most complex mashup category. They connect two or more applications, automating certain tasks, and include awareness of workflow [15]. Enterprise mashups usually depend on some server-side components and compete with data integration and service orchestration technologies such as BPEL and Enterprise Service Buses (ESBs).

To effectively adopt the Enterprise Mashups in organizations the following "Five Cs" principle is used to identify the different enterprise requirements [6]:

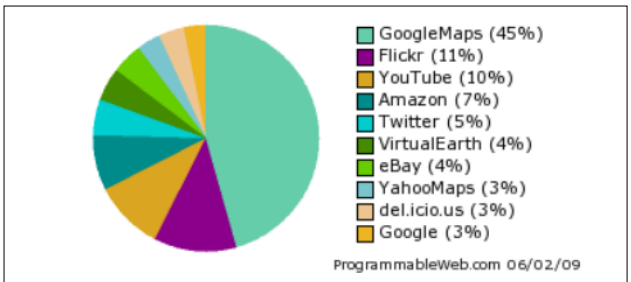

Figure 1. Top APIs for creating Mashups

- Consume: Users need to consume public and private Web-enabled SOA-style services and mashups on demand.
- Create: Users need to create new enterprise mashups from existing SOA-style services and mashups, preferably in a visual editor.
- Customized: Users need to customize (e.g. filter, annotate, etc.) existing mashups and create variants which can be published visually in standardized user-interfaces such as portals.
- Collaborate: Users need to tag, describe, publish, and share their mashups with others in their community.
- Confidence: Users need to be confident that all mashup consumption, creation, customization and collaboration occur in a secured and governed environment.

In the rest of this paper we will have a short survey of main mashup solution-providers. Then some personal and business use cases will be discussed that may benefit from mashup architecture. This paper mainly focuses on the concept of Semantic Mashups which is introduced as a key enabler for business mashup repositories.

II. STATE OF ART

Today organizations are confronted by business pressures to decrease costs, reduce workforce and transform their business from an internally focused organization into a service oriented and customer centric organization, which target the need of their customers. Therefore organizations have to deal with different domains and bring them together which in turn means also dealing with lots of common business process concepts and architectures.

SOA (Service Oriented Architecture) and RIA (Rich Internet Application) are leading to standardized access to business functionality and data with desktop-like interaction over Web. But for users like non IT-experts, it's really difficult to use these new technologies to improve their daily business. Companies, who are using and "living" the SOA approach to get faster business responds and cost reducing effects, have the problem to manage and provide information on how the services interact and whether they are used in a right way. Mashups enable users to get access to data sources through SOA by a user-driven Process with short development cycles for new Mashup applications.

One of the Web2.0 pioneers in the last few years is Google. Google started with a native web application – a revolutionary search engine – which was delivered as a

service to the private market. At this time Google was not focusing on Web2.0 and therefore did not put too much emphasis on topics like web standards, social communities or web services.

In the course of years Google come up with a handful of user-centric Web2.0 projects such as Blogger, online collaboration tools, Google Earth, etc. This mushrooming of projects led also to Mashup solutions with a focus on the web user. Application areas of their Data Mashup solutions are Google maps and the Google Mashup Editor (which will be integrated to the Google App engine). Especially Google Maps can be seen as the initiator of this trend. Users got easy and intuitive access over their web browser to an amazing application per moving around on the map. For this reason users wanted to have also access to company data, data from other sources, feeds, services, etc over web and as easy as Google maps.

Companies like Yahoo with Yahoo! Pipes [21] and Microsoft with Microsoft Popfly [20] developed web based data Mashups. These Mashup solutions are really easy to use via a visual programming environment to integrate data from different sources like WebPages, RSS feeds or web services. With Microsoft Popfly (in BETA phase) users can additional to Mashups also create web pages and games and share them with other users. Popfly is based on the Silverlight technology. But for presentation reasons besides Silverlight also AJAX und DHTML are available. With Mashups, Microsoft also tries to expand the Windows personalization features by giving the user the possibility to embed Mashups in the Windows Sidebar. Therefore users can get access to created Mashups directly through their personalized desktop environment.

A newcomer to the market of Mashup solutions is Intel with their product so called Intel Mash Maker [23]. Intel developed an innovative service which allows users to extract content from websites and merge them with the Intel Mash Maker solution in a user friendly and intuitive way. The Intel Mash Maker can be installed via browser plug-in on all common web browsers in the market. This integration to the web browser brings personalization possibilities directly to the end-user. Especially using existing websites and enriching them with new and personalized information is a strengths point of Intel's solution.

Compared to Presentation- and Data Mashups, Enterprise Mashups have the pretension to deliver content and services with the necessary grade of automation. Enterprise Mashups solutions have to provide in addition an easy way of collaboration and documentation with an adequate conducted support. JackBe [24] is one of the leading Mashup Solution providers on the business market. With their enterprise mashup solution Presto, they are focusing on enterprise customers, especially companies with an affinity to Web2.0 and the necessary enablers like SOA and RIA. JackBe's solution is not considering the personalization and user-centric aspects of mashups. JackBe has a data-driven approach by offering a lot of integrated data connectors. The server-side mashup components facilitate the exchange and reuse of created Mashups for internal and also external use cases in a secure and trustworthy way. Serena, playing in the same league as JackBe, is more focusing on the user-centric aspects of mashup solutions via their Mashup Composer application. Serena's solution enables users to design Mashups via a graphical interface to automate business activities.

Another important player in this market of enterprise Mashup solutions is IBM. Recently IBM has developed a number of Web2.0 and Mashup products such as QEDWiki [22], Lotus Mashup, etc. Lotus Mashup is an enterprise-grade Mashup editor developed and distributed by IBM as part of the IBM Mashup Center solution [25]. Parts of the suspended QEDWiki are also integrated into the IBM Mashup Center. They main focus of IBM lies on integration of different data sources, creating so called widgets and make them shareable for other users.

Some other Mashup providers such as Kapow technologies [26] have focused on Web Intelligence solutions that cover features from all three kinds of mashups. Kapow Mashup Server offers access to different data sources and services where users can easily access content and analyze data on their desktop. Especially monitoring and management tools can be integrated with the necessary scalability, high availability, security and automation.

The evaluation matrix (Table I next page), delivers a survey of Mashup products according to the different functionality features of the three mashup categories introduced.

The result of the above table is summarized in fig. 2 which clearly shows the priority of introduced mashup categories for different mashup providers.

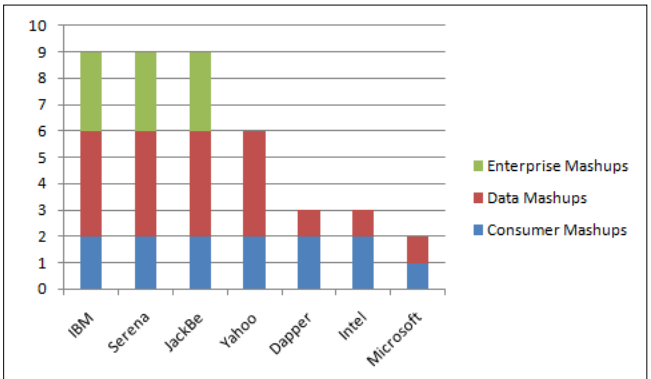

Figure 2. Mashup product classification

III. SERVICE PERSONALIZATION USE CASES

As business processes gets more complex and publicly available, there is a growing need to customize the business processes according to user requirements. The underlying reason for customization is the fact that business processes often do not match exactly to the customer needs [35]. Most of today's business processes are still mainly designed to satisfy the mass of users. Unfortunately customization and mass generic production are at odd with each other. As a matter of fact IT solutions typically focus on 20% of user requirements that affect the most users and the long tale of requirement is usually ignored by IT providers.

TABLE I. COMPARISON OF MASHUP PRODUCTS

Mashup Type	Feature / Product	IBM Mashup	Serena Presto	JackBe	Yahoo pipes	Dapper	Intel Mashup	Microsoft Popfly
Consumer	Visualization Widgets	✓	✓	✓	✓	✓	✓	✓
	Screen Scrapping	✓	✓	✓	✓	✓	✓	×[a]
Data	Visual Data Assembly	✓	✓	✓	✓	✓	✓	✓
	Use Web 2.0 Resources	✓	✓	✓	✓	×	×	×
	Advanced Data Aggregation	✓	✓	✓	✓	×	×	×
	Advanced Data Flow	✓	✓	✓	✓	×	×	×
Enterprise	Workflow	✓	✓	✓	×	×	×	×
	Enterprise Integration	✓	✓	✓	×	×	×	×
	Server-based	✓	✓	✓	×	×	×	×

a. Microsoft Popfly can indirectly support screen scrapping via embedding Dapper artifacts

Some field studies has shown that the "Hidden Costs of Information Work" in an organization with 1,000 employees is over $10 million annually for reformatting and recreating information [30].

Current solutions for solving data integration issues are Enterprise Service Buses and Business Processes Engines that are rather expensive solution following the above mentioned 20% rule. Mashups on the other hand are the new approach towards information personalization promising lower costs and higher coverage of user requirements. In this section, first the different models of personal services will be discussed and then the mashup applications and use cases will be explored in more details.

The service requirements of a typical business process user (i.e. the actor who takes benefits of some business use cases) can be roughly divided into three basic categories:

- Outbound flow services: the information that has been generated and / or managed by the end-user. This information can be locally stored on user's end-device or uniquely registered for user somewhere on Internet. An example of such services is the user calendar information that might be used by other colleagues in the organization to organize an event. In our previous works we have introduced the SemanticLIFE [35] as Personal Information Management System (PIMS) that realizes such use cases based on Semantic Web technologies.
- Inbound flow services: services that customize and adopt the incoming flow of information according to user capability and preferences. An example from this group of services is the rendering of web pages for people with memory, cognitive or visual impairments. The content of a web page can be annotated with history of life items or rendered differently depending on the user's physical and mental capabilities (the concept of connecting ontologies for people with special needs has been covered in our previous research works).
- BPEL-like services: these services can be seen as a combination of inbound and outbound services that are able to manage and run long-term processes.

A. *Personal Business Processes*

Unlike the Consumer and Data Mashups that are usually triggered and finished in one single step, Enterprise Mashups describe processes that need multiple steps for completion. Such mashups might be seen as a data source that extract and process the data from different resources and hand in the useful information to external world. As an example of an Enterprise Mashup consider an online shopping use case (fig. 3), where the price limits should be first tested against user's bank account and credit information. A personal Enterprise Mashup is able to call the external bank web services in a trusty way and calculate the user's shopping limit based on user's cache amount in the banks and the planned monthly loans.

Enterprise Mashups are also interesting from the security and privacy perspective where the end-user does not need to publish the details of his/her private business processes and the logic behind the processes.

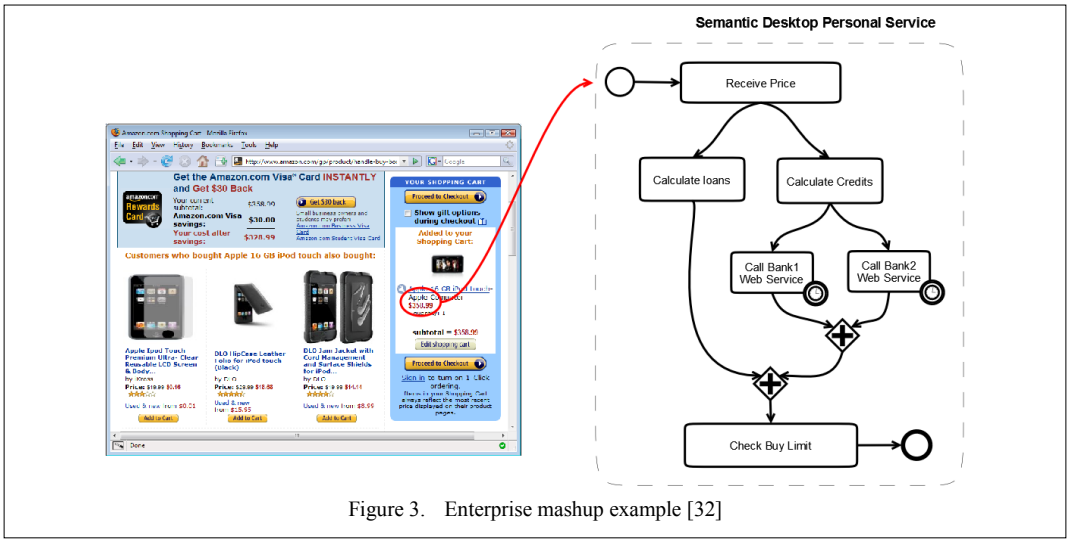

Figure 3. Enterprise mashup example [32]

B. *Web Accessibility for People with Special Needs*

Despite the advances in design and implementation of web applications, the human interaction with the applications is still a frustrating experience for most of the users. The user with "normal" cognitive abilities is able to combine the application's logic and goals with his / her experiences and knowledge to accomplish the use of Internet application. On the other hand, the users with severe cognitive limitations either face difficulties in identifying the data model behind the web form, or cannot map the model to their knowledge models. More over the recent Web 2.0 applications has made the interaction of people with disabilities more difficult.

To address these requirements, some international initiatives have proposed standards and guidelines to make the information accessible to people with special needs. One of such recent initiatives is the Web Accessibility Initiative for Accessible Rich Internet Applications (WAI-ARIA) [31]. In spite of such standard and guidelines a high percentage of web content is not yet accessible and the content authors are moving very slowly toward WAI-ARIA goals.

In this context mashups can provide a lightweight solution for the transition phase from traditional web to modern web pages that support accessibility features. More precisely, mashups will extract the required data from hosting web pages and add the accessibility annotations and convert them to an accessible resource that can be used by user agents.

C. *Semantic Desktop Integration*

Semantic Desktops are a group of applications that are benefiting the Semantic Web technologies and aim to capture the user activities for a long time period and assist user to take benefit of his/her historical information. Such systems are usually equipped with a user profile plug-in that tracks the dynamic, long term user activities to find out the user interests which might even change from time to time. The information captured in the user profile can later on be refined and annotated by the user to make a more precise user behavioral model. This model has the potential to be integrated in user processes and enrich the quality of exchanged data. For instance the order of search results can be rearranged based on the user interests and/or preferred ranking indicator.

Another interesting aspect of mashups is the role that it might play in the integration of desktop information (user's world) with other business processes using Semantic Web technologies. More precisely, the Semantic Web should enrich the mashups to bridge the gap between user information and external processes by mapping the user resources to those needed by global services and vice versa. As an example consider an online e-shopping system that requires the payment information from the user. Such data should be provided by each shopping (or once per e-shopping system); however, this could be avoided by integrating the user information which reside on the user's desktop. Mashups can be used as a tool that mediate between shopping process and backend semantic repository by reading the required input data and mapping the semantic of shopping processes to semantic of user profile.

IV. Business Use Cases

Mashups provide a paradigm to describe the user-defined service compositions and data resources as pipelines. It enables the end user to use existing data resources and make customized data integrations for user-specific use cases. The result will be a new data resource that can be again reused by other Mashups as a data resource. Also a benefit of Mashups is the possibility of easy documentation of the operation mode of services. Therefore it is easy for the end-users to use these services in the right way.

A. *Information merging, filtering and distribution*

Mashups provide a paradigm to describe the user-defined service compositions and data resources as pipelines. It enables the end user to use existing data resources and make customized data integrations for user-specific use cases. The result will be a new data resource that can be again reused by other Mashups as a data resource. Also a benefit of Mashups is the possibility of easy documentation of the operation

mode of services. Therefore it is easy for the end-users to use these services in the right way.

One scenario of a service composition as Mashup could be the fulfillment of communication requirements in a company. Typically there are many different communication channels in an organization. The wide range of communication channels include email, intranet, newsletter, SMS, Instant messaging and so on. As a result, large communication divisions need to gather information, merge information and manage the information flow through all this communication channels. The employees in this division can do this only manually or semi-automatically.

Mashup solutions can support this process by gathering the information, if necessary enrich or filter the data and then perform the automated distribution. In this case the user can define the data sources, set data merge transactions from the Mashup solution or by using other services and distributes them among required communication channels. This approach leads to a more efficient delivery of the information.

The end-consumers of communication channels can also benefit directly from Mashup solution by creating other mashups by themselves for their own requirements in a very flexible way. A simple example could be an incoming appointment for a conference via email. A created Mashup can then get the actual weather information for the conference location and also within available hotel-rooms in the neighborhood. The appointment enriched by the weather and hotel-room information can be send to the users mobile. In this scenario a lot of extensions are conceivable like getting travel information for flights, railroad, car-renting, etc.

B. *Data Validity and Consistency*

Data quality is a critical success factor for enterprises and plays an important role in companies aligned with business strategy, information and technology.

Data validity and consistency is one of the most important issues that users have to deal with everyday to guaranty the correctness of input or generated data. In this context Mashups can be used to connect the data with relevant services that make data validity and consistency checks.

For example consider the product delivery service of a shipment department. Delivering the product to the wrong address costs the company at least money and at the worst case the customer. Therefore the address validation check is a necessary step which is usually an integrated feature of the system. But if there is no possibility intended in the existing IT-landscape to do this check, Mashup solution can help easily by employing the proper validation service. In general Mashup solutions can be used as extensions of existing systems without long term development cycles and big investments.

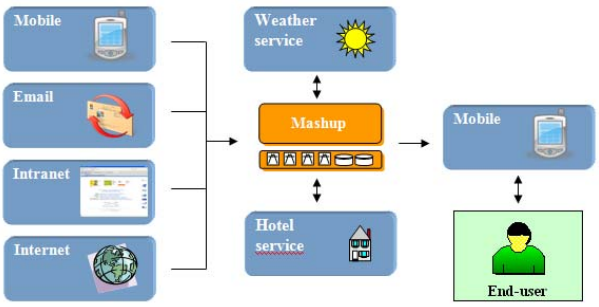

Figure 4. Mashup support for appointment management tasks

C. *Temporal Merge of Information*

Another Use-Case for Mashup solutions could be a merger of two companies. One of the biggest issues on merging two companies, besides the business process harmonization, is the integration of the existing IT landscape and accompanied with it the consolidation of the business data. A typical way of doing the integration of two different ERP systems is to define the leading system and import all the data from the other system. At this state Mashup solutions can perfectly support this process of consolidation by creating temporary Mashups (fig. 5). This temporary Mashups can then do a check on quality, integrity and consistency of the data which need to be imported. Also temporary test scenarios for import can be created.

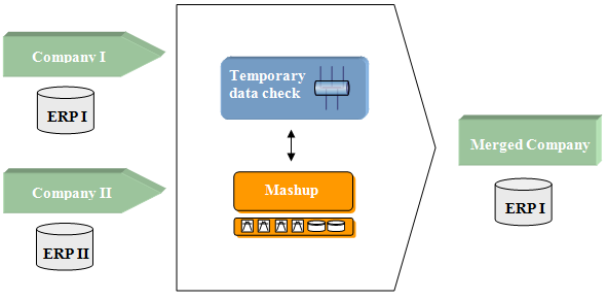

Figure 5. Mashup support for temporary merge of data

D. *Business Intelligence*

In each business domain there are methods and practices that help the stakeholders to get better understanding of their commercial context. Today most of these business intelligence services are accomplished via data mining, benchmarking, predictive analysis, or text analysis. Usually these services are implemented in context rather complex applications which are not easy to use.

Enterprise Mashups can change the situation by presenting the ad-hoc business intelligence as building blocks for creating more complex and advanced services. For instance in a software development process, the evaluation of software measures, during the lifecycle of software product is of great importance which together with other factors may guarantee the project success. In this context mashups can be helpful by assisting the project manager to define a

customized view of project activities and discover the deviations at the very early stages. The business intelligence in software process are services such as code measures, bug statistics, etc that can be extracted from the code repository and issue management systems by means of appropriate mashup components.

V. SEMANTIC MASHUPS, THE WAY AHEAD

The Semantic Web vision is to turn the available data on World Wide Web to a rich information resource that can be comprehended by machines. Until recently the data available on web has been solely human understandable and the computers (user agents) are not able to assist the end users effectively in their tasks. So the current web's Achilles' heel is the lack of semantic information that can be used to link this huge amount of information efficiently and this is the reason that some web specialists are expecting Web 3.0 to complete the deficiencies of current web. Without the explicit semantic context, the process of data analysis and putting the data to work in business process safely is still unthinkable without significant human involvement. Ontologies as the fundamental basis of Semantic Web technologies aim to provide a shared understanding of domain concepts and their relationships.

Despite this classical definition of semantic web that is coupled with Internet and World Wide Web, the elegant data structure of knowledge in ontologies has been widely accepted and used to capture and document context information in several knowledge domains. Ontologies play a significant role in information sharing scenarios and interoperability across applications and organizations [34]. This added-value of ontology opens the way to merge data from different resources and integrate them efficiently in applications without human interaction.

There are several methods for making the web pages semantic-enabled. These methods range from adding simple text annotations, to embedding richer RDF snippets into web pages. A more elegant and more precise approach for enriching the Web 2.0 content is to embed the semantic information in the web content at creation time so that machines can read and interpret the content without the overhead of natural language processing methods. One of the solutions for latter approach is the W3C's initiative RDFa which provides a set of HTML attributes to augment visual data with machine-readable hints. It is highly beneficial to express the structure of web data in context; as users often want to transfer structured data from one application to another, sometimes to or from a non-web-based application, the user experience can be enhanced. For example, information about specific rendered data could be presented to the user via right-clicks on an item of interest [27]. The rules for interpreting the RDFa are generic, so that there is no need for different rules for different formats; this allows authors and publishers of data to define their own formats without having to update software, register formats via a central authority, or worry that two formats may interfere with each other. There are many major use cases where embedding structured data in HTML using RDFa provides significant benefit. For example people's contact information, events and content's license (for example creative commons) can be included in web contents using RDFa syntax and relevant namespaces.

The RDFa is not the only solution for providing more intelligent data on the web. A similar approach for embedding machine-readable data in web content is microformats [28] which are supposed to be coinciding with the design principles of "reduce, reuse, and recycle". The main difference between these approaches has a historical background. The microformats have grown out of the work of blog developer community as an easy and ad-hoc response to common applications, but RDFa, on the other hand, is built with a more systematic vision of the W3 Semantic Web group and its associated thinkers.

Even though the Semantic Web technologies have flourished consistently in the past few years, it is unlikely to achieve the Semantic Web goals on global web in near future. The reason is that so far it is not easy to get people to learn and apply Semantic Web concepts in their web content. The real breakthrough in Semantic Web implementation happens by emergence of semantic-enabled content authoring and management tools that make this paradigm shift feasible. In this regard some popular Content Management Systems (CMS) such as Drupal, see their future in Semantic Web [29] and have started to add built-in ontology support in their system.

In our belief, mashups have the potential to facilitate the transition from traditional web to Semantic Web era and support this paradigm shift with "zero footprints" on the web pages. In order to distinguish our proposed approach we introduce the concept of Semantic Mashup. Semantic Mashup is an ad-hoc mashup that on one hand connects to the preconfigured information resources and processes their data and on the other hand maps its context data to the relevant domain ontology. In other words, instead of embedding the semantic meaning to the web content, the semantic is attached to relevant content via mashups in a dynamic and loosely coupled manner. This approach has the following advantages:

- Unlimited number of mashup ontological mappings can be defined for the same content depending on the context of use. As a result two different users can extract and use the same data but interpret it differently according to their use cases. So for example an extracted price from a web page can be mapped to income_amount concept to be used in an accounting system and in another use case the same price is mapped to costs_amount concept for a private user.
- Semantic meaning can be added by community and it is not limited to the content owners. As mentioned before the content owners are reluctant to embed semantic meanings in their web contents. Using Semantic Mashups the semantics can be added to web pages on the fly with no need to manipulate the original content.
- Semantic Mashups may also support the "open model" communication between organizations. At the moment the conceptualization of business

processes and their relevant objects and entities are limited at organizational level. Semantic Web and ontologies are potential candidates to harmonize the inter-organizational data exchange via open models; however, the implementation progress of such systems is time and money extensive. Semantic Mashups as a flexible light-weight component can facilitate the creation of semantic-enabled "open models" that can be shared and understood by business partners via shared ontologies.

VI. CONCLUSION

The shift away from traditional Web 1.0, is forced by the growing need for more efficient information sharing, collaboration and business processes. Mashup Architecture is one of the outcomes of Web 2.0 paradigm that has been widely accepted and used for user-centric information processing. At the moment mashups are mainly used for less fundamental tasks such as customized queries and map-based visualizations; however it has the potential to be used for more fundamental, complex and sophisticated tasks too.

As more serious applications make use of mashup architecture, there is a growing need to study the business chances and feasible scenarios of mashup architecture and foster its applications for organizational use cases. Combining the Semantic Web concepts with power of mashups can realize the Semantic Web scenarios at the current time where the web content is not yet equipped with semantics. Moreover the Semantic Mashups facilitate the creation and presentation of open models for inter-organizational communication.

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