Chapter 5

Service-Oriented Collaborative Business Processes

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ABSTRACT

The ability to rapidly find potential business partners as well as rapidly set up a collaborative business process is desirable in the face of market turbulence. Traditional linking of business processes has a large ad hoc character. Implementing service-oriented business process mashup in an appropriate way will deliver the collaborative business process more flexibility, adaptability and agility. In this chapter, we describe new landscape for supporting collaborative business processes. The different solutions and tools for collaborative business process applications are presented. A new approach for supporting situational collaborative business process, process-oriented mashup is introduced. We have highlighted the security and scalability challenges of process-oriented mashups. Further, benefits of using process-oriented mashup are discussed.

INTRODUCTION

Modeling and managing collaborative business processes that span multiple organizations involves various challenges. The main challenges are regarding the ability to cope with change, decentralization, and the required support for interoperability. We will have to deal with a raising complexity of collaborative business processes and a demand to configure those processes to allow them to respond to changing environments and requirements.

The Internet lies at the core of a connected world, acting as a conduit for the exchange of information, allowing tasks to be processed collaboratively. It enables the formation of communities amongst users with similar interests. An Internet interconnected world has increased both
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business and personal efficiency and performance (Litan & Rivlin, 2001).

As the business environment changes rapidly the ability to rapidly find potential business partners as well as rapidly set up a collaborative business process is desirable in the face of market turbulence. Collaborative business processes are increasingly driven by the need for business agility, adaptability, and flexibility. To stay competitive in the global market and a company and its systems need to be able to adapt to the continuously changing business conditions. This leads to increased pressure to be able to build collaborative business applications quickly in order to respond to situational needs of the business.

Collaborative business applications include both data-oriented and process-oriented applications. Within the context of collaborative business applications, data-oriented applications deal with where the data comes from, where it goes to, and how data is processed. A process-oriented application handles a different kind of collaborative business applications. A process-oriented application is not centered around the processing of data, but the control of the data, activities, and state plays a central role. For example when, where and how to process data or trigger activities by whom. Cross organizational workflow systems and business process management systems are the typical systems that support process-oriented applications.

Service-orientation allows a way of thinking of business process management in terms of computational infrastructures, services, service-based development and outcomes of those services (Papazoglou & Georgakopoulos, 2003). Service-oriented architecture (SOA) is a significant computing paradigm and is being embraced by organizations worldwide as the key to business agility. Web 2.0 technologies such as AJAX enable efficient user interactions for successful service discovery, selection, adaptation, invocation and service construction. SOA and Web 2.0 technologies also balance automatic integration of services and human interactions, separating content from presentation in the delivery of the service. Another Web technology, such as Web services, implements functionality using pre-designed building blocks. Integrating SOA, Web 2.0 technologies and Web services into a service-oriented application connects business processes in a horizontal fashion.

In the context of a web based service-oriented environment, the tools and applications for handling data-oriented applications are widgets, gadgets, pipes and data-oriented mashups. The traditional tools and applications for handling process-oriented applications are workflow systems and business process management systems, e.g. ERP, CRM, and SCM systems. These are heavyweight systems that are far from trivial to reconfigure for new processes. Inspired by the ideal of data-oriented mashups, i.e., supporting end users, easy usage, integrating web resources and data sources, and good virtualization, we propose a new concept, a process-oriented mashup, which allows users to specify their needs, find related web resources, and eventually execute the resulting process for rapidly building business processes. Users are enabled to automate their own processes without the active involvement of IT specialists.

In this chapter, we examine the capabilities for building collaborative business using service computing technologies. We first identify potential Internet technologies, present background information and a motivated example, and the needs for supporting collaborative business processes. We provide existing solutions for the motivating example and analyze the problems of using existing solutions. This is followed by discussion on process-oriented mashup and key issues. Comparison between similar technologies is also explained. We highlight process-oriented mashup challenges on security and scalability in the chapter. A preliminary design of the process-oriented mashup is introduced. An enterprise application is used to explain benefits of using the process-oriented mashup. Finally, we outline the future research directions and conclusions.
BACKGROUND

Collaborative business processes have been a worldwide phenomenon for the past four decades (Gereffi & Sturgeon, 2004). Growth of business collaboration is driven by a number of business forces such as competition escalation, organizational reengineering, and new technology trends. Over the past decade, the number and quality of suppliers offering price-competitive and high-quality business services has increased significantly. Organization has become more able to focus on the company’s core business strengths. In addition, large organization sizes are no longer a necessary advantage in production of products or services, and neither is small size—quality, flexibility, agility, and the ability to meet diverse consumer demands count for more (Drucker, 1992). Firms now respond to change by outsourcing when they face heightened competition pushes. Traditionally, after the part of business services is assigned, the initial organization can hardly monitor or get to control of the outsource services. Even a minor change of service is not easy.

The advent of global digital networks, the Internet, the World Wide Web, and more recently, Web services, has drastically lowered the cost of coordination between firms and improved the possibilities for organizations and individuals to communicate in an effective and standard manner. New environment, newer technology, and rapid technological change provides an avenue for reducing human and equipment resources that do not fit with a company’s strategic direction for meeting the latest needs with up-to-date resources at competitive rates by outsourcing those business processes. Furthermore, the current technologies are also allowed to get control of business process collaboration.

Service-oriented architectures (SOA) are rapidly becoming the dominant computing paradigm. It is now being embraced by organizations everywhere as the key to business agility. Web 2.0 technologies such as AJAX on the other hand provide effective user interactions for successful service discovery, selection, adaptation, invocation and service construction. SOA and Web 2.0 technologies also balance automatic integration of services and human interactions, disconnecting content from presentation in the delivery of the service.

Semantic technologies, such as WSMO, WSMO-lite (for WSDL Web services) and micro-WSMO (for RESTful Web services), or Semantic Web services could help to generate a business process out of services (semi-) automatically. The goal-oriented approach of these languages allows users to specify general goal-related requirements. According to such a goal, computers can reason based on web service annotations which services should be composed. These services thus provide a promising future for flexibly generating collaborative business processes. SOA, Web 2.0, and semantic technologies can be integrated to implement and fulfill collaborative business processes. For running web services consistently across the enterprise, an enterprise infrastructure that provides enterprise architecture and security foundation is necessary.

In short, Internet and related technologies have changed the way we do business. Knowing, adapting to and managing changes are an important aspect of today’s business environment. In the chapter, we will investigate how to apply new web technologies, to establish collaborative business processes. A new approach, process-oriented mashup, is introduced.

Motivating Example: International Moving Services

In this section, we introduce a motivating example, international moving services. We demonstrate how to using existing Web services, widgets, feeds, and other APIs to build a virtual enterprise (VE) for international moving services (IMS). An international moving service aims to facilitate international relocations in various ways. These
services go beyond moving items, but can include things such as visa applications and assistance in finding a new residence. In brief, the goal of international moving services starts with helping customers to find moving companies and request quotes. A very brief, incomplete and abstract description of the various services offered by an international moving service would include:

- **Find Moving Companies**: compare the services of international movers by requesting free quotes for the customer; provide moving tips, and information documents needed for international moving such as official government customs, visa and immigration, health, weather, etc.
- **Travel Arrangements**: find cheapest tickets and/or car renting in both places of departure and destination if needed.
- **Temporary Stay Arrangement**: find hotels or holiday/service apartments in both departure and destination if needed.
- **Home Search**: pre-select properties according to client requirements such as proximity to a childcare centre and provide neighborhood guide which contains information on doctors, shopping, schools, leisure activities etc.
- **School/childcare Search**: provide explanation of the local education system, options including public, private and international schools, provide information on pre-school options including nurseries, toddler groups and other childcare facilities, provide list of possible schools, childcare or other facilities relating to the home search are.
- **Settling-in Services**: advice on banking systems, provide information on insurance of health, home, car etc., and advise on importing a car into the destination if applicable.
- **Leaving Assistance**: arrange property hand-back or sale, close utility accounts and arrange final bills, and manage property if client leaves before end of tenancy.

An overview of VE-IMS’s services can be found from Figure 1. Being a VE-IMS, the payment, CRM, and bookkeeping functions that should be included for being a normal business are sourced from third parties. However, we only concentrate here on the VE’s core business processes. General business related processes are not discussed here.

Because of the various requirements from its customers, the services provided by a VE-IMS are dependent on the particular situation of its customers. Different customers require a different process. This process is supported by a special-purpose piece of software, which we call an enterprise service mashup, with particular services, processes or activities. In addition to added ca-

![Figure 1. Meta Model for the VE-IMS Example](image-url)
pability, new service mashup can modify, enhance, customize or extend an existing service mashup, or include and combine parts or components (or both) from multiple existing service mashups.

A preliminary service of the VE-IMS is to help customers to find a moving company for shipping their household effects to the new place of residence. Figure 2 shows the process of the finding a moving company. First, the VE-IMS will request free quotes from moving companies according to the customer’s place of departure and destination, if needed, arrange for visits, and provide a list of competent movers with their quotes.

Another, extended, service the VE-IMS may provide is finding an international mover and arranging temporary places of residence at both the locations of departure and destination, based on the dates of moving, travel, and the arrival of the household effects. The temporary place of residence at the destination should be close to a certain address such as the customer’s working place. Customer can also ask for travel arrangements to be made. The time to fly and time of staying the temporary place should be worked out to minimize the total costs. Further, the customer may want the VE-IMS to find an available childcare place for the children of the customer as soon as possible, then find a rental home close by around the time that the household effects arrive. The second extended international moving service is shown in Figure 3.

Available Web Resources
Supporting the Example

We have found following available Web services, feeds, widgets, and mashups from Web sites like syndic8.com and programmableweb.com. A list of available feeds, Web services, widgets, gadgets, mashups that can be used as components in implementing the example:

1. Childcare Position Offered in France
2. Childcare Position Wanted in France
3. Dental Plan Comparison: Compare Dental Plans Side-By-Side, Dental News, And Dental Coverage Information
4. Cheap Flights Special Deals: Europe low cost, the worldwide cheap fights search engine. Price comparison on low cost fights in real time.
6. Home Value Calculator: Uses Zillow data to calculate the value of single family homes in the U.S. Small widget suitable for placing on your Google home page.
7. My Camps Facebook APP: Facebook application for searching, rating, reviewing, and sharing summer camps. Put your favorite camps on the map and meet other friends who share the same experiences.
8. Real Estate Daily Widget: Real estate facts, terms, people, Websites, history, and events in a Google Gadget. Each day of the year contains a reference about the real estate and housing industries.
9. Easy One Loan and Home Values: Mashup of Zillow and Yahoo Maps as supplement to on-line mortgage service.
11. PeekaCity API Users Google Streetview for neighborhood amenities PeekaCity is used primarily by real estate agents as a service to their customers (currently in Chicago and Dallas/Fort Worth). The addition of Street View enables customers to view street level photos of properties, and virtually drive up and down the streets in the neighborhood.
12. Moving Companies Feeds from 123movers.

We provide information of which services can be implemented by which available Web services, feeds, widgets, and mashups in Table 1. It shows that the core business of VE-IMS can be fulfilled by existing resources manually in the certain areas, i.e. up to a user’s requirements. The list of available Web services, feeds, widgets, and mashups does not include universal school or childcare information, home searching information even information of universal cheap fight tickets. Therefore, we do need a mechanism which supports the possibility to look for the required resources such as Web services, feeds, and widgets and can compose them automatically. To be able to find related resources, we need semantic technologies. We must thus annotate Web services, feeds, widgets and so on in advance to support their automatic composition by users.

In this example case, it will be expensive and difficult to build a traditional workflow system to support the business process. It means that we have to know all information in advance or providing an interface to add information in the traditional workflow solution. The dependences are various, such as finding a home close to the best school or the available childcare, find the good schools close to the home address. It would however be handy for using a business process mashup solution, specially, if automatically invocation of needed feeds, Web services, etc. and execution processes are supported. The different processes of VE-IMS can be implemented by different process instances. Users (i.e. owner of VE-IMS) may only need to edit the certain processes to be able to meet all requirements from new customers.

Table 1. Available Web Services for the VE-IMS Services

<table>
<thead>
<tr>
<th>Services</th>
<th>Services</th>
</tr>
</thead>
<tbody>
<tr>
<td>Find Moving Service</td>
<td>12, 13</td>
</tr>
<tr>
<td>Travel Arrangement</td>
<td>4</td>
</tr>
<tr>
<td>Temporary Stay Arrangement</td>
<td>5, 7, 8, 11</td>
</tr>
<tr>
<td>Home Search</td>
<td>6, 8, 9, 11</td>
</tr>
<tr>
<td>School/childcare Search</td>
<td>1, 2, 10, 11</td>
</tr>
<tr>
<td>Settling in Service</td>
<td>3, 11</td>
</tr>
<tr>
<td>Leaving Assistance</td>
<td>6</td>
</tr>
</tbody>
</table>
SOLUTIONS FOR COLLABORATIVE BUSINESS PROCESS AUTOMATION

There are existed solutions to support collaborative business processes across multiple organizations. Complexity of implement such collaborative business process automation depends on the flexibility of the collaborative process, the cardinality of participating business processes and the correlation of collaborating process instances. Setting e-contracts among involved partners’ workflow systems is one of solutions for supporting collaborative process automation. Web service orchestration and choreography is another solution by exchange information and data in a loosely coupled environment.

Contracting Among Involved Partners’ Workflow Systems

Collaborative business processes are used to facilitate collaborations, while collaborations origin from contracting among organizations. Previous work on contracting (Xu & Jeusfeld. 2003; Milosevic et al. 2006; Colombo et al. 2002; Chiu et al. 2002) has ever discussed to support collaborative business processes on modeling processes, tracing processes, and (pre-active) monitoring processes.

Applying the contracting approach for implementing the motivating example is possible, but it does not satisfy flexibility requirements. Customers of the international moving can ask different destinations and different packages of services. Therefore, it is difficult to know in advance how many partners and which partners involved in the processes.

Web Service Orchestration and Choreography

In a loosely coupled mode, participating businesses of a collaborative business process can be implemented by exchanging information and data. The approaches like WS-BPEL (Andrews et al. 2003), ebXML (http://ebxml.org), RosettaNet (http://rosettanet.org), and IBM WebSphere (IBM 2005) enhance a collaborative business process with messaging exchange mechanisms.

The ebXML business process specification schema (ebXML BPSS) (UN/CEFACT, 2003) provides a standard framework by which business systems may be configured to support execution of business collaboration consisting of business transactions. However, ebXML BPSS only supports two partners involved business process collaborations. When multiple partners are involved in business process collaborations, the specification needs to be broken down into multiple bilateral relationships. This bilateral model easily results in increasing loads and complexity of tracking business processes. As a result of this and other limitations ebXML BPSS supported business collaborations lack flexibility and agility needed to respond to a changing environment.

Specifications, like WS-BPEL and WS-CDL, support service orchestration and choreography according to predefined processes or rules (W3C, 2005). Such a static coordination mode can not easily capture the dynamics of business processes in collaborations.

Being agile in adapting business process of organizations to market dynamics, the new approach should look beyond the traditional solutions through collaborative interactions and dynamic e-business solution binding. Our process-oriented enterprise mashup however aims to handle dynamic, flexible, end user friendly creation, modification and automation of business processes.

Process-Oriented Mashup and Key Issues

A new and user friendly tool, process-oriented mashup, is desired to handle situational businesses applications by the business users. To be able to allow business people to self-serve using process-oriented enterprise mashups, many issues need to be resolved first. A lightweight business
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Process modeling tool allows the users of process oriented enterprise mashups to specify their requirements easier.

Process-oriented mashups in the enterprise can help to solve both business and IT challenges, especially for small, medium and virtual enterprises that have less resources to create traditional BPM solutions. Businesses seek greater agility, greater configurability, cross-platform, and need to respond faster to an increasing pace of business. A process-oriented enterprise mashup offers the next step in technology to aid business people to find best deals over the Web. Process-oriented mashups should also be end-user friendly. The creation of process-oriented applications should be based on re-usability and adaptability.

It should not require high IT skills from the end users to create or customize mashups.

A pattern is an abstraction from a concrete form which keeps recurring in specific non-arbitrary context (Riehle & Zuellighoven, 1996). The use of patterns is a proven practice in the context of programming, as evidenced by the impact made by the design patterns of Gamma et al. (1995). Process-oriented enterprise mashups need to provide process modeling patterns, modeling fragments/process modeling templates and even completed process models of typical cases to our end users. The end users can reuse, edit or add process models using patterns and/or templates. In using process patterns, templates, it is very important to compare and specially to point out the differences of similar models (process patterns and templates). Because the end users are not experts in process modeling, the process model needs to be verified before invoking Web services. Process verification should be supported. In this way, the end users can run their processes easier while reasonable execution results can be expected.

Besides, current standards for describing Web services use syntactic (XML-based) notations such as WSDL. As these descriptions do not provide machine understandable service semantics, automation of Web service discovery, composition and invocation is thus not possible. Using semantic technologies such as SA-WSDL (W3C, 2007), OWL-S (Martin et al., 2004), WSMO (Fensel et al., 2006), and WSMO-Lite (Vitvar et.al, 2008) to describe Web services instead, Web services discovery, contracting, mediation, composition, and invocation can be performed automatically. Computers use machine processable descriptions of Web services to reason and invoke according user specified requirements. Within Web 2.0, there are many services like mashups, gadgets, pipes which do not use standard Web services technology to describe their interface, communication or enactment, but work by merit of interpreting string. These entities should also be annotated.

Semantics facilitate the management of categories of process templates, Web services, Web 2.0 services and other resource as whole. It aids users to discover, select and finally automate services. From a technical standpoint process-oriented mashups are still an immature technology. Besides the challenge of semantic heterogeneity, the technological basis for process-oriented mashup is mature though.

A big technical challenge to mashups is software evolution. Mashups are built flexibly and fast. Where mashups are further predominantly built up of external components, mashups are highly sensitive to change of these components. External components can come from the mashup platform, from within the enterprise, and from outside providers on contract or without contract. Especially components from outside providers can easily change, and require change to the mashups.

COMPARISON BETWEEN SIMILAR TECHNOLOGIES

In the following sections, we introduce data-oriented mashups, web services composition environments, traditional workflow systems, and process oriented mashups.
Data-Oriented Mashups

Current popular mashups, such as provided by IBM mashup tools (IBM), Yahoo pipes (Yahoo), Google mashup editor (Google), etc., aggregate data from different sources and virtualizes it. A process-oriented mashup on the other hand provides more control on the data or activities and state information, i.e. when, where and how to process data or trigger activities by whom. Figure 4 shows the components of a process-oriented mashup. From Figure 4 we can see the difference between data-oriented mashups and process-oriented mashups. Disregarding the “control flow”, the Figure shows the structure of current data-oriented mashups, where data comes from, which kinds of Web services or APIs process the data, and presentation of data.

Data-oriented mashups can provide collaborative business applications, such as integrating data from different sources. Data-oriented mashups have the capability to combine data with (possibly external) functionality to create and produce useful outputs. Data-oriented mashup suitable applications are e.g. embedded renting or selling house information in a map with all facilities’ information, automatically forwarding related information of federal animal disease to a veterinary’s costumers.

Mashups have a broader range of functionality than Web service compositions. Composing services is only a part of what mashups do. For example service compositions do not have an independent instantiation. They are initiated by calling the composed service. Mashups on the other hand, especially business process mashups, can have active parts that can monitor the environment or be notified of events.

Mashups, being broader in scope than Web service compositions, actually differ most in the area of approach. A mashup is the result of fast development on a small scale. In the UNIX world, scripts are used for various tasks within the system, and for administration. These tasks can be performed by complete programs, but for many tasks, scripts are more suitable and convenient. Mashups can be compared with scripts, where Web service compositions are programs. The capabilities (looking only at Web service mashups) are similar, but the strengths of the approaches are in different areas.

Traditional Workflow Systems

Traditional workflow systems provide user a stable system more reflect to routine. Business process mashup can be complement of a traditional workflow system. Because of agile ability,
a process-oriented mashup can reflect changes better, changes of user requirements, changes of process related resources, etc. It should be cheaper and easier to use. Because of the use of Internet as the application basis, it may also include accessibility problems, security problems and so on. Process-oriented mashups are on the very beginning of their journey, and have a long way to go.

From a technical perspective, besides the need to add control-flow in business process mashups, the data-flow also needs to cover data visibility. This can be a pain point for supporting business process in a mashup way. Data integration related issues of the current mashup tools have been analyzed in (Lorenzo, et al., 2009). Data flow operators allow performing operations either on the structure of the data, or on the data itself. Besides, data is generated and updated using different data refresh strategies, like pull strategy and push strategy. While the pull strategy is based on frequent and repetitive requests from the client, in the push strategy, the client does not send requests but needs to register to the server. There are two possible strategies to handle pull interval. The pull interval of the global strategy is set for the whole application. In the local strategy, each data source is given its own refresh interval. According to definition of the data flow patterns, the data operators and data refresh strategies only cover data transfer, data interaction, and data routing. Data visibility is not covered by currently data-oriented mashups.

**Existing Enterprise Mashups and Related Work**

Most existing enterprise mashups, such as SAP enterprise mashup Rooftop (Hoyer & Stanoevska-Slabeva, 2009), JackBe’s enterprise mashup up Presto (Jackbe.com), IBM Mashup Center, provide connectors to databases, customer relationship management (CRM) systems, content management systems (CMS), or MS Excel sources. They are aggregation tools at a business data level which original mashup concept covered within corporate environments or lower levels of a business function level. Business functions can be considered at different levels of aggregation. At a high level of aggregation, business functions like “Procurement”, “Sale” and “Operations” may be distinguished, where “Sale” is further decomposed into “Pre-Sales”, “Sales Order Processing” and “Rebate Processing” and so on. The lowest level of aggregation business functions is called tasks or activities. The Rooftop mashup only deals with the lower level business function, such as monitoring the progress of “Contacting”, which is updated statute of contract performance. It does not deal with higher level business functions.

The on-going EU project FAST (fast.morfeo-project.eu) is taking the same position for handling low level business data aggregations. It aims at providing an innovative visual programming environment that will facilitate the development of next-generation composite user interfaces. The platform provides the data oriented aggregation and does not necessarily take a business process perspective. The platform is categorized into a data-oriented mashup platform, but focusing more strongly on visualization, while has not management of business process features.

The on-going EU project SOA4All (www.soa4all.eu) aims to provide a platform to build process-oriented applications for end users. It will provide a lightweight process composition environment. The main research focus is on semantic technologies and automatic discovery and composition of semantically annotated Web services. It does not consider composition or discovery of other Web resources, such as widgets, gadgets, pipes, feeds and mashups.

**Process-Oriented Mashup Challenges on Security and Scalability**

When exposing enterprise information systems, it is important that proper security and authorization
is in place. Security issues such as privacy and confidentiality of collaborative business process modeling and enactment are of particular importance in the business collaboration scenario, where trust and security issues are highly featured. Traditional inter-organizational business process approaches present the same process for all participating organizations, and therefore neutralizes the diversity of participants in term of authority levels and perception scopes. Mashups are however built flexibly and fast. Where mashups are predominantly built up of external components, mashups are highly sensitive to change of these components. External components can come from the mashup platform, from within the enterprise, and from outside providers on contract or without contract. Especially components from outside providers can easily change, and require change to the mashups. To handle privacy, confidentiality, and changing of components are important security issues for process-oriented mashups. Mashups act in the name of their owners, but these owners should not need to log in to each individual Web service. This means that single sign on technologies need to be supported by the mashup platform.

Mashups represent an interesting challenge in the area of IT Governance. End-user programming means that the control over the application functionality moves to the end users, away from specialized departments. This may create political problems as well as genuine management problems. For example, when an enterprise mashup becomes business critical, who then is responsible for its functioning? The “IT department” has no influence or knowledge of the design. The “Developer” is not schooled in program design and cannot be expected to be held responsible for flaws. This problem however, is not altogether different from mission critical spreadsheets. It is a problem that must be understood and managed, not an unmanageable problem. A solution could be for example to transfer mashups that become mission critical to specialized departments, or to have a more permanent solution written.

Another management issue in the mashup area is the issue of duplicated work. When two people work on similar mashups part of the effort is wasted in duplication. On the other hand, coordination costs are avoided. Given the current difficulties to have custom solutions created, it seems that the benefits gained outweigh the costs of duplication. Especially when good sharing mechanisms are used that enable easy retrieval of existing mashups.

These possible issues show the limits of mashups. Mashups cannot take the place of more elaborate information systems. The role of mashups is in addition to existing information systems, providing automation to tasks that now have to be performed manually, as traditional information system development for the tasks is not economically viable. After having identified all key issues of process-oriented enterprise mashup, a preliminary design of process-oriented enterprise mashups is presented in the next section.

Process-oriented enterprise mashups help to solve these challenges through self-service application development, enabling to move to the next level of innovation, speed, and agility by allowing users to combine and remix different sets of data in new ways. In this way, process-oriented enterprise mashups can provide insight into corporate data that was simply not possible before.

Process-oriented mashups are not designed for large amount of users. It is designed for situational business applications which are take business user’s perspective to develop and deploy quickly and “good enough” applications. Scalability will be an issue when the mashup becomes popular. For overcoming such problem, an IT professional design, development systems are needed. Such mashup applications will be eventually added into the organizations’ core business process systems.
PRELIMINARY DESIGN OF PROCESS-ORIENTED MASHUP

To visualize what an enterprise business process mashup may look like, we focus a simple process which mentioned in the motivating example, the request of quotes for removalists. This is at its base a fairly simple process, but it can be enriched in many ways.

A key part of the business process mashup is some form of control panel. This control panel at least allows the user to instantiate new processes, view his current processes, and to edit and view the available process models. The create process dialog (see Figure 5) allows the user to select a base process model for the process. The dialog also allows the user to name the process instance, and to provide a description. Both the name and description are there to allow the user to retrieve the process instance more easily; they are not needed for the processing itself.

The process model for requesting quotes is actually a parameterized model. Therefore a dialog is presented that allows the user to specify when to stop waiting for quotes after sufficient quotes have been received, how many quotes to request, and the minimum amount of quotes needed.

After specifying the process parameters, the user can review, and if necessary edit the process model. The process viewer (Figure 6) allows users to see all their process instances, and take a deeper look into them. The user can for example look into sub-processes directly from the main process. The idea is to allow users a better understanding of the entire process, especially where the sub-process is needed to perform activities over a number of items resulting from earlier process activities. If a sub-process is part of an instantiated process, and the sub-process itself has been activated, it is also possible to see the actual process instances.

For example suppose that another removalist has heard about the pending removal, and that the user has allowed them to provide a quote. When the user then receives the quote from this removalist, he would still like to make the quote part of the regular process. This means that the user needs to edit the process instance. First, the user needs to find the related instance, based on the process name and description.

When a process instance has been selected, the user can edit it. Therefore he is presented with the process instance editor (see Figure 7). This editor allows the user to see and edit the current progress in the process. As we see in the figure, at

Figure 5. Process creation screen
this stage, some removalists have already submitted quotes, and we can see all process instances.

The sub-process view can also be collapsed to keep the overall overview. In Figure 8, the sub-process is collapsed. Further, to allow the additional quote to be part of the process, a new activity (“Add additional quote”) has been added. As the additional quotes need to be added to the results of the quote requesting and receiving sub-process, this is visualized as the results of the additional quotes activity going to the transition between the sub-process, and the conditional that allows the process to go on if there are sufficient quotes and the quote deadline has passed.

The way in which we have edited this process instance should be fairly easy and allow the user to still leverage the process system for dynamic processes where exceptions occur. The results of this edit however, cannot be used as a process model as the additional quotes activity is not initiated anywhere. The business process mashup must also have the ability to have process edits reflected in the process model, and perhaps even use one edit to update a number of process instances.

**Benefits of Using Process-Oriented Mashups**

Our example is a process-oriented mashup server as an open service platform for a virtual organization of international moving services. The process-oriented mashup can be used by owners of the virtual organization to model and execute core business processes of international moving.

There are many advantages of using these process-oriented mashups. Firstly, the mashup platform allows end users such as owners of the virtual organization to handle simple process development tasks instead of requiring a more expensive and potentially longer IT development project. Moreover, cheaper process development makes it economic to include those processes in the platform, which are rarely used, so that the long tail effect can be harvested.

Secondly, development tasks that cannot be handled by end users and are done by the service developers from external service providers will also be faster and cheaper due to the seamless interaction among parties over the platform (e.g., for communicating requirements or performing beta tests in the target environment).
Thirdly, the mashup platform is a shared process repository so that new processes or modifications become immediately visible to users, reducing propagation times and costs. Finally, the modularity of the underlying SOA allows an owner to buy only those services they really need instead of complete products, reducing the total cost of their IT infrastructure.

In addition to these efficiency gains, the platform also has the benefit of an effectiveness gain because the platform allows owners of the virtual organizations to handle different requests from consumers in a central place, which leads to a better service for the consumers.

For service providers, resellers, and consultants, the main advantages are a potentially larger market reach and easier market access, because the process-oriented enterprise mashup platform provides a central entry point for service consumers so that it is easy to find, try out and integrate services. Moreover, service providers, resellers, consultants, and developers can also benefit from an efficiency gain because of an easier integration and development process, and improved agility because of a faster interaction with customers (e.g., when developing a new service) and market trends in general.
CONCLUSION AND FUTURE RESEARCH ISSUES

The internet has a continuing impact on everyday life. Web based technologies not only impact our communication patterns, but also provide opportunities to bring information or knowledge to our daily activities. Process composition in a process-oriented mashup is shown to be a potentially useful technology for SOA-based business integration. It provides an agile approach to adapt to fast-paced business environments.

Process-oriented mashups coordinate different process orchestration activities. This allows users to automate their activities. When a user needs to perform a task this often involves getting information from one place, aggregating, filtering, and shaping it, and then sending the result to a different place, and then again until some time when the process is finished.

As an example of an enterprise application, we have provided a scenario of international moving services of a virtual organization. Showing how owners of the virtual organizations can use a process-oriented enterprise mashup to build their applications and how they can benefit from using the mashup.

In the registration of a business process in an international moving service can be automated, such that those elements which do not by their nature require human intervention can be carried out automatically, or, if wanted, with the click of a single button. A process-oriented mashup allows the users to specify this execution themselves, and it will be executed as if they had performed the tasks manually. This approach is different from traditional workflow management approaches in that the mashup is focused on a single user/role, and the actions are performed as they would be if they were done manually. These process mashups are situated at a lower level in the process and are more focused on concrete tasks than abstract tasks that must be decomposed into other, more detailed tasks.

This chapter explains new landscape for supporting collaborative business processes: a service-oriented approach. The different solutions and tools for collaborative business process applications are presented. A new approach for supporting situational collaborative business process, process-oriented mashup is introduced. We have highlighted the security and scalability challenges of process-oriented mashups. Further, benefits of using process-oriented mashup are discussed.

To fully exploit the potential of Web-centric compositions, we are starting new work in several areas. We are exploring a lightweight business process modeler (Xu et al. 2010), (Xie, de Vrieze & Xu, 2010a), (Xie, de Vrieze & Xu, 2010b). We are providing most popular process templates which are based workflow patterns (van der Aalst, 2003). We are aiming that users can pick up and to run. Further we are also interested in annotating the resources using WSMO-Lite and Micro-WSMO.

We currently do not have a unified way to browse or an efficient way to discover different web resources. We are interested in discovering a unified way to list all web resources, access existing enterprise services and data/content repositories. Semantic technology can facilitate web resource discovery. The term web resources here refers to web services, widgets, gadgets, pipes and mashups. On Site 6, a leading mashup directory, there are over 4100 registered mashups listed. Every month, about 100 new mashups are added. Descriptions of feeds can be obtained, for example, from social bookmarking web sites like Site 7, which lists about 560,000 feeds. These show there are too many web based resources for end users to manually discover, select or compose. The process-oriented mashup environment needs to unify the web resources landscape and provides an efficient discovery mechanism and maybe semantic technology can help facilitate this. Secondly the influence enterprise security on the use of mashups and is critical for popularity of mashup applications. This needs further exploration.
Service-Oriented Collaborative Business Processes

A further issue is how to improve the executability of service-oriented business process applications? There are special issues for service-oriented business process applications. Even if the control-flow of the business process is correct, conflicting pre-conditions and postconditions for invoking web services can still lead to an unexecutable business process application. Therefore, beyond the checking process models, there are more issues for executability verification of service-oriented business process applications.

Finally, we would like to emphasize that process-oriented mashups will not completely replace core business process management systems. Process-oriented mashup applications address different needs and are built for just a handful of users, applications that are used for only a few weeks or months, or situational applications that address a small piece of functionality. For example, perimeter ERP applications, such as vacation scheduling, seminar and presentation management, etc., are normally not included in an organization’s ERP system. However, they can be desirable for individuals who manage those matters on a daily basis.

REFERENCES

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Google mashup editor, http://editor.google-mashups.com


