A Framework for Automatic Generation of Evolvable E-Commerce Workplaces Using Business Processes

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ABSTRACT

Business processes encapsulate the knowledge of operations and services provided by organizations. Due to the changing nature of business processes, the design and implementation of e-commerce applications, such as workplace applications, could not be evolved consistently to support changing business requirements. E-commerce workplaces suffer from design and usability problems and may not conform to updated and constantly changing business processes. In this research demonstration, we present a framework that automatically generates business workplaces using workflow specifications. The generated workplaces can easily adapt to the changing business needs and reflect better the interaction within complex business processes in organizations.

Categories and Subject Descriptors

D.2.2 [**Design Tools and Techniques**]: User interfaces

General Terms

Design, Human Factors

Keywords

Business Process, User Interface Design, Software Evolution, Software Engineering, E-Commerce Applications

1. INTRODUCTION

Business processes encapsulate the knowledge of operations and services provided by organizations. Typically, a workflow represents a computerized business process as a sequence of steps. It describes essential tasks, business roles, resources and business rules required by a business process. For example, a *Book Purchasing* business process may consist of a number of tasks, such as *Request Book*, *Select Payment Method, Approve Book Order and Ship Book*. Multiple roles, such as *Customer*, *Sales Manager and Shipping Clerk*, participate in this business process. A *Sales Manager* approves an order, and creates an invoice. A *Shipping Clerk* prints a shipping slip and contacts the shipping company for pickup.

Organizations are subject to continuous and constant changes to reflect the rethinking and redesign of business processes, and to achieve dramatic improvements in critical measures of performance, such as cost, quality, and speed. For example, customers once needed books to be delivered in a few days or weeks. Nowadays customers frequently require books delivered in the next business day. Furthermore, technological updates and innovations also affect the way business is carried out. For example, manually matching a book order with an invoice can be replaced by automatically matching in a database.

Unlike navigational Web sites, which mainly allow access to huge amounts of information, e-commerce workplaces support and execute business processes for various business scenarios, such as Business to Business (B2B), Business to Consumer (B2C), supply chains between organizations, and hosting services for an organization. An e-commerce workplace implements a set of business processes by integrating applications, and tools to create a customized, personalized working environment for each business user to fulfill daily business activities and transactions. Each user in an organization (*e.g., Sales Manager* or *Shipping Clerk*) is assigned a workplace. Tasks are distributed to the appropriate workplaces based on the workflows. For example, when a book is selected by a customer, the *Approve Book Order* task is displayed in the workplace of a *Sales Manager*. Once the order is approved, the workplace of the *Shipping Clerk* is updated with a *Print Shipping Slip* task. An application is assigned to perform each task.

Currently, the user interfaces (UIs) of most workplace applications are designed by IT personnel. The functional features and user interactions in the UIs of these workplaces are not directly associated with a particular task within a business process. Furthermore the design and implementation of e-commerce workplaces are not able to evolve consistently to support changing requirements in business processes. Therefore, e-commerce workplaces suffer from design and usability problems and may not conform to updated and constantly changing business processes.

To empower the business users (rather than relying on IT) to drive the design of an evolvable workplace, we leverage the knowledge embedded in the business processes to design and develop *a **business process driven workplace**.* The workplace allows business information and applications to operate intelligently and to respond quickly to changing policies and service requirements in a volatile business environment. In particular, we analyze the business processes in order to understand how people perform their activities and in order to design software to facilitate their natural work rhythms. We proposed a framework and developed a prototype tool that utilizes business processes and automatically generates a personalized workplace infrastructure. The personalized workplace gathers tasks and collaborators relevant to only one user in an organization. For example, the workplace for a *Shipping Clerk* would contain only tasks relevant to the clerk, it would not contain any tasks related to rating books which may relevant to a customer. Using our framework, changes to business processes and role assignments can be easily tracked down to the affected

roles and business processes, and the corresponding workplaces can be automatically updated with no need for manual intervention. Moreover, our framework offers a workplace infrastructure which provides a central location to facilitate the distribution of change information and upgrades of applications that implement business processes.

2. GENERATING BUSINESS PROCESS DRIVEN WORKPLACES

Business processes describe the functionality of a workplace that implements the set of tasks specified in workflows. Moreover, a workflow stipulates a possible processing order in which users interact with the workplace in order to fulfill a business process. A workflow also describes the data required by a task and conditions (e.g., manual or automatic invocation) to perform a task. As a result, the knowledge in the workflow can be leveraged to serve as the initial design requirements for a personalized business workplace application.

Generally, workflows are represented in BEPL (Business Execution Process Language) [5] or XPDL (XML Process Definition Language) [6]. Workflows can be modeld using modeling tools, such as IBM WebSphere Business Integration Workbench[2] and IBM WebSphere Business Integration Modeler [2]. A workplace can be implemented using workplace implementation technologies, such as Lotus Workplace, WebSphere Portal server, and Rich Client Platform. In our work, we aim to develop a generic workplace generation framework that is independent from various technical infrastructures. Our workplace generation framework is detailed in our previous work [1][7][8]. The structure of our workplace generation framework is depicted in Figure 1. We employ model driven development techniques to automatically generate a workplace using the following steps:

o Parse workflows, defined for various business scenario (such as, buying a book) to infer a role model that is independent of a particular workflow specification language. The role model captures the information pertaining to a role, such as the functionality of roles within an organization, the restrictions of each role, and collaboration between roles. For example, the role model of the *Sales Manager* in the book purchasing business process includes a set of tasks (e.g., approves an order, and creates an invoice), and specifies a *Shipping Clerk* as one of her or his collaborators.

o Determine bindings between tasks in workflows and applications that implement the tasks. If an existing application is available to fulfill one or more tasks specified in workflows, we define this tasks-to-applications mapping in the binding specification.

o Develop a workplace model that abstracts various workplace implementation technologies. The workplace model is converted later to a specific workplace implementation by generating the corresponding configuration files. The workplace model specifies user interface components, navigational and contextual information among user interface components.

o Define mapping rules that transform the role information aggregated in the role model to the user interface components required in the workplace model. We generate a static workplace configuration based on the role model and workplace model.

o Develop code templates for generating workplace infrastructure components using specific workplace implementation technologies. The infrastructure components support the consistency between workflows and applications integrated in the workplace. In this step, we associate workplace configurations with a particular user who is assigned to perform a role. We currently support code generation for web portal platform [3] and the Eclipse Rich Client Platform [4]. Figure 2 illustrates a screenshot of a web portal based workplace we generated from a set of typical e-commerce workflows. The interface of the workplace is divided into many "mini-windows", called "*portlets*". Each portlet is an independent application that has its own functionality and accomplishes one or more tasks.
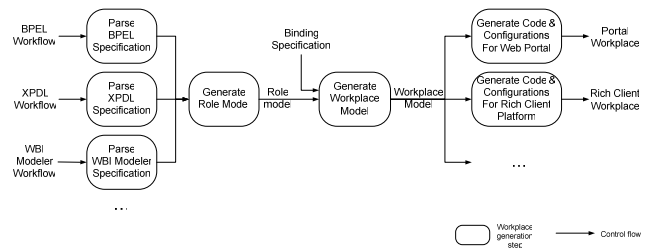

Figure 1: Workplace Generation Framework

3. FEATURES OF THE GENERATED WORKPLACES

We designed and developed a prototype tool for automatically generating workplaces from workflows. The current version of the generated workplace provides the following the features: the support for evolving business processes, the event-driven work activities collaboration, the context-awareness support in a personalized workspace, and the automatic navigational transitions in user interface components to assist business users in fulfilling business processes.

Support for Evolving Business Processes: A workplace acts as a unified single point to access an employee's work items. To facilitate the consistency of the underlying business processes, we generate the appropriate content of a workplace based on the specific business process. We identify the contents of a workplace from workflows specifications, including tasks, control flows, and data flows. We automatically generate the following components that are essential for the fulfillment of tasks and coordination.

• **Process List component:** gathers a set of business processes that a user participates in. A user can select a process name from the process list. A workflow instance, a run-time instance of a workflow specification, is spawned after the selection. As depicted in Figure 2, the business processes are organized based on the role of the user in a business process. In the *Process List* component the user is assigned to two roles, including *Product Manager* and Marketing *Manager*.

• **Work Items component:** A work list displays a set of work items (i.e., tasks) waiting for the user to complete. The user can select a task from the Work List to work on. Once the user finishes the task, it is removed from the Work list. In Figure 2, the *Work item* component indicates the current incomplete task is *Categorize product*.
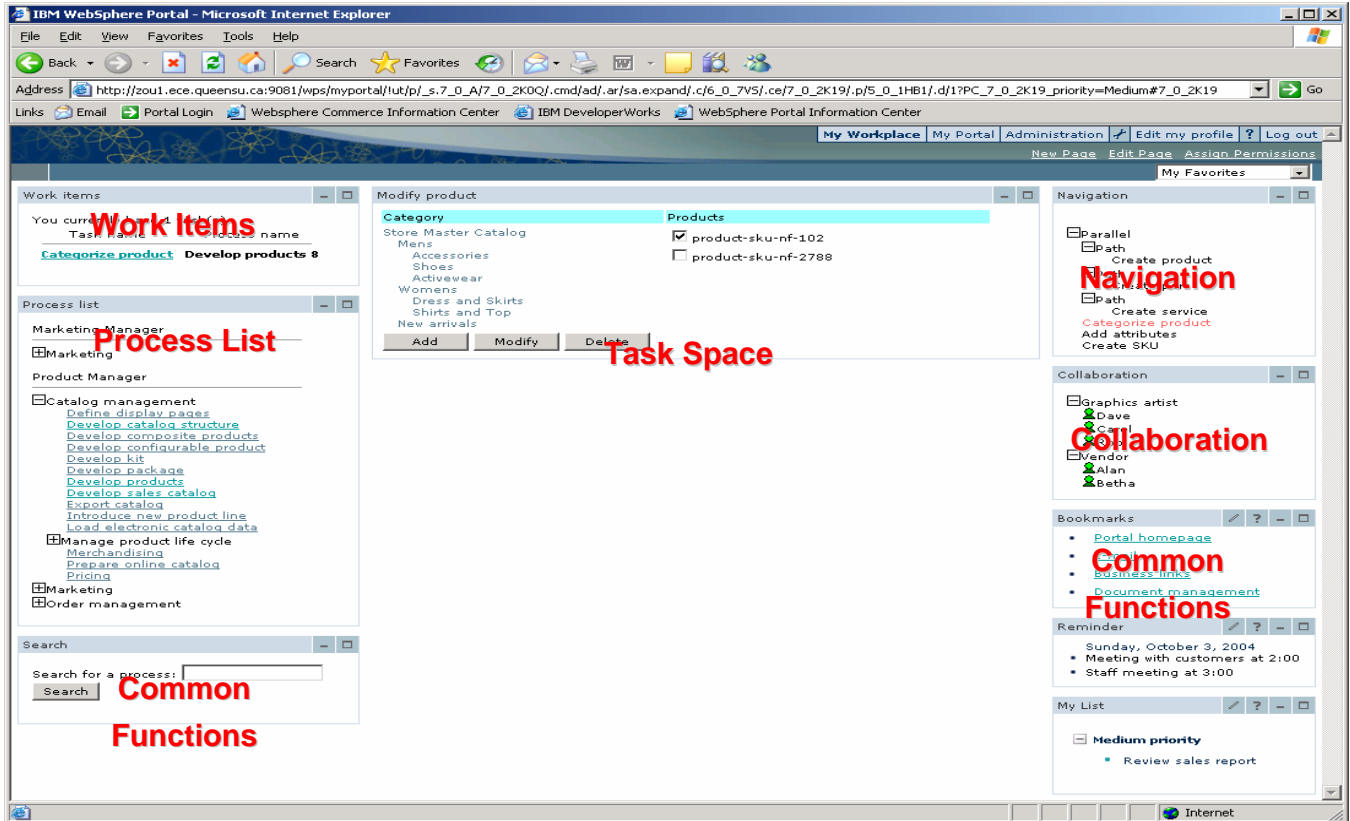
Figure 2: Example Web Portal Based Workplace Application Produced Using Our Framework

- **Navigation component:** describes the simplified views of a workflow structure. It is used to indicate the progress of the user, and highlight the task which they are currently working on. For example, in Figure 2, the Navigation component illustrates the structure of *Categorize product* workflow. The user is working on the *Categorize product* task in the workflow instance.

- **Task Space component:** presents a user interfaces that allows a user to access backend applications to conduct business activities defined in workflows. The bindings between applications and workflows are specified in a configuration file. In Figure 2, the center area shows the user interface of task related applications. In this case, a user interface is displayed and allows the user to accomplish a task *modify product*, defined in the *Categorize product* workflow.

- **Collaboration component:** lists other roles when multiple roles participate in a business process. For example, in Figure 2, other roles such as *Graphics artist and Vendor* participate in this *Categorize product*. As listed in the Collaboration component, three users (i.e., Dave, Carol, and Rob) are assigned to the role *Graphics artists*.

Event-Driven Work Activity Coordination: To ease the integration of the workplace with existing applications that implement tasks in workflows, we developed an event mechanism to coordinate work activities executed in a workplace. We generate an event engine that captures and dispatches events between workplace components and exiting applications. The event engine maintains the configuration of the workplace as well as the run time

workflow instance information. The *Process list*, the *Work list* and the *Navigation* components communicate with the event engine to exchange the run time workflow instance information. To integrate the existing applications that implements tasks defined in workflows, we allow existing applications to register events that are captured and interpreted by the event engine. For example, when a user selects the *Categorize Product* business process from
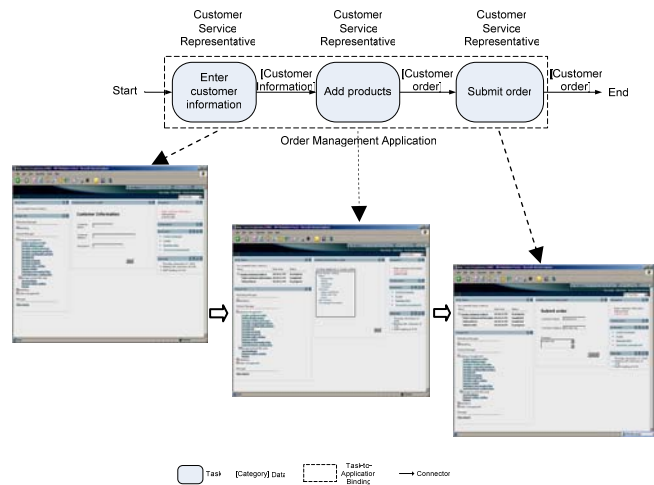

Figure 3: Performing Create Customer Order Process in Our Generated Workplace

the *Process List* component, the event engine receives the selection event, and automatically opens the user interface of the applications for users to perform the first task in the *Categorize Product* business process.

Context-Awareness Support: Context awareness is the ability of an application to sense and analyze context from various sources; it lets an application take different actions based on the current context. From the perspective of a workplace, available content of a workplace for a user to perform tasks is determined by different contexts, such as, business processes involved, collaborators for each business process, resources available to execute a task, and user's information. Menus in our generated workplace are adjusted dynamically based on the underlying business processes to permit the user to focus on the current tasks through relevant menus. For example, when a *Customer service representative* is at the *Add products* step in Figure 3, we display the product information and the other associated products in the workplace. Furthermore, when the user switches from one workflow instance to another workflow instance in the workplace, the workplace can automatically display the relevant information for the latter workflow instance and hide the information relevant to the former workflow instance.

Navigational Transitions for Fulfilling Business Processes: In current commercial workplace products, a business user has to locate different application UI components and navigate through them in order to fulfill business tasks. However, the business users are often overwhelmed by the rich and complex functions in the user interface. In our generated workplace, we guide users to access the appropriate user interface components. We utilize the bindings between tasks and applications to divide a workflow into segments Each segments contains a sequence of tasks that are performed by the same user interface component. Figure 3 describes a part of the *Create Order* business process which contains three sequential tasks including *Enter customer information* task, *Add products* task, and *Submit order* task. These three tasks are implemented by one application (the *Create Order Editor* application). We consider these three tasks as a segment. Each task corresponds to one page in the user interface component of the *Create Order Editor* application. We follow the sequence of tasks within a workflow segment, and generate the inner flow of page transitions in the user interface components of the application. In this case, once the user enters customer information in the first page of the user interface component, the task space component automatically transits to the second page that allows the user to continue with the next task in the workflow.

4. DEMOSTRATION

In the tool demonstration, we will give an overview of business workflows and give examples of workflows. We plan to demonstrate our proposed framework for the automatic generation of workplace. We then give a tour of a simple generated workplace running on IBM WebSphere Portal server with the features discussed in Section 3. We will describe the correspondences between the workflow specifications and the design requirements for generating workplaces. To demonstrate the feasibility and usability of our approach, we will work through two example e-commerce workflows and will use the example workflows to illustrate how the generated workplace facilitates the fulfillment of business processes.

5. CONCLUSION

As an enhancement to current e-commerce infrastructures, the result of this research will maintain the consistency between e-commerce workplaces and the underlying business processes by automatically generating functional infrastructure (*ie.*, a workplace) from workflows. To simplify user operations in the e-commerce applications, we define a work environment that is adaptive to changes in business processes, and which presents the user interface in a way that is intended by the designer of workflows. The result of this research will produce higher return on investment for corporations by improving the development productivity and work efficiency, facilitating business interactions, and reducing maintenance costs of e-commerce applications. In the demonstration, we will focus on presenting the features of our generated workplace applications using two example e-commerce workflows.

6. ACKNOWLEDGMENT

7. REFERENCES

[1] Qi Zhang, Ying Zou, Tack Tong, Ross MacKegney and Jen Hawkins, "Automated Workplace Design and Reconfiguration for Evolving Business Processes", In proceedings of the 15th Centre for Advanced Studies Conference (CASCON), Toronto, Canada, November 2005, pp. 262-277.

[2] Websphere Business Integration Modeler home page. http://www.ibm.com/software/integration/-wbimodeler.

[3] Corporate Portals Empowered with XML and Web Services, Butterworth-Heinemann Newton, MA, USA, 2002.

[4] Eclipse Rich Client Platform. http://www.eclipse.org/rcp/.

[5] Business Process Execution Language for Web services version 1.1. http://www-128.ibm.com/developerworks-/library/ws-bpel.

[6] Workflow Process Definition Interface -XML Process Definition Language http://www.-wfmc.org/standards/-XPDL.htm.

[7] Ying Zou, Qi Zhang, Tack Tong, Ross McKegney, and Mark William Hubbard, "Dynamically Configuring a Role-based Collaborative Space", Filed Patent, No. CA9-2005-0008US1, June 2005.

[8] Qi Zhang and Ying Zou, "Using Self-Reconfigurable Workplaces to Automate the Maintenance of Evolving Business Applications", in the Proceedings of the 21st International Conference on Software Maintenance (ICSM), Budapest, Hungary, September 25-30, 2005.