

Business activity patterns: A new model for collaborative business applications

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In this paper, we describe the vision behind the Unified Activity Management project at IBM Research. In particular, we describe and discuss activities, activity-centered computing, and activity patterns and illustrate the potential impact of this approach and its value to individuals, teams, and the enterprise. We discuss business activities and their integration into the development of business processes. We share insights from user studies and feedback from customers on the benefits of the activity model in a variety of business settings.

INTRODUCTION

This paper is a companion to “Activity management as a Web service,” which also appears in this issue of the *IBM Systems Journal*.¹

Accomplishing complex work in businesses requires a great deal of coordination between people and careful management of the numerous disparate resources that are necessary for the successful completion of the work. The Unified Activity Management (UAM²) project at IBM Research is investigating the “activity model” as a new approach to work coordination and management by presenting all of the work’s resources in a single unified context.³ In the following, we present the basic concepts behind activities and activity-centered computing and explain why this new approach has the potential for creating business value and increasing productivity.

Definitions

A *business activity* consists of regular collaborative work among participants to achieve a business

objective. An *activity structure* (or “activity”) is a digital schema-based representation that describes the properties of a business activity (such as organizing a conference) and that semantically relates it to the people, artifacts, tools, and events involved in carrying out the business activity. There are also relationships between interacting activity structures (such as subactivities or dependent activities). An *activity pattern* (or *activity template*) is an activity structure that is suitable for reuse by creating instances to guide the work. *Activity-centered computing* brings together the disparate computing systems and tools that are used to perform and manage work by creating linkages among activity structures and their associated resources. *Activity management* is the use of an

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activity-centered computing system to manage all the digital elements of collaborative business work.

Using activities in this sense constitutes a new model for managing digital work. The activity model has the potential to create a paradigm shift in how work is represented within computer systems. While existing tools (such as word processors, spreadsheets, e-mail, instant messaging, workflow, and business processes) will continue to be used, the new model will enable users to see and manipulate work from any tool. Activity-centered computing tools present the entirety of the work as a single first-class activity object. This will change how users communicate, coordinate, and collaborate on work and will create new value for businesses as the new tools increase productivity through better organization and sharing of work.

Motivation

Activity-centered computing provides three key services for businesses. First, activities bring together in one system everything needed to support the achievement of business objectives. Content, data sources, processes and tools, and people and roles from existing systems are presented as a single shared context. Second, activity templates or patterns provide guidance by presenting a best practices checklist of the necessary people and roles, the steps to be taken, and the resources such as tools, templates, and learning objects to perform the work. Third, activities provide a record of the emergent communication, coordination, and collaboration that contribute to the completion of the work. This record facilitates the monitoring of an activity's progress, modifying an activity "on the fly," evaluating an activity's effectiveness, and creating new activities. The record of the activity as an activity structure is also an important source for the future reuse of work and plans, including informal processes that emerged during the work. These services are elaborated in the section "Activity services and infrastructure."

Related work

Our work in activity-centered computing can be understood in the context of a variety of research and technology—hypertext and the World Wide Web, communication tools, work process systems, and recent activity-based research.

Hypertext and the World Wide Web

Activity-centric computing has roots in the vision of collaborative intelligence starting with Englebart's "augmented human intellect," as embodied by his famous demonstration of NLS (on-Line System) in 1968.⁴ NLS was one of the early examples of hypertext, but NLS was a collaboration support system, whereas hypertext research focused on creating rich linkages between documents (as in the work of Egan et al.,⁵ McCracken et al.,⁶ and Halasz et al.⁷). The World Wide Web made a simplified version of hypertext practical and ubiquitous. The Web is as much about linkages as about content, but the linkages are between information in documents. UAM adds to this explicit activity objects around which links are created to resources by means of URLs (Uniform Resource Locators). There are currently efforts to add meaning to the unlabeled links of the Web, under the banner of the "semantic web".⁸ The semantic web is based on representation technologies, such as RDF (Resource Description Framework),⁹ in which semantic ontologies are expressed. UAM is building on these technologies to define an explicit ontology for activities.^{1,10}

Communication tools

Most business work is supported by communications tools, such as e-mail, instant messaging, blogs, discussion forums, and so forth. E-mail is said to be the "habitat"¹¹ in which most people do online work. In the last few years, there has been renewed attention to research in e-mail and its problems as a work support tool.^{12,13} Much e-mail research is investigating how to add task management to e-mail clients by such devices as threading, grouping, and tracking. The notion of "thracks" of Bellotti et al.¹⁴ is a good example of this approach (a thrack is a collection of message file threads, links, and document drafts which make up an interdependent task). UAM takes a broader approach, seeing e-mail as just one of the resources that need to be integrated with activity structures. Beyond e-mail, the Activity Explorer (described elsewhere in this issue¹⁵), is a communication-based approach to activity management, where the communications are posted to shared activity objects rather than directly between individuals. The Coordinator¹⁶ is the most famous system based on the language-action perspective, which views work as communication acts, based on speech-act theory.¹⁷ The theory defines the structure underlying the communications which coordinate the work. Like other formal systems, the Coordina-

tor was criticized for stifling communication by its simplistic view of language use.¹⁸ The UAM approach defines the activity structure at a higher level than communication, and thus does not restrict communication.

Work process systems

Business processes are usually supported by formal workflow systems. These systems are based on a programmatic representation of work, such as that enabled by the Business Process Execution Language. Workflow systems run processes automatically and direct tasks to people in order to involve them in the processes. Workflow systems have been criticized for the strict and rigid requirements they impose on people.^{19,20} There is some research that tries to “soften” workflows by making them more adaptive.²¹ However, there is evidence that most business work is inherently different from a workflow. People engage in “artful” processes, as argued in the paper by Hill et al.²² in this issue. The UAM project studied a number of responses to RFPs (requests for proposals) in both IBM and other corporations.²³ The studies show that there is a fairly consistent structure to the work across a number of industries and businesses, though the work practice details “artfully” vary according to industry, enterprise, and specific situations. Other UAM studies reveal a structural consistency in the roles people play in a variety of office activities.²⁴ The UAM approach represents work as an activity pattern, which is an initial checklist of activities and subactivities and their associated people and resources. The activity pattern has no control structure; the checklist in each case is totally under the control of the people carrying out the activity.

Activity-based research

In the last few years, there have been empirical research investigations of work practices from the perspective of activity theory.²⁵ Recently, there have been research efforts to provide computer support of users’ activities.²⁶ These systems capture the sequence of user actions on computational artifacts and help the user by organizing actions into clusters of activities. Examples of this approach include UMEA (User-Monitoring Environment for Activities²⁷), TaskTracer,²⁸ and Activity-Based Computing.²⁹ The UAM approach is different in two ways. First, UAM does not attempt to automatically create activity structures, but rather requires them to be created either from patterns or by the users

themselves.³⁰ Second, these systems all support individual work, whereas UAM is focused on collaborative work.

ACTIVITY SERVICES AND INFRASTRUCTURE

In this section, we describe in detail some of the services which the use of activities can provide and the infrastructural elements which support these services.

Services

As mentioned previously, three of the main services that activities provide are those related to context setting, informal process guidance, and the recording and reuse of work products. These services are explained in depth in the following subsections.

Context setting

Activities represent the collection of relationships that emerge between people, the resources they use, and the artifacts they work on, as well as the communication, coordination, and business processes that are used to complete their work. Activities represent objects that already exist in a number of tools, such as e-mail messages, word-processing documents, and workflow-based business processes.

The activity representation itself contains very little data. An activity contains metadata that connects and shares resources from existing tools. These connections contextualize those tools in terms of the business activity rather than by the individual tools or processes originally used to create or represent the resources. In our RFP example, team members do not have to go to their e-mail to find a communication about the activity or to their “buddy list” to check the availability of a collaborator. Instead, they find these resources together within the RFP activity representation.

Informal process guidance

Formal business processes (i.e., workflows) manage work by specifying what to do, how to do it, and who is to do the work. However, there will always be new and unique work that calls for the use of informal processes for its description. Like formal processes, some informal processes are well-known and may even have informal tools (checklists, templates, etc.) and best practices (instructions, training, etc.) associated with them. An activity can be used as a template that guides the informal

process without constraining it. In the RFP example, the activity can act like a workflow that permits any step or requirement to be a point of flexibility, allowing the participants to determine the best manner, schedule, and persons to do the work for each step, including the ability to add or remove entire steps in the process as the response to a particular RFP is customized.

Recording and reuse

Business processes involve a number of tools, content types, and persons. Pulling together all the elements of the process into a single context of an activity provides a powerful way to understand what is happening during the process and provides a record of what happened. In some cases, such as in the financial sector, this kind of record is mandated by compliance regulations. Even when there is no mandatory requirement to record and archive how work was done, there is value in giving an organization the ability to monitor performance and to retain a good record of the work for use in developing best practices. Formal processes often provide a way to record and measure ongoing performance and produce a record of the work, but informal work has been difficult to monitor and record in detail. Business activities can capture an informal work record, and performance can be measured against other activities that used the same activity pattern. In our RFP example, informal work is captured and recorded. By tracking progress along the set of typical RFP response steps, one can measure the performance of the response effort. Because a business activity records the people, the plan, and the artifacts, it becomes a source from which future work can reuse people, artifacts, and even the plans and structure of previous work.

In *Figure 1*, an example of an activity application user interface is shown. The figure illustrates how an activity contextualizes the people, resources, and processes used to do the work. The timeline (near the top of the figure) and the checklist (at the left) provide guidance and structure, and a record of the emergent work patterns is produced.

Infrastructure

The services described above are provided by the activity model when applied to a complex work project. In this section, we describe how activities provide these services by use of the following infrastructural elements: tool and content integra-

tion, community resource sharing, and promoting awareness of work and resource status. These elements are described in the following subsections.

Tool and content integration

A big challenge for previous attempts at activity-centered models has been the integration of existing tools into the activity system. Users are strongly attached to their e-mail applications (as described in Reference 18) and use existing content and tools that leverage existing document editors such as Microsoft Word or Excel. Most systems that attempted to replace these key tools have failed because the depth of existing features and capabilities is not easy to replicate in a new system.

Existing tools have recently added alternate access to content and features through Web technologies such as HTML (Hypertext Markup Language), XML (Extensible Markup Language), and Web-Services-based application programming interfaces (APIs). These tools have also provided a way for activities to integrate disparate content through Uniform Resource Identifiers (URIs). URIs provide a common way to represent and access content and capabilities in HTML, allowing for integration.

Service-oriented architectures (SOAs) and Web Services APIs provide access to capabilities through Dynamic-HTML-based JavaScript** applications. These advances enable activities to gather and manipulate many types of content without relying on their native applications. A companion paper in this *Journal* describes a prototype architecture and system providing these capabilities.¹

Community resource sharing

Activities can help individuals work more effectively by themselves and in collaboration with others by facilitating access to the right people and the right data at the right time. However, the ability to gather content from multiple systems and tools does not ensure access to the content. Access is often controlled by either the storage system or the applications themselves.

The close collaboration enabled by the activity model relies on shared user access to many resources. Activities themselves can be used as a new way to specify who has access to any unit of content. Underlying technologies will be challenged by this new access control approach. Some systems,

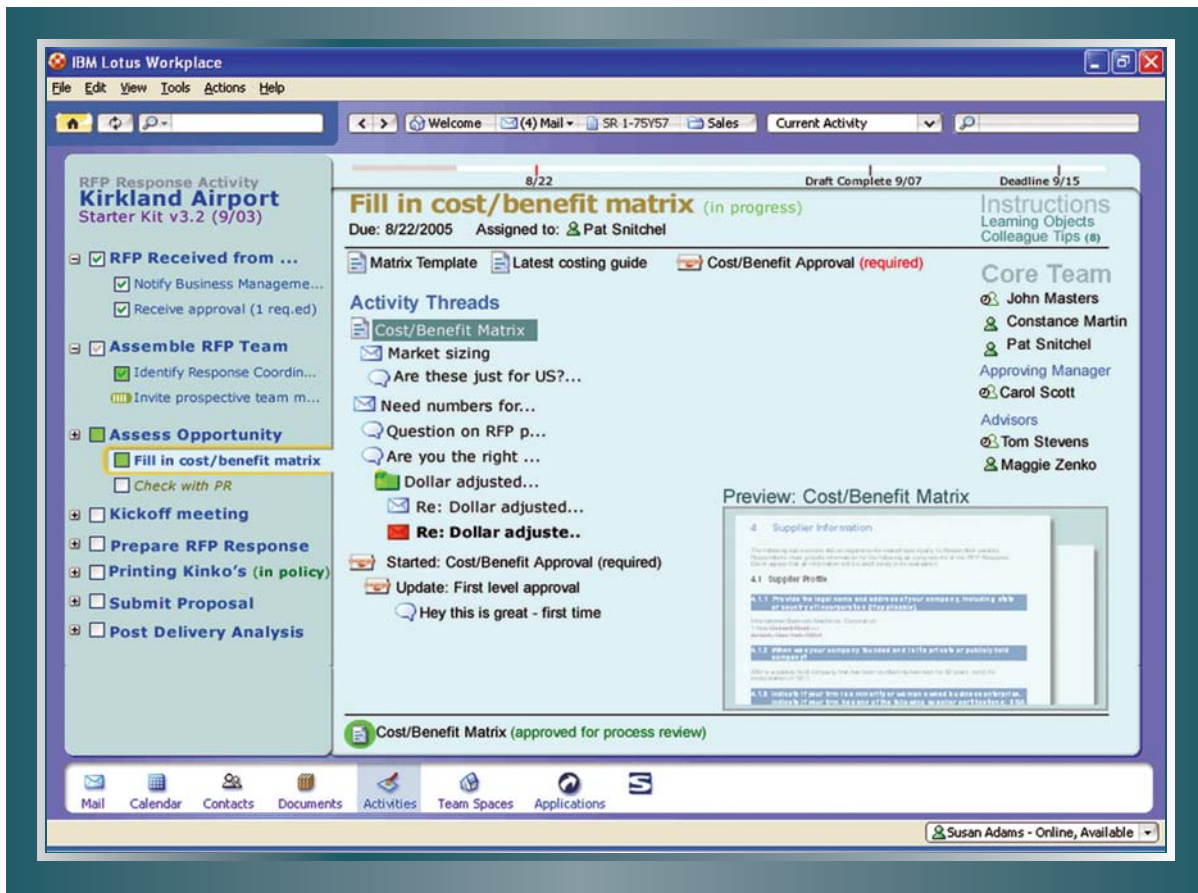


Figure 1
User interface for activity application

such as e-mail, are not designed to allow access to individual messages in someone's private mail database. A successful activity system either needs to allow this kind of fine-grained access control or has to provide access through its own storage system.

IBM's Activity Explorer is an example of such a system.¹⁵ When one wants to include a private e-mail in a shared activity thread, the e-mail is copied from the private e-mail database to a database that allows sharing of specific content items.

Status awareness and notification

In addition to providing access to the collected data, tools, and people, activities can also provide awareness of the state of the work and the availability of collaborators.³¹ Awareness of the current ("live") status of objects aids in coordinated collaboration by allowing team members to see that

a document is being edited or that the person editing it is currently online.³² Notifying team members of changes in the state of the work is also important in tracking and coordinating collaboration. An activity can provide notification of changes to the work and collaborator status.³³ Notification and awareness are critical to successful collaboration.

BUSINESS ACTIVITIES

A business activity is a set of actions that deliver business value, such as responding to an RFP, holding a meeting to close a sale, or resolving a trouble ticket. Business activities are cohesive work contexts that involve a set of people communicating, coordinating, and collaborating toward a particular outcome. They contain a mix of formal business processes and informal work practices; from these efforts, a plan and set of actions and resources emerge. In a number of businesses, because of compliance requirements such as those related to

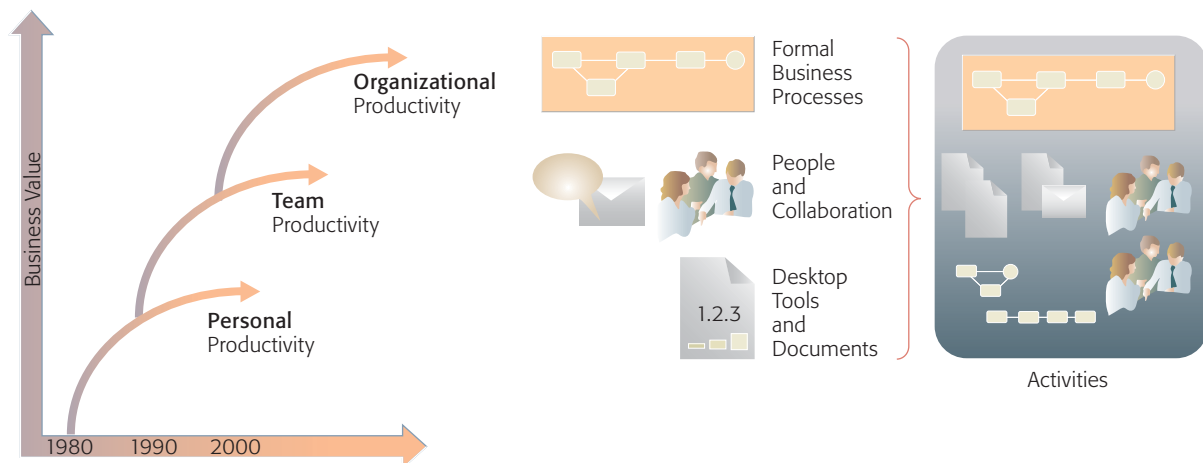


Figure 2
Evolution of business computing

the ISO 9000 standard, activities must be recorded and monitored for performance. Businesses are increasingly receptive to the activity model and activity-centered computing for reasons which we discuss in the following subsections.

Background

To understand the move to activity-centered business collaboration, it is useful to look at the evolution of business computing, as shown in *Figure 2*. Our observations are based on the experience of Lotus* customers, but apply equally across the industry. In the 1980s, businesses invested in desktop computing to improve desktop or personal productivity. This goal was achieved through tools and documents that were increasingly easier to use and more compatible, but productivity leveled off as the tools became ubiquitous and commoditized and came to provide no competitive advantage.

Business computing investment then targeted the area of team productivity with communication and collaboration systems. Productivity gains involving collaboration are also leveling off, as these tools mature and reach full deployment. Currently, customers are shifting their technology investment to cross-organizational business process systems in the hopes of achieving another round of productivity and efficiency improvements.

Computing metaphors evolved with these customer shifts. In the “desktop” era, a unit of work was

represented with document and tool metaphors, and data was separated from applications. In the “team” era, the person metaphor was used for communication and collaboration. As attention shifts to contextualizing collaboration within business processes, a new metaphor, the activity metaphor, is needed to represent the work and provide a context for efficient collaboration.

Example: Responding to an RFP

In this paper, we use as an example the work that a company performs to respond to an RFP with a bid.²³ We chose this as our example because it represents an area of business work that is commercially important and one that has been difficult to support with traditional tools such as word processors, e-mail, and workflow.

In *Figure 3*, a business activity involving a response to an RFP is shown abstractly, with time flowing from the left to the right. An RFP is received by e-mail, and a decision is reached to respond to this RFP. This leads to the formation of a team, a plan, and an emergent set of interactions, artifacts, and processes. This set of resources results in a proposal that is presented to the requesting company.

In the process of responding to an RFP, an organization goes through a mix of informal work practices and formal business processes. In 2004, we interviewed 15 people, distributed across eight companies, who were involved in responding to



Figure 3
Depiction of RFP response business activity

RFPs. While each case was slightly different, we observed the following overall process. First, there were a series of informal steps as the firm discovered or received an RFP and decided whether it was suitable in terms of their business and their current workload. Another series of informal steps clarified whether the RFP presented a good opportunity; these steps included finding the stakeholders, determining the profit to be made, verifying the business's capacity to do the work, developing a budget for the RFP response, and so forth. Next, a formal business process was used to get approval to respond to the RFP. If approved, more informal steps were taken involving forming the team and constructing a proposal, often reusing sections from previous proposals. Finally, once the response was drafted, a formal process was used to verify pricing and to get final approval for the proposal.

Applying the activity model to business

In the business environment, teams collaborate by using processes to produce something of value. Processes range from the informal to the very rigid and formal. Bernstein shows how this spectrum of rigidity is inconsistently supported by our digital tools.³⁴ Business activities are very well-suited to fill the void caused by this inconsistent support.

An aggregator of activities using “off the shelf” business tools (e.g., e-mail, instant messaging, and

documents) can also aggregate informal and formal business processes, many of which are implemented using Web technologies. For example, the Web page used to initiate a request to respond to an RFP can be included in an activity thread that includes the decision or the requirement to initiate the request for approval. The RFP response activity involves a number of formal processes, including those related to the initial approval to develop a response, accounting issues, legal issues, and the submission process. The order of the multiple processes is something that an activity pattern provides. Many different systems can be aggregated into the activity.

Formal process systems lack support for discussion and observation of a process by a group. Workflow systems were designed to limit the access to process instances from everyone except those directly responsible for their execution; there is no support for sharing process instances and helping other team members complete or monitor processes. In the activities approach, everyone can see that a formal request to respond to the RFP has been submitted, updated, and approved and share in the discussion and completion of processes.

Business activity functions

The following subsections describe the many functions that business activities can provide for improving and facilitating collaborative work.

Formalizing informal work practices

Workflows often require informal work practices to complete a particular step.²⁰ For example, filling out a form requires gathering a number of specific pieces of information. Gathering or generating the information can involve elaborate informal work practices. In our example, the work by the team to generate a draft of the business justification for responding to a particular RFP involves such informal practices. Activities can be used in the completion of formal workflow steps to support informal collaboration. In one experimental system, we demonstrated a business process monitor that created an activity assigned to the team responsible for the business process when a particular condition was met (such as an unexpectedly low number of process instances or a delay in processing an instance). The team then used their typical informal work practices to respond to the problem. Because the solution was supported by an activity, they were able to collaborate on the problem and also record which people, communication, and artifacts were used in the solution.

Individual organization and work management

Individuals need tools to organize and manage their work. In current systems, this means developing and maintaining organizational structures with a number of tools such as e-mail and document collections. Business activities can collapse this to a single organizational structure, a single place to find content, tools, and people related to a particular activity. Once the work has been done, it needs to be shared with other participants in the activity so they can collaborate on it or consume it for their work. Currently, the way to share work varies depending on the tools used. Shared work folders, workspaces, and e-mail are typical ways of sharing collaborative work. When all three of these tools exist in an organization, it is not clear which should be used, leading to confusion and inefficient sharing.

Team coordination and collaboration

Teams of workers need a way to share a plan of the work, notify each other on the state of the work, and then coordinate and collaborate on the work. Today's systems provide some of this through "team spaces" or other collaborative work environments. However, these systems lack integration with the team's communication and coordination systems (typically e-mail, calendars, and instant messaging). Business activities can provide a single place to

share, communicate, coordinate, monitor, and collaborate on work.

Organizational best practices

Beyond the record keeping that may be required for compliance, business activities (using activity patterns) provide a new means for promoting organizational learning and leveraging that learning through best practice harvesting, refinement, and distribution.

Business process development

There are a number of ways to leverage activities during business process development, as described in the following subsections.

As-is analysis and process modeling. In business process development, one of the first steps required is an analysis of how the business is conducting the process which is to be formalized. Traditionally, this as-is analysis is an expensive step of process development, because the analyst must observe some number of process examples or try to reconstruct what happened through an audit of the materials used in the process. If an organization has been using activities to conduct the process to be formalized, the activity instances will have captured much of what the analyst needs for the as-is analysis, thus reducing the cost of this step. If the process remains informal, the analysis can be used to develop a pattern or template that guides the informal process to more nearly optimal performance.

Collected activity instances or an activity pattern derived from such a collection can provide a model of the as-is process. In 2005, we developed a prototype that enabled an activity instance to be imported into the WebSphere* Business Integration Modeler. In a formal process development engagement, this could save time and money by assisting in the creation of an as-is model.

However, activities and process modeling tools are not a perfect fit. We found that there were several areas where they differ enough to make automatic modeling from an activity a challenge. Activities are ambiguous about control flow, conditionality, and data flow, while modeling tools are not. For example, in an activity, control flow is decided by those working on the activity, and they can determine whether a step can be started before

another step is complete or whether steps must be handled in sequence. In process modeling, the control flow is specific and fixed: steps are handled either in parallel or in sequence, but not both.

Developing a process. Another opportunity to leverage activities occurs during the actual development of the new process. An activity pattern can be used to try out the process. Because the activity does not constrain actions to the trial process, any problems with the process can easily be handled. The activity instances from the trial period record where users had problems with the trial process and capture how they resolved the problems. The new solutions can be incorporated into the new process without expensive development in traditional business process systems and workflow.

When the development of a formal process calls for points of variability in the workflow, activities can also be leveraged in support of the informal work practices used during the point of variability. Workflow-initiated activities can guide the informal work, provide support for collaboration, and organize the work during the point of variability.

Business activities can be used as an alternative to formal processes. Many business processes have proven difficult to automate, such as our example involving the response to an RFP. Each RFP response varies in the persons, resources, and processes involved, and this variability requires flexibility that traditional workflow systems are unable to support. Because all RFP responses share some structure and resources, activity patterns (templates to be used as the basis for new work) can support and guide similar work without overly constraining it. An activity pattern can simplify aspects of the work by providing guidance, access to people and resources, and a context for any ad hoc collaboration that occurs. Business activities and activity patterns can thus help enterprises realize benefits that traditionally apply only to the parts of their business that can be well represented in formal workflow and transaction systems.

Process optimization. Another opportunity to leverage business activities comes after an activity-based process has been deployed and has been in operation for some time, when the business analyzes the results of the process to determine if the original optimization goals have been reached.

Typically, this analysis can be costly; business activity instances would capture how the process was used and could speed up the analysis of how the process could be optimized by revealing patterns of “workarounds” (i.e., temporary solutions) or other supporting tasks not included in the original process. These emergent work best practices can be collected and incorporated into future versions of the process and activity patterns.

FIELD EXPERIENCE WITH ACTIVITIES AND ACTIVITY PATTERNS

IBM Research has been exploring and developing an activity-centered computing system through its UAM research project. The UAM research project was conducted by IBM’s Cambridge and Almaden Research laboratories, with the goal of defining a new model for collaborative business applications based on unified and integrated representation of activity. We have researched a number of early attempts at activity systems and created several prototype systems.

To evaluate the impact of the activity model, we collected feedback on our activity-centric approach and vision from IBM customers in a number of settings (including formal executive briefings and a trade-show research laboratory), and through follow-up discussions with IT and business professionals at outside companies. We used a combination of formal presentations, storyboards, and prototype demonstrations to convey the ideas. We similarly conducted discussions with groups internal to IBM including the CIO office, a methods group in our services organization, and a team involved in supporting patent work. Some of the sessions, external and internal, included creation of skeletal activities and patterns using our prototype, based on the participants’ descriptions of their work.

The overall reaction was quite positive. There was particular interest in the use of activity patterns as a simple, low-cost way to specify and deploy business processes on a departmental (line of business) level, and several potential users regarded them as providing a new paradigm for constructing business applications. On the other hand, there was some concern over the potential proliferation of activities, resulting in problems for users similar to those they face today with numerous e-mail threads and traditional folder systems (as described in Reference 20). Also of concern was the management and control of

activities and activity patterns: who could create and approve them for broader distribution and how they would interact with other policies in place to control access to content in the organization.³⁵

One executive at a manufacturing company was interested in using activity patterns to support employee self-service use of human resource information and other processes. He particularly liked the potential for a single system to support what he termed the need for a “spectrum of rigidity”—that is, a range of process types, from business processes in which certain items or actions were required or constrained because of internal policy or external regulation, to others which would offer employees more flexibility. It was critical to him that this range of processes would be integrated with the existing systems used in his organization.

In reacting to the activity model, some users contrasted it with traditional systems, especially in the context of processes for which a traditional system was not appropriate. This mismatch could be due to the need for many adjustments to the initial system implementation or to difficulty in getting the funding required to construct a system. An example was the monthly change management of work associated with updates and modifications to a record system. The informal process used for these modifications involved reviewing and prioritizing requests received from users of the system, making and testing the changes, and notifying users of the changes and system updates. Depending on the modifications, the documentation might need to be updated to reflect the new features. It was also important to review the educational materials used in training sessions to see if any changes would need to be made to them.

The current system had no formalized process to guide the work of the team responsible for these changes; instead, it was necessary to rely on employees remembering the tasks they needed to do and coordinating informally among themselves. While this worked well much of the time, occasionally, work items were neglected. An activity pattern could be created that would be well-suited to guide the monthly change management activity, outlining the steps and their status, and providing pointers to facilitate access to the outside resources (such as documentation and training materials) that team members would need to consult. It was

particularly helpful that this pattern did not need to be complete or exhaustive before it could be used and useful; rather, the basic activity could be specified quickly and enhanced further as it was used.

Activity patterns were seen as providing the right combination of structure and flexibility necessary to support custom design and manufacturing jobs that required deviation from standard offerings. These patterns and specializations of them were also seen as providing a means of supporting repeated projects for a single customer or similar projects from multiple customers. Starting from a standard pattern for each of the main types of products they offered, the patterns could be customized for each project or customer by the inclusion of their particular art, requirements, and other content.

Overall, this feedback encouraged us to proceed further with activities in general and the notion of activity patterns in particular. Chief among the requirements that arose included mechanisms for specifying various levels of constraints, additional support for the management of multiple activities, access control related to the management of activity patterns, schemes for selective inheritance of updates to patterns, and mechanisms for culling and archiving activities no longer active. Along with this set of needs, we were mindful of one executive’s caveat to “keep it simple” and avoid burying the core concept under a great deal of interface complexity or unnecessary infrastructure requirements.

CONCLUSION

Activities show promise to change the business computing landscape by contextualizing work and providing a place to share and collaborate on the work while capturing a record of how the work was done, by whom, and when.

The key to enabling activities is the maturation of Web-based technologies that provide a way to link disparate systems. As business activities begin to be used in large numbers, they will offer new ways to look at business process development, process monitoring, performance measurement, and the discovery and optimization of best practices.

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