IGI PUBLISHING
701 E. Chocolate Avenue, Suite 200, Hershey PA 17033-1240, USA
Tel: 717/533-8845; Fax 717/533-8661; URL-http://www.igi-global.com

ITJ4210

This paper appears in the publication, International Journal of E-Business Research, Volume 4, Issue 2
edited by **In Lee © 2008, IGI Global**

Analysis of Business Process Models in Enterprise Web Services

Mabel T. Kung, California State University-Fullerton, USA

Jenny Yi Zhang, California State University-Fullerton, USA

ABSTRACT

This article reports a series of process-based models for the development of e-business using enterprise software applications. Merging management technology in workflow systems is a critical step to provide service-oriented architecture and on-demand business. We propose a value-oriented process technique as a strategic alignment to improve investment value. Our framework focuses on the guidelines for traditional users to identify the structural conflicts in integrating Web services. A comparative study of workflow models for intra-and inter-organizational process control is presented. This article identifies the current progress in the adaptability in the design of process models coupled with structural changes of workflow views. The study provides a resource list of successful implementations for practitioners in organizational management. The research highlights the motivation of market facilitation, expert sharing and collaboration that enable commercial applications to support complex heterogeneous, autonomous and distributed information systems.

Keywords: *business strategy; electronic business; process improvement; workflow models*

INTRODUCTION

Business process modeling is a significant activity in enterprises as e-business and enterprise integration drive the need to deploy business processes online (Aissi, Malu, & Srinivasan, 2002; Weiss & Amyot, 2005; Sewing, Rosemann, & Dumas, 2006). Most business process modeling efforts are knowledge-intensive and require organizations to formalize a large number of complex inter- and intra-organizational processes to facilitate their ensuing deployment in large-scale workflow systems in enterprise planning (Tagg, 2001). These management systems need to be integrated with the tools of a process to perform within it: productivity tools, specialized technical support systems, such as CAD systems, graphic packages, enterprise-wide integrated software applications, such as enterprise resource planning (ERP), customer relationship management (CRM), mail systems and other communication systems. When the applications become more modulated and service-oriented, there will no longer be work-

alone software. (Cimatti, Clarke, Giunchiglia, & Roveri, 2000).

The most common application for process modeling, control and management is Workflow Management Systems (WfMSs). The technology has become readily available (van der Aalst, Desel, & Oberwies, 2000; van der Aalst & van Hee, 2002; van der Aalst & Jablonski, 2000; Fischer, 2001; van der Aalst & van Dongen, 2002; Grigori, Casati, Dayal, & Shan, 2001; Herbst & Karagiannis, 2000; Cook & Wolf, 1999). Commercial workflow management systems (WfMSs) such as Staffware, IBM MQ-Series, and COSA offer generic modeling and enactment capabilities for structured business processes. Besides stand-alone systems, WfMSs are becoming integral components of many enterprise-wide information systems (Leymann & Roller, 2000). Consider, for example, Enterprise Resource Planning (ERP) systems such as SAP, PeopleSoft, Baan and Oracle, Customer Relationship Management (CRM) software, Supply Chain Management (SCM) systems, Business to Business (B2B) applications which embed workflow technology.

The introduction of large scale systems such as the ERP system changes the structure of the organization of software applications. This moves from numerous independent software development procedures to an integrated Web based software framework with components for different purposes. Although ERP system can improve organization's performance, standardized ERP system from the vendor such as SAP, need to be customized to be deployed in an organization. It has to be customized to fit the business goals of the company. This customization needs the continuous input of end user involvement. In order for the dynamics of the Web services to succeed, the deployment team needs to understand the business processes of the company that can be incorporated into a workflow design. The design layout can then be used for discussions with the management and end users to provide better understanding of the processes during changes.

Currently, "Eighty percent of the software that needs to be written has already been done collaboratively" (McKendrick, 2006). It was estimated that in U.S. alone, there would be 55 million user developers compared to 2.75 million professional software developers (Sutcliffe & Mehandjiev, 2004). Because the user developed software may affect the entire organization's system, more challenges and conflict issues arise in a more dynamic state (Bergeron & Berube, 1990). Although the centralized Information Technology (IT) department provides the traditional support of the enterprise-wide system, integration and workflow design are far from trivial. Without appropriate policies and control mechanisms, user development cost can be higher than the benefit it brings in (Galletta & Hufnagel, 1992). The cost related to such user software includes poor security, incompatible hardware and software, inadequate documentation (Davis, 1988), insufficient validation and testing (Alavi & Weiss, 1986; Davis, 1988; O'Donnell & March, 1987), and ill-defined policies regarding access to corporate databases (Alavi & Weiss, 1986). Without a structured process control flow or policy, collaborative computing in enterprise wide systems can hardly be effective.

This article presents the components of a standardized business process with the emphasis from the user point of view. The individuals involved in each process have the skills and human capital that complement one another. Next, a value-oriented framework is proposed as a benchmark for economic assessment. The synthesis and the process-based approach are discussed to align with organizational strategic goals. In this context, the types of inputs, the nature of tasks needed to perform the activity, the sorts of coordination required among the various tasks, and the intended scale of output depend on the internal top management reactions to assess values in the production level as well as the social level among the employees. Lastly, a summary of current research in workflow models provides the technological and managerial issues involving the current designs in organizations. By combining these different streams of research, our objective is to provide guidelines and structural designs to

enable evaluations of process goals to improve the overall value of enterprise Web services.

BUSINESS PROCESS

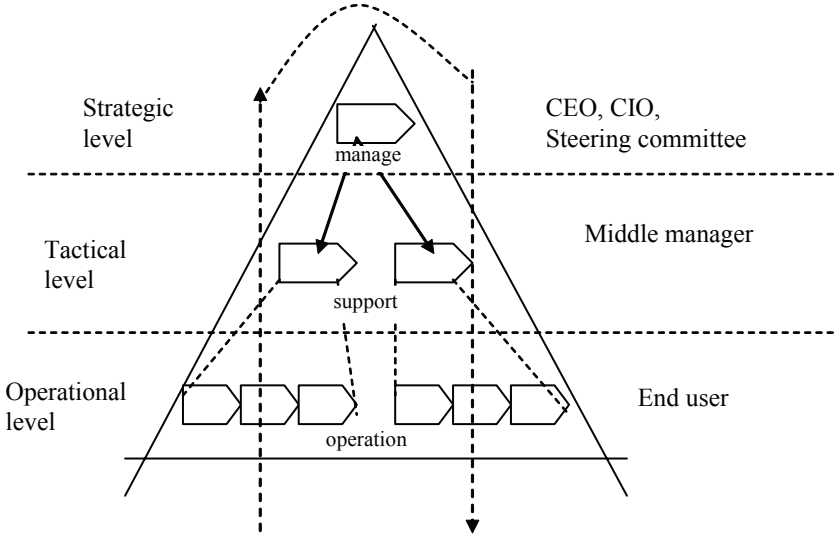
A business process is composed of a series of continuous actions or operations that are performed upon a commodity (Childe, Maull, & Bennett, 1994). It is usually initiated by a customer. It must provide results directly to a customer, who may be internal or external to the company. CIM-OSA Standards Committee (1989) has subdivided processes into three main areas: manage, operate and support. The CIM-OSA framework regards manage processes as those which are concerned with strategy and direction setting as well as with business planning and control. Operate processes are viewed as those which are directly related to satisfying the requirements of the external customer, for example the logistics supply chain from order to delivery. They are sometimes referred to as core processes. Support processes typically act in support of the management and operate processes. They include the financial, personnel, facilities management and information systems provision (IS) activities.

Information systems (technologies) make an impact at different levels (Brancheau & Brown, 1993; DeLone & McLean, 1992; Harris, 2000; Powell & Moore, 2002; Seddon, 1997; Andreescu, 2006): system or information level, individual level, group level, organization level, and system or information quality level. When user develops application changes in organizational information system, these modifications will also affect all four different levels. Without careful coordination at all levels, the organization will not obtain the possible benefit that the user intends to bring. Consider the coordination from the process perspective. The collaboration begins in these stages: (1) manage processes are related to organizational level, (2) operational processes are related to system and information level and individual level, and (3) support processes are related to group level influence.

Traditionally, project initiatives begin from the top management level and filter down to the lower level. However, sometimes a project may start from the bottom level with an idea to modify the existing system to improve effectiveness or efficiency of their job. This initial idea will then be presented to the tactical middle management level to convert it into higher-level business requirement and redirected back to upper management. Upper management will then judge it based on its strategic direction. If the proposal is approved, it will be sent back to tactical level where it will be converted to a detailed plan on how to perform the project. The project will be divided into sub processes and activities, which will then be transferred to operational level where the implementation takes place. Figure 1 illustrates the hierarchical processes within the infrastructure:

- **Strategic level**: The top level process mainly deals with direction setting, high-level strategic planning activities. One common problem with many improvement initiations being less successful is the lack to the organizational strategy, or the big picture (Rummler & Brache, 1995; Hacker & Brotherton, 1998). Sometimes, an initiation might be beneficial in local operation level, but might be malicious for the enterprise-wide strategy. In most IS projects, manage process acts as an overall management that takes ideas about direction based upon business requirement reported from the operational level, decides whether or not to proceed it based on its alignments with the company's overall direction, and sets the high-level goal for the project. Competitive advantage requires the learning, change and adaptation processes over the time horizon in terms of the availability of resources and the capabilities of the users involved. (Helfat & Peteraf, 2003; Adner & Helfat, 2003). The CEO and CIO's office has the responsibility to define the strategic enterprise architecture that provides the infrastructure for activities in each of the business units, the tactical level and the operational levels. Strategic level will decide the organizational level impact from the project.

Figure 1. A hierarchical process perspective (or top-down and bottom-up perspective)



- **Tactical level**: This level serves as a converting or communication level. It performs several critical roles:
  - Transfers the high level strategy into plans on how to convert an initiated idea into a finished product.
  - Serves as a bridge between business perspective and technical perspective
  - Provides guidance and support at operation level.

This level is the most important among all three levels. It serves as a glue to combine strategic and operational process all together. It encourages the creativity of user, and at the same time guarantees the quality and integrity of user development. The level does all the managerial tasks that directly related to the project, for instance, agreement of requirement changes, monitoring project timetable, and quality control. Meeting customer and partner demands with proactive and efficient services, special attention to preferred business alliances such as joint market launches, analyst briefings, technical collaboration, or premium customer support, help increase custom satisfaction. Customers are provided a set of collaborative tools and relationship portals for interacting with core partner services and become stakeholders for the income generated by applying this value-oriented model. In many instances, the success of the implementation of a project depends on this level's function.

- **Operational level**: This is the level where an idea of implementing a system starts and also where it changes into a final product. With the trend of deploying enterprise-wide information systems, the most important issue at this level is to consider how the final product be integrated into the company's existing IS infrastructure, and be reused by other departments. The Web services and user relationships can be measured by the value of the final product. The user satisfaction may take into effect greater creative freedom and channel the skills in an innovative fashion for career growth, such as obtaining deeper specialization in an area, taking broader responsibility in serving the area services, acquiring decision making skills to meet enterprise transformation and culture changes.

Level	Responsibility
Strategic	Strategic alignment Sustainable advantage Benefits measurement Evolution of resources over time
Tactical	Cost control Quality control Connectivity Control Planning Coordination with other department
Operational	Functionality/Capability Development Unit test Documentation

A Value-Oriented Framework

The value of the computing depends largely on the quality of the use to which it is put. Pressure to decrease costs has led to downsizing of data centers, reductions in programming staff for development, fewer resources for maintenance and an overall push to move computing power out to the users (Livari & Livari, 2006; Melville, Kraemer, & Gurbaxani, 2004; Fischer, Giaccardi, Ye, Sutcliffe, & Mehandjiev, 2004; Tallon, Kraemer, & Gurbaxani, 2000; Boynton, Zmud, & Jacobs, 1994; Guimaraes, Gupta & Rainer, 1999; Hitt & Brynjolfsson, 1997). Instead, these managers should be asking: *"How much more value can the organization create, in a given period of time, with the user computing as opposed to without it?*"

What follows is a value-oriented framework that addresses interrelated problems through the value of information technology. The assessment starts with Level I as the lowest stage with each level dependent on all lower levels (see Box 1).

Level I: Mechanical/ Physical

Naturally, the first and most elementary question is: Do the hardware, software, and communications do what they are supposed to? The significant problems at this level today have to do not so much with individual systems, but more with integrating multiple systems from a variety of vendors. Software vendors have responded to this dilemma by aggressively developing products and services to meet the demands of both the systems personnel and users. They have embraced new technologies such as distributed processing, client/server architectures and relational database technology. But more importantly, they have developed new systems that provide users with the ability to maintain, enhance and run their own systems without constant involvement and assistance from the systems department.

Level II: Economic

Once the user computing works as it is intended, it must do so at an acceptable cost. Of course, purchasing managers do have up-to-the-minute information on how much the next system will cost to acquire. The problem is, once the systems have been acquired, nobody keeps track of the user computing assets as a separate category, aside from office equipment or sometimes, furniture. This often has to do with the structure of the company's chart of accounts. In the scheme of things, these technologies are still relatively new, and accountants absolutely hate to change the chart of accounts (Hitt & Brynjolfsson, 1997).

Even where all the hardware and software costs are tracked regularly and careful, companies often stumble on the scope of costs associated with the user computing. Most important, training and support costs are almost always underestimated or, worse still, ignore. These costs, combined with the cost of the users' own time, turn out to be much larger than the initial cost of the hardware and software.

Level III: Business Linkage

The third layer address whether the user computing is being used in ways, which promote the company's objectives. The chief question here is whether the user computing is deployed most intensively, where it can best leverage the organization's ability to create value. Too frequently, user computing gets deployed strictly along organizational lines, without much regard for the fact that user computing, like any other tool, has more value in the hands of certain groups or individuals (Compeau, Higgins &

Box 1.

Level	***Issues***
IV Transformation	New Business Doing Business Differently Sustainable Advantage
III Business Linkage	Alignment/Organization Service Level/Support Flexibility/Responsiveness Benefits Measurement
II Economic	Applications Development Production Support/Maintenance Overheads
I Mechanical/Physical	Functionality/Capability Reliability Connectivity

Huff, 1999; Shah, 2001; Talon, Kraemer, & Gurbaxani, 2000).

The issue of business linkage also involves hardware and software selection, as well as training and support. In particular, there is a strong, natural tendency for central information systems organizations to limit the user computing choices from which user organizations can make selections and receive support. While this approach helps the information/systems managers hold down their budgets, if taken too far it can seriously reduce the user computing leverage for a particular business or unit.

Level IV: Transformation

The final layer focuses on whether the business strategy has been conceived and implemented in ways that take advantage of the opportunities provided by the user computing. Doing things the same old way is comfortable, and often seems to entail less risk. As fundamental changes in the corporate environment have given rise to the wave of restructuring, dramatic advances in user computing technologies are enabling fundamental changes in the ways in which work is structured. Because some managers are unwilling to embrace substantial change to the internal culture, many of these companies are overlooking opportunities to eliminate vast amounts of paperwork, along with the associated costs and risks to quality. In retrospect, user computing enables new organizational reporting relationships. In this age of restructuring, user computing supports the need to move away from conventional hierarchical structures to more relational organizations, with less management filters (Biazzo, 1998; Davenport, 1993; Hammer, 1996).

Synthesis with Workflow

Business linkage and transformation are the most crucial levels. As the most successful deployers of user computing have found, not moving up from the lower two levels of the model is analogous to manufacturing a product, shipping it to a warehouse, and then waiting for potential customers to notice it is there (Stras-

smann, 1997). Put simply, products alone do not deliver value, customers do.

In any business, it is the customer who eventually determines the product value, sets a reasonable price and establishes marketplace demand. It is the customer who controls cash flow into the organization and, thereby, drives shareholder value.

For information systems management, the customer is the user, and the marketplace may be the business divisions or functional groups within the enterprise. It is the organization's users who will, therefore, ultimately determine the value and return on the user computing investments.

Consequently, the focus of management must shift from the traditional comfort zones of Level I and II – technical standards and acquisition control – toward the user and the organization's business strategy. Of course, the Level I and II issues must also be addressed appropriately if the benefits of Level III and IV are to be realized. A key element for evaluation process has been holding sessions with users to get their input on how well the current computing environment meets the real needs of their businesses. User may hold the technical expertise of their information systems organizations in high esteem, but consider it of limited value when that expertise is not applied to their business in ways that not only work technically, but also add significant value.

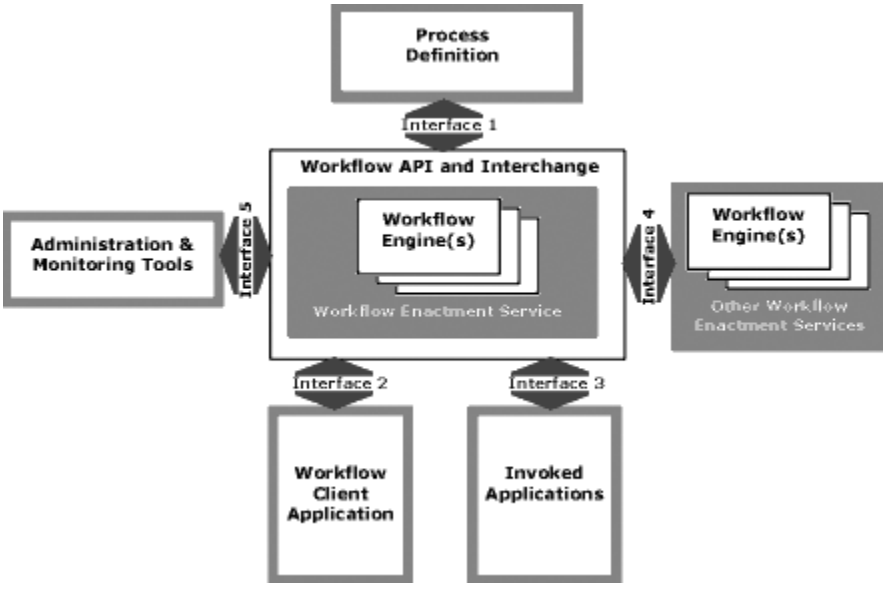
Today's dynamic environment has no place for the drawn-out, form-driven, bureaucratic planning process and thick planning documents. Instead, the alignment process is based on frequent, structured dialogues between the information systems management and users, and great care is taken to ensure that the discussion gets beyond the "gripe session" level. Findings from these meetings and subsequent surveys have been somewhat surprising and enlightening for the information systems management. As a direct of these efforts, some businesses can be identified as "under-served;" others as "over-served." Adjustments can be made to both resource allocation and support levels, resulting in both cost saving and revenue enhancement. Further, emerging opportunities for high-value applications of the user computing can be uncovered, particularly in the areas of marketing and sales.

This approach enables the information systems organization to enter into a partnership with the users. Equally important, by focusing on Business Linkage (Level III) and Transformation (Level IV) issues, the connection between the user computing and shareholder value has been clearly established. Finally, user managers now have responsibility for both their business unit's performance and shared responsibility for the users who support it. For their part of the partnership, the information systems managers play a supportive role with respect to user computing applications, and serve as the keepers of the corporate standards (Keen & Knapp, 1996).

In fact, coordination support is the key component that distinguishes task-oriented from process-oriented technologies. When it comes to currently available computer-supported process coordination, workflow technology has been widely recognized as the leading process-oriented coordination tool (Workflow Management Coordination, 2006). Workflows are designed to specify, execute, manage, monitor and streamline business processes that span the functional boundaries in an organization. Figure 2 shows the technology that offers effective coordination support by allocating the right task to the right person at the right point of time along with the resources needed to perform the assigned task.

In Figure 2, Interface 1 is used at build-time to define the workflow process. Interface 2 defines the standard mechanism for interacting with the user of the WfMSs, the worklists that appear on user screens. Interface 3 is the API through which the WfMS interacts with other user applications such as ERP or CRM systems. Interface 4 is the standard API through which WfMSs provided by different vendors can interoperate. Interface 5 is the API through which administrators gather information from the log maintained by the WfMSs. Facilities such as e-meetings with electronic white-boards,

Figure 2. Workflow reference model (Workflow Management Coalition, 2006)



instant messaging, Web casts, and task-oriented community tools supplement the existing synchronous communication facilities, such as teleconferences. Asynchronous communication is supported by specialized team rooms, project databases, interactive team portals and forums, and e-mail.

The strategic level of the organization should establish a demonstrable connection (direct or indirect) to one or more critical business issues (Process Definition). Accountability related to process modeling requires a clear specification and has to be adapted with changes in the objectives, scope or size of the modeling initiative (Administration and Monitoring Tools). The true economies of scale and synergies occur when communications among the end-users at the operational level are open and are willing to migrate the wide range of purposes to one common platform (Workflow Engines). The managerial tasks at the tactical level are to identify the required skills by means of educational training, to locate expert process representatives, to explain to the users the holistic picture, and to facilitate the process visibility across the heterogeneous group of stakeholders, the strategic, tactical and operational levels (Workflow Client Application and Interchange).

The workflows or processes within a single organization can be extended to multiple, geographically distributed locations over wide-area communications networks (Basu & Kumar, 2002; Sewing, Rosemann, & Dumas, 2006). Applying the value-oriented process framework and workflow perspectives, the user can create digital interface by means of common platform, such as Java 2JEE, Java Servlets, or using JSP, a process that requires minimal development time (van der Aalst, Weske, & Grunbauer, 2005). Workflow management systems such as Ensemble (FileNet) and InConcert (InConcert) support workflows by the end-user of the system under unexpected undesirable events (van der Aalst & Jablonski, 2000). Many enterprises select standardized commercial workflow management systems, COSA, Visual Workflow, Forte Conductor, Lotus Domino Workflow, Meteor, Mobile, MQSeries/Workflow, Staffware, Verve Workflow, I-Flow, InConcert, Changengine,

SAP R/3 Workflow, Eastman, and FLOWer (van der Aalst, ter Hofstede, Kiepuszewski, & Barros, 2003).

Mediation to link service requestors, providers and end users is supported by middleware such as the Enterprise Service Bus (ESB) (Robinson, 2004; Schmidt & Kalyana, 2004). The ESB is the infrastructure which integrates the user roles involved in creating and managing the solutions, describing service endpoint requirements, capabilities, and relationships, including information describing the specific details of interaction contracts. The service registry assembles the runtime entities, dynamic adaptation components, multiple crosscutting configuration, connection, matchmaking, channel structures and event application domain for users (Kon, Costa, Blair, & Campbell, 2002) These ESB usage patterns are realized through large-scale retail and brokerage applications. The ESB plays a central role in the implementation of the architecture for the IBM On Demand Operating Environment (Cox & Kreger, 2005; Schmidt, Hutchison, Lambros, & Phippen, 2005; Sadtler, Cotignola, Crabtree, & Michel, 2004).

In both intra-organizational and interorganizational WfMSs, traditional workflow systems have limitations in support of flexibility, adaptability, these limitations result in restraint control, delegation, and coordination of processes and tasks for mid-level managers (van der Aalst, Weske, & Wirtz, 2003). In the next section new developments in WfMSs will be presented to overcome the limitations and to support workflow control over multiple organizations.

COMPARISON OF DESIGNS IN PROCESS-BASED OPERATIONS

In order for a process model to operate coherently, not only the users need to know how each activity works, but they have to *manage* the dynamic changes in the processes so that the flow of work and information between participants is reasonable and efficient (Basu & Blanning, 2000; Bolton & Davis, 2000; Stohr & Zhao, 2001). Traditionally, WfMSs support process control within one organization, Intra-organizational WfMSs (Hevner, March, Park, & Ram, 2004). However, with the evolution of the commercial Internet, the trends for virtual corporations and e-commerce, increased global networking of economies is accelerating. Work has also shifted from creation of tangible goods from one organization to the flow of information through the value chain that across multiple organizations. The research in WfMSs has also shifted to define, analyze, and management the flow of information-intensive work (Basu & Kumar, 2002). This extension allows the users on the operational level to communicate and refine the process as these Web-based systems move toward an open environment. Such open processed-based systems enable the employees at the operational level of companies to implement their ideas in the form of inherently distributed and interorganizational design (Verbeek, Basten & van der Aalst, 2001; Basu & Kumar, 2002). The flexibility as an interaction agent over the Internet pushes more control of the middle managers and their subordinates to perform more market-based solutions. Implementations using the Unified Modeling Language (UML) serve to be a useful technique in integrating this design (Fowler & Scott, 1997). Another analytic tool that users can develop company's views of the process is the bridging of the eXtensible Markup Language (XML) and supply chain modeling that define data elements in business documents.

Intra-Organizational Process Control

Intra-organizational WfMSs are implemented to support the modeling, analysis, and performance of routine business processes. With the trend of companies going global and joining e-commerce, many business processes are subject to change. However, the traditional WfMSs typically fail to allow for unexpected or developmental changes occurring in the business practices and processes they model (Casati & Pozzi, 1999; Borgida & Murata, 1999; Heinl,

Horn, Jablonski, Need, Stein, & Teschke, 1999; Van der Aalst, 1999). They also have limited support to emergent processes which is a challenge to the coordination-related tasks that an end-user is likely to perform (Alvai & Leidner, 2001). Most available commercial workflow systems rely on a monolithic, single-schema architecture, which makes it difficult to fully capture the business process to be supported (Bichler, Preuner, & Schrefl, 1997). This has been recognized as a major limitation in the uptake of WfMSs (Heinl et al., 1999). Also, these WfMSs provide little support for exception handling at the process-conceptual and instance-execution layers (Casati & Pozzi, 1999). These limitations restrain the control of the end users on the WfMSs, which makes it less efficient.

Recently, research in intra-organizational WfMSs has been focused on providing solutions to the above problems so that WfMSs can offer the automation of the routine tasks, and help users deal with exceptional situations, breakdowns, or emerging new processes in a secured manner. Van der Aalst (1999) presented a generic model which can provide management information at the right aggregation level and also offer adaptability. Kumar and Zhao (1999) proposed a general framework to implement dynamic routing and operational controls in WfMSs. Faustmann (2000) proposed an approach to configure parts of a detailed process model with different ways of assigning tasks to a worker, which they call support strategies. These support strategies allow changes if the situation requires. In this approach, the end user can have different ways to accomplish on a task. They can do it directly, or delegate subtasks to other workers. Kumar, Van der Aalst, and Verbeek (2002) proposed an approach to dynamically distribute work in order to create a balance between quality and performance. Wang and Wang (2006) used a cognitive approach to take real-time decisions on activities into consideration so that the system is more adaptable. Adams, Edmond, and Hofstede (2003) proposed an approach of handling flexibility by deriving principles for work practice from "Activity Theory." Klein and Dellarocas (2000) presented a notation, Ariadne, to support different dimensions of process modeling to achieve adaptability. Hagen and Alonso (2000) presented an algorithm for improving fault tolerance of WfMSs based on exception handling from programming languages. Klein and Dellarocas (2000) proposed to use a knowledge management system for exception handling.

Another concern in WfMSs is security. Workflow authorization models were proposed in late 1990s (Atluri & Huang, 1996, 1997; Casati, Ceri, Pernici, & Poss, 1995). In recent years, Wainer, Barthelmass and Kumar (2003) proposed security models for WfMSs with Role-based Access Control (RBAC) model. With the advances of the Internet technology, companies are becoming distributed and multinational. An extensive array of functions across the organization is being performed through the Web services. The security concern is also moved to the cyberspace (Gudes, Olivier, & Riet, 1999; Gudes & Tubman, 2002). Several studies address the organizational structure changes due to the decentralization and globalization of the companies (Tan & Harker, 1999; Klarmann, 2001; Muehlen, 2004). Other assessments in WfMSs involve monitoring business process performance (Thomas, Redmond, Yoon, & Singh, 2005), using incentive mechanisms to formulate organizational modeling (Raghu, Jayaraman, & Rao, 2004).

Interorganizational Process Control

Compared to intra-organizational workflows, interorganizational workflow has its unique issues. Among them, the most important ones are *heterogeneity* which consists of the hardware, software, automation level and workflow control policies, and *autonomy* of the local systems which result in a lack of cross-company access to workflow resources and the missing of a complete view of the whole workflow (Zhao, 2002). In this area, research focus is in developing techniques for ensuring semantic integrity of the information and rules for mapping it correctly between any two partners. Cur-

rently, XML and Web services gain popularity across enterprise systems and infrastructures. These services sustain major roles in interorganizational workflow management. A major challenge in achieving the goal of Web services composition for process management is semantic interoperability. Communication among heterogeneous, independently developed Web services demands a well-defined mechanism for semantic description of services and their properties so as to make services semantically understandable by business process. Security is also a concern (Zhang, 2005).

Van der Aalst (1999) presented two possible process-oriented architectures for interorganizational workflow systems. Several research studies in this area focus on defining languages or schemas to support interorganizational workflow (Van der Aalst & Kumar, 2003, 2005; Workflow Management Coalition, 2006). Chiu, Cheung, Till, Karlapalem, Li, and Kafeza (2004) used workflow views for interoperability of multiple workflows across business organizations. Web services present another popular topic in interorganizational process control. Zhang (2005) evaluated the roles of Web services in cross-organization process management. Cardoso and Sheth (2003) developed ways to discover Web services in interorganizational WfMSs. Kumar and Wainer (2005) explored the exception handling problem in interorganizational setting. They used XML defined metaworkflow knowledge for control and coordination. Singh and Salam (2006) discussed the security aspect of interorganizational process control. They deployed ontology analysis to identify central concept for e-business process modeling.

Figure 3 gives a summary of the current progress for workflow models for both intra- and inter-organization.

CONCLUSION

Using the value-oriented framework from a systems perspective, the user is typically working with some sort of task. Ideally, this task is adding value to an activity. This activity should add value to a process output, a product, and the process and product should be vital to the organizational strategy.

While the user tend to have excellent knowledge of day-to-day operations and what is needed in these operations, he/she may not have full understanding of the process goals and how different activities together add value to the process output. On the other hand, management tends to be withdrawn from day-to-day operations and may not fully understand the details at each task level.

Ideally, the holistic big picture should be understood by the personnel in the organization, yet few seem to do. Problems potentially occur when user recognizes a clear need for some sort of improvement or development, yet because he/she may not have knowledge of the bigger picture, this improvement may cause suboptimization of the system. In other words, the improvement may help at task level but not at process level. If users understand the systemic picture and the connection between strategy, processes and operations, then user development of activities as well as systems can be a valuable tool for organizational improvement and efficiency. This form of development will not cause suboptimization of processes. On the contrary, organization can use standard forms of software, and still create unique solutions at user/task level. Similarly, ideas to improve operations can be implemented. WfMSs can be used to help both managers and end-user understand the business process better. It also helps managers to control and delegate tasks more efficiently and effectively.

The management of the new information based company is the entrepreneurial spirit through user computing. Exchanging and distributing knowledge allow people at the line levels more aggressively setting their own direction and objectives. Individual managers feel more control and satisfaction with the end product to resolve issues on their own. Mentoring opens wider communications between the systems personnel and levels of employees closest to operations, customers, and their associated problems. Such strategy continues to encourage the creativity and team cooperation

Figure 3. A summary of current progress in workflow models

Author	Aspect	Solutions	Technology used
Van der Aalst (1999)	Capture management information; Adaptation	Present a generic model inspired by the techniques used in product configuration to aggregate management information and also support dynamic changes	Product configuration
Kumar & Zhao (1999)	Flexibility; Exception handling	A general framework to implement dynamic routing and operational controls	Workflow control tables; Sequence constraints; Event-based workflow management rules
Hagen & Alonso (2000)	Exception Handling	An algorithm for implementing more reliable processes based on exception handling in programming languages, and atomicity	Exception handling in programming languages; atomicity
Agostini & Michelis (2000)	Flexibility; Adaptation	Present the MILANO system which is highly flexible and adaptable. The system is built on the principle that workflow models must be as simple as possible	Elementary Net System
Faustmann (2000)	Flexibility; Adaptation	Proposed an approach that configures parts of a detailed process model with different support strategies (how a system assign tasks to a worker). The explicit modeling of these support strategies allows them to be changed if demanded by the situation.	Used in the WAM approach (Wide Area Multimedia Group Interaction)
Klein & Dellarocas (2000)	Exception Handling	Proposed an approach for exception handling that is based on exploiting a generic and reusable body of knowledge concerning what kinds exceptions can occur in collaborative work processes, and how these exceptions can be handled.	Artificial Intelligence
Divitini & Simone (2000)	Adaptability	The paper claims that adaptability involves different dimensions of process modeling. These dimensions concern the possibility to flexibly combine a rich set of basic categories in order to obtain the most suitable language for modeling the target business process and the work practices around it.	Ariadne, a notation providing a set of linguistic features suitable to model processes and their evolutions.
Kumar et al. (2002)	Dynamic work distribution	A systematic approach to dynamically create a balance between quality and performance issues.	Use metrics to represent work distribution
Adams et al. (2003)	Flexibility; Exception Handling	Derive a set of principles for work practice from "Activity Theory" to create a set of criteria to provide adequate support for flexible work methods.	Activity Theory

continued on following page

Figure 3. continued

Wang & Wang (2006)	Adapt to change	A cognitive approach to help manage complex business activities based on continuous awareness of situations and real-time decisions on activities.	Cognitive Process
Tan & Harker (1999)	Organizational structure: centralized vs. de-centralized	Use of mathematical modeling to compare the total expected costs of decentralized and centralized organizational designs. Coordinate the flows of information and work.	Mathematical modeling
Klarmann (2001)	Changes in organizational structure	Existing systems cannot cope with frequent structural change of organizational and process structure. Use of an organizational meta-model that describes meta information about organizational structures.	Meta Model
Muehlen (2004)	Organizational Management	Provide an overview of the organizational aspects of workflow technology in the context of the workflow life cycle	Meta model
Thomas et al. (2005)	Monitor business process performance	A loosely coupled semantic architecture overlaid upon a business process, where agents communicate and monitor business process performance. The descriptive power of semantic languages can be used by agents to provide input for process reconfiguration decisions based on process performance measures.	BPEL, Web Ontology Language
Raghu et al. (2004)	Economic incentives	An approach to organizational modeling that integrates both agent-centric and activity-centric approaches using incentive mechanisms.	Combine agent-centric and activity-centric to model organizational process
Gudes (1999)	Security	Present a three-level framework: modeling, specification and implementation. The participation of an Alter-ego in each message enables the complete authentication and some specific individual-based checks that are required in such an environment.	Alter-ego: one object in which all relevant of an individual person is kept and which can execute actions.
Gudes & Tubman (2002)	Security	A system AutoWF is presented for secured WfMS over the Web.	Autonomous objects
Wainer et al. (2003)	Security	Present a pair of role-based access control models for workflow systems known as W-RBAC models	The Role-based Access Control (RBAC) model
Van der Aalst (1999)	Process-oriented architecture verification (across organizations)	Evaluate two approaches of interorganizational workflow architecture with the concern of possibility to verify correctness of interorganizational workflows	Case transfer architecture; Loosely coupled architecture

continued on following page

Figure 3. continued

Singh & Salam (2006)	Security aspect of interorganizational Business process (across organizations)	An ontological analysis of an e-business process and identify a set of central concepts that are essential to model the e-business process. Utilize this e-business process to develop a semantic architecture.	OWL-DL (description logics)
Alast & Kumar (2003, 2005)	Interorganizational information exchange (across organizations)	Develop process models of interorganizational workflows and their coordination structures. Design an eXchangeable Routing Language (XRL) using XML	Petri nets, XML XRL
Kumar & Wainer (2005)	Exception handling (across organizational)	Control and coordination of interorganizational workflow systems using metaworkflow knowledge of interorganizational e-business processes	XML
Zhang (2005)	Interorganizational process management (across organizations)	Discuss the role of Web services in process management. Propose an architecture for process workflow via Web services composition.	Web services
Chiu et al. (2004)	Interoperability (across organizational)	Use of workflow views as a fundamental support mechanism for the interoperability of multiple workflow across business organizations.	XML, Web services
Cardoso & Sheth (2003)	Interoperability (across organizational)	Develop ways to efficiently discover Web services – based on functional and operational requirements and to facilitate the interoperability of heterogeneous Web services in e-services. Use of ontology to achieve service discovery and interoperability functions more efficiently.	Web services, Ontology-based systems

in the business functions of the company and ultimately the systems achieve usability from the people who design and develop themselves, the users.

Although WfMSs provide us a promising solution to help understand and control processes and motivate communications among different levels of personnel in an organization, current commercial WfMSs still have limitations in supporting flexibility and adaptation, and lack of interoperability to support B2B workflow control. As the gap between academic and industry standards reduces, the above weakness can be overcome.

This article aims to address a guide to practitioners through a series of well-defined structural steps necessary to make informed, consistent and efficient changes to business processes. The research has also contributed to the new knowledge in Web-based services with the collaborative workflow applications. The mechanisms of interorganizational workflows coupled with the performance incentives of the process framework enable the users to integrate enterprise applications in a distributed environment. In order to gain a sustainable competitive advantage in the wide spectrum of e-services, workflow technologies coupled with cross-functional business processes offer fully automated coordination support. Future debates include the standardization to bridge between systems with an organizational boundary, where the internal

systems meet the external Web systems and other ways of using value-oriented patterns to improve performances.

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Mabel T. Kung is professor of information systems and decision sciences at California State University, Fullerton. Her PhD is from the McCombs School of Business at The University of Texas at Austin. Her research publications and industrial experience include the fields of e-commerce, corporate training, strategic planning and benchmark technology, web component development and enterprise database systems.

Jenny Yi Zhang is associate professor of information systems and decision sciences department at California State University, Fullerton. She earned her PhD in information systems from the New Jersey Institute of Technology. Her research areas are mainly focused on e-business, knowledge management, virtual communities, virtual teams, and business intelligence.