Proceedings of the 2003 Winter Simulation Conference
S. Chick, P. J. Sánchez, D. Ferrin, and D. J. Morrice, eds.

TOWARDS SIMULATION-BASED BUSINESS PROCESS MANAGEMENT

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ABSTRACT

Simulation and optimization of business processes can provide a basis for Business Process Management.

1 INTRODUCTION

This paper explores how work flow performance can be improved through an approach that aligns the network architecture with an organization's business processes. Simulation is examined as a way to optimize this alignment.

We consider that there are three layers to this issue: business processes, network architecture, and the work flow application. Each layer will be considered, followed by a look at the central alignment problem.

2 BUSINESS PROCESS FLOW – CONCEPTS AND METRICS

Looking at business process flow from a modeling viewpoint, it involves the movement of work objects or "entities" within and among organizations. Business processes are the work activities of an organization. "Entities" are inputs to and outputs from each business process, and (from the CRUD matrix used by information engineers) are created, read, updated or deleted by a business process.

These entities have "states," and a bottom-level business process is responsible for transitioning an entity from one of its states to the next. A "sales prospect," for example, might progress to a "new customer," then to a "regular customer," then perhaps to an "inactive customer," through the same business processes that will move an order through to fulfillment. Business process analysis requires understanding and mapping these states, and the processes that take place to transition each entity through the states of its lifecycle.

"Business process flow" is the representation of entity movement, so that the complete business process network and the position of each entity on the process network, its state, and its "queue membership" can be represented in a simulation. Thus workflow creates a network based on the business process network, but which includes mechanisms for management and flexibility. Management of the workflow network gives users a view of where individual entities are in the network and what their states are. Flexibility allows the work flow network to be configured differently (often by users, sometimes on the fly) to realize the business process network in different ways.

Metrics for business process flow may include wait time (time in queue), throughput time (delay caused by the work of a process), number of entities processed per time period, time spent in rework, number of rework instances, etc., and the variability of these measures. Other, sometimes unstated, aspects of business process flow are how successfully the process flow model coincides with participants' mental model of the business, and whether it enables meaningful analysis of business processes.

Good process flow "performance" is characterized by low wait times, low throughput times, a high number of entities processed per time period, and low variability of these metrics. A process flow network that is sub-optimal will often have delays, low throughput, and high variability in certain areas. Often, local problem areas can be identified in the model where bottlenecks or the need for rework will cause unsatisfactory values for the entire process flow network, and when discrete changes are made in these areas, values will improve dramatically for the entire system. At other times, these metrics will point to system-level problems such as variable transportation or communications, or a weak understanding on the part of the participants of the underlying business process network. This problem of "transparency" occurs when individuals may not have an adequate view of the process flow network and therefore may not know in some circumstances what actions to take next.

3 BUSINESS PROCESS SIMULATION – A FOUNDATION FOR MANAGING BUSINESS PROCESSES

Currently, few organizations maintain a formal model of their business process network. When constructed these business process models usually represent the results of a project to infer the network through interviews, examination of source materials, and review of existing computer applications. Construction of business process networks is usually undertaken for remedial purposes in the face of obvious problems.

Modeling and simulation of a business process network serve three immediate purposes: organizing the results of interviews and research, identifying the cause of observed performance issues, and exploring alternate process network configurations that improve performance.

The first step is to represent the inferred process network in a useful way. Modeling tools that represent the process network hierarchically are the most useful. Advantages of hierarchical representation include simultaneous understanding of high-level and detailed views, and the manageability of a model. It is often useful to start with construction of a business process network at the top level, and then develop detail in only those areas being studied, or where it will be possible to make changes. This approach makes it possible to develop detailed understanding in certain areas, while maintaining the "big picture" of how those areas fit into the overall organization.

Construction of a business process model makes use of several accepted modeling constructs: delays associated with performing work, statistical distribution of these delays to represent observed variability, dependency of processes on completion of earlier processes, queuing of input entities waiting to be "processed," decision logic that directs entities into alternate flow paths depending on their characteristics, application of resources to the work of a business process, and the costs associated with these resources. Resources can be, for example, labor, equipment, or information.

Development of an *as-is* model based on these constructions endeavors to represent the current, observed reality of business activity in an organization or part of an organization. The model is developed based on the results of data gathering about business activities, and is complete when it can be "calibrated" to resemble closely observed behavior of that organization or part.

Alternative business process configurations can then be explored by changing characteristics of the *as-is* model to determine the effects of changes. If the *as-is* model is based on modeling constructs relevant to the changes, and has been satisfactorily calibrated, then derived *what-if* alternative models can be reasonably expected to provide an adequate level of prediction about the effects of actual business process changes.

4 FROM HIERARCHICAL MODELS TO A BUSINESS PROCESS MANAGEMENT LANGUAGE

Simulation models can uncover problems with business process flow, and can be used to improve or even optimize the process flow "network." Discrete-event simulation models of business processes can provide a rich basis for identifying problems by highlighting the effect of aberrant conditions, such as roadblocks, rework, and misalignment between business processes and their automate support applications.

Business process modeling languages are still in flux, but the current contenders are all based on Web-based workflow (see `www.ebpml.org`). There are five major business process definition languages being specified today:

- BPML
- BPEL4WS
- EDOC
- XPDL
- UML 2.0

While all of these languages are flawed from the non-Web-services point of view (see Jean Jacque Dubray, `www.ebpml.org/bpel4ws.htm`), these languages do (to varying degrees) accommodate manual (non-Web-service-based) business processes (a case can be made that BPEL4WS, although still Web-services-oriented, is the most flexible in this regard).

As businesses become more formal in their mapping and handling of business processes, we can expect that they will combine manual and Web-services processes. Ability to define the interaction between Web-based services and manual business processes will gradually come to be critical to Business Process Management. This is because Business Process Management, despite its Web-services orientation and heritage, fundamentally describes the organized work activities of a human organization, and so must finally support description of the organization with all its human variation.

Practical concerns with Web-services applications supporting the varied business processes of a real, varied organization, will address questions like the following:

- What will be the overall level of performance combined manual and Web-services system?
- Where will business processes have to wait for Web-services applications (especially work flow applications) to provide entities?
- Where will the Web-services applications have to wait for manual business processes?
- What technology changes can be anticipated, and what will be their performance characteristics?

Note that by considering Web-services applications as supporting business processes, we are defining the performance of these applications in terms of the purposes and performance of the business processes that they support.

Once simulation can be applied to design Web services applications that support an organization's business processes, the Web-services technology can be aligned with the business process flow needs of the organization. These process needs are already described by the business process network.

The steps for bringing Web services into alignment with business process needs start with mapping the business process flow across an organization, based on the business process work flow. Then we should identify the major data stores, both manual and supporting Web services. State diagrams can be used to help establish at a high level how the business processes change the states of the data objects.

Based on an understanding of the relationship between Web services and business processes' role in changing the states of data classes, a "scalability strategy" can be developed that will plan how Web services can be applied to the processes of different-sized organizations. Finally, it is possible to map out a Web services approach that reflects demands of the organization's business process flow.

Figure 1 shows a high-level view (in a hierarchical model) of a simulation of the business processes underlying a business process flow network. Optimization of such a network, which can be accomplished through simulation, can provide a sound basis for the design of Web services that will successfully support the organization's business processes.

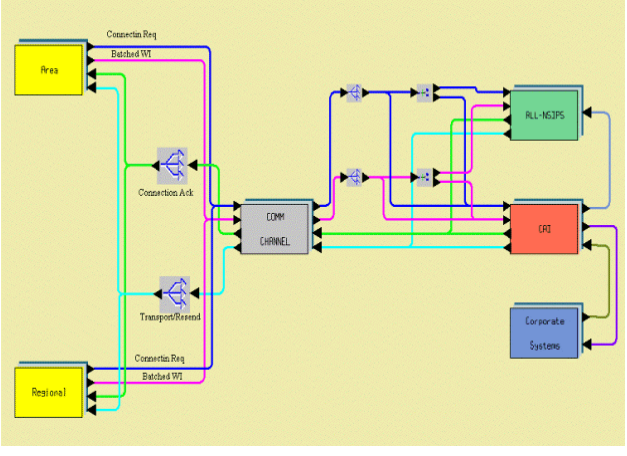

Figure 1: Simulation of Business Processes Underlying Web-Services Functions

5 CONCLUSIONS

The intent of this paper has been to explore how simulation and optimization of business processes can provide a basis for Business Process Management.

We have identified three layers to this issue: the business process modeling language, the relationship between manual business processes and Web services, and the Web-services application. The following argument has been put forward:

1. Business process flow can be optimized
2. Simulation can serve as a basis for business process optimization
3. Despite the flaws of current languages, business process modeling languages can be used to describe and understand the relationship between manual business processes and Web services
4. Finally, we have suggested a practical approach for aligning the Web services with business process needs, and identified the steps of that approach.

REFERENCES

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