SIMULATION ON DEMAND: Using SIMPROCESS in an SOA Environment

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Services-Oriented Architecture

The one constant in business is change. New technology makes better systems possible. Leading companies are constantly striving to use the latest technologies to make themselves more agile and to provide their customers with better products and services.

In the last 3-4 years business and IT managers have begun to implement a new approach to organizing IT resources which is usually referred to as a Services-Oriented Architecture (SOA). Like other recent IT architectures, SOA provides flexibility for an increasingly complex business environment, and requires that companies master new tools to assure that new applications are designed effectively.

In the early Nineties, most companies adopted the Client-Server Architecture for new applications. This was the era when many companies moved away from mainframe-based applications, and the Client-Server Architecture provided a blueprint for linking applications running on desktop PCs with servers that managed and maintained databases. The software one most often associated with the Client-Server era was PowerBuilder and Visual Basic, tools that let developers create programs that could be distributed between PCs and Servers.

In the late Nineties, there was a shift to Multi-Tier Architectures. This approach organized the IT environment into three parts, desktop PCs, application servers that hosted the programs being used by the desktop PCs, and database servers that maintained data. This type of architecture was heavily dependent on the use of software components and the software associated with this approach was Java, J2EE, and COM, which helped create and manage the components on application servers.

Today, IT resources are being reorganized, yet again, to reflect new developments in the Internet and in XML protocols. The Services-Oriented Architecture assumes that companies will create applications that will use software services provided by a wide variety of different organizations. Thus, for example, a customer might go to a Travel Reservations website to make airline reservations. There he might use a service that allows him to examine all flights between two locations on a given day. That service would depend on being able to access data from a number of different airline databases. Having chosen a flight, the customer might proceed to make a reservation on a specific flight, where, in effect, he would be working with a booking service operated by a specific airline. In a similar way, the same individual might proceed to make a car reservation and a hotel reservation, in each case using services provided by a variety of hotel and car rental companies. A Services-Oriented Architecture pulls together other software modules or services from a variety of sources, via the Internet and XML, to create a collaborative application.

The problem that designers face when they begin to design SOA applications is to understand how all of the services will work together to achieve the final result. Thus, the software most associated with Services-Oriented Applications is Business Process Management software. As Services-Oriented Applications become more complex, more sophisticated business process modeling tools and BPM servers are required.

SIMPROCESS and SOA

SIMPROCESS is a process analysis tool commonly used to support business process improvement and operations research projects. It provides both a modeling and a simulation capability. The models are used to define complex business process flows that are represented graphically as activity diagrams. The models also include resource definitions needed for each activity in the model and entity definitions to represent the objects that flow through a business or work flow process. SIMPROCESS has a powerful simulation capability that provides an analyst with rapid simulations of process models to examine alternatives and experimental scenarios. The experiments are used to make decisions about improvements to business processes.

The use of SIMPROCESS as an analytical tool has many benefits. However, the purpose of this paper is to describe how SIMPROCESS can be used in SOA. SIMPROCESS has the capability to provide simulation models as a callable services. This capability provides simulation-on-demand to any application that needs to perform predictive analysis as part of its solution, anywhere within the enterprise. This concept is similar to mathematical forecasting and prediction capabilities offered by some commercially available applications. The major difference is that the prediction is done within context of a customer's business processes; using the same business process models that are built in earlier business process analysis phases using SIMPROCESS.

Using SIMPROCESS in an SOA environment extends the usefulness of business process analysis models beyond analysis phases and through to business process management phases. Through on-demand simulation implemented as a Web service, business performance predictions can be easily plugged directly into business activity monitoring, balanced scorecard, and decision support solutions. In other words, you can now design applications that provide simulation on demand. Soon, managers faced with process related problems will be able to access and run simulations to explore alternatives, just as they currently use spreadsheets to explore the implications of changes to financial models.

SIMPROCESS Models

SIMPROCESS models are developed using a graphical user interface with a set of predefined model constructs. Models are made up of three major components: activities, resources, and entities.

Activities define the work steps in a SIMPROCESS model. Activities are connected to create a process flow diagram that is equivalent to a connected graph or network diagram. Process flow diagrams in SIMPROCESS are hierarchical and may be defined to the level of granularity required by the user to represent the overall business process. An activity may be detailed as sub processes that contain nested sub processes down to atomic nodes representing single discrete work steps. The activities at the atomic node level may include timing data (i.e. delay times using statistical probabilities) and the types of resources needed to carry out the work step. Each activity needs only be defined to the level necessary to represent that process and may vary in the level of detail from one activity to another. If more interest is shown in a particular process, the high level activities may have additional details at a later time without requiring changes to the rest of the model.

Resources are defined to represent the human resources, equipment, facilities, and consumables required to perform work in a SIMPROCESS model. For example, a single work step to repair an automobile engine may require a mechanic, some tools, a shop stall, lubricants, and clean up products to perform the work. Resources also have costs associated with them. For example, human resources may be represented by hourly costs while consumable resources may be represented by cost per unit of measure (i.e. pound, each, barrel, etc.).

Entities represent objects that are worked on in a SIMPROCESS model. For example, an automobile may be an entity in an auto repair process. Entities can also represent administrative objects such as paper work, service objects such as insurance claims, consumer objects such as purchase orders, or human objects such as hospital patients. Entities flow through the activity diagram in a SIMPROCESS model during simulation to create the dynamic behavior that mimics a customer's real-world process.

Activities, resources, and entities in a SIMPROCESS model, collectively define a complex dynamic representation of the business processes. The model can be simulated to examine business process performance and focuses on business-related metrics such as cycle time, throughput, activity-based cost, entity cost, resource cost, and resource utilization. The ability to rapidly experiment with variations on processes, entity rates, and resource levels results in a powerful analytical capability for business process analysis and operations research.

SIMPROCESS as an Analytical Tool

SIMPROCESS is normally used as a desktop analytical tool. It is used to support business process redesign and improvement efforts by providing a structured way of representing an "As Is" process model, experimenting with various changes to business processes ("What If" scenarios), and justifying, through performance measurements, feasible "To Be" processes for implementation.

When SIMPROCESS is used as a business process analysis tool, it provides the capability to communicate the dynamics of complex business processes with stakeholders and to help gain buy-in of proposed business process changes. For example, alternative business process flows; changes in the rate of entities flowing through the business, and changes in resources and resource costs can be considered in a SIMPROCESS simulation. These types of "What If" scenarios can be rapidly tested to see if changes based on proposed process improvements are feasible, or they can be used to stress a model to see when critical breaking points will be reached.

Continual business process improvement can be supported with SIMPROCESS using the "What If" simulations. For example, if a business has fine-tuned it processes and resource levels to handle an expected arrival rate of entities flowing through its business, varying the entity arrival rates (especially peaks and valleys) through simulation can help to identify business performance issues.

Figure 1 depicts how an analyst typically interacts with SIMPROCESS when using it on business process reengineering and business analysis projects.

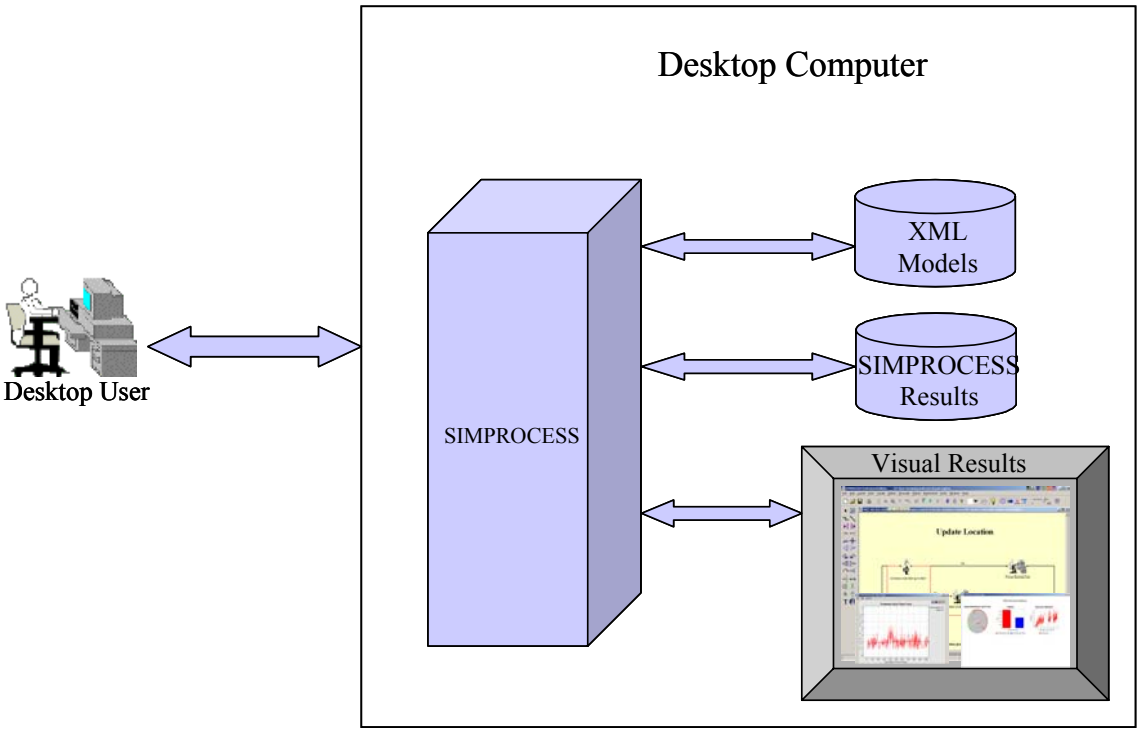

Figure 1 – Typical Desktop Analysis with SIMPROCESS

As a by-product of using SIMPROCESS, validated process models are produced that can be used to perform operations research and continual business process improvement activities that are typically underutilized beyond the up-front analysis phases in other modeling tools. Since SIMPROCESS does not require an analyst to "drive" the model, a huge capability and added benefit of using the models as an on-demand simulation service is realized.

SIMPROCESS as a Service

SIMPROCESS has the capability to extend the use of business process analysis models to a continual business process management solution. The models built in SIMPROCESS are XML documents and can be simulated as a callable service from other applications to provide valuable predictive analysis capabilities. The SIMPROCESS architecture is such that the simulation engine and the models are separated from the graphical analytical tool making simulation-on-demand services a reality. The SIMPROCESS architecture is based on a model-view-controller architectural pattern and loosely couples the model (the XML definition of the model), the viewer (the graphical modeling tool), and the controller (the graphical and simulation controllers). The controller part of SIMPROCESS is actually made up of two separate controllers (implemented as threads in Java); one for controlling the graphical commands in the "desktop" usage of the tool and one for the discrete event simulation engine.

SIMPROCESS is written in portable Java and can operate on any hardware platform that provides a Java Runtime Environment. This cross-platform capability coupled with the ability to execute the models without the GUI opens up the ability to provide simulations in a SOA. SIMPROCESS implements the services capability using a Web services paradigm. The simulation controller thread is managed by a Web services Dispatcher module that is placed into a customer's Web services implementation for access by any application that can make a SOAP call to the service. Figure 2 depicts how SIMPROCESS is implemented in a Service Oriented Architecture.

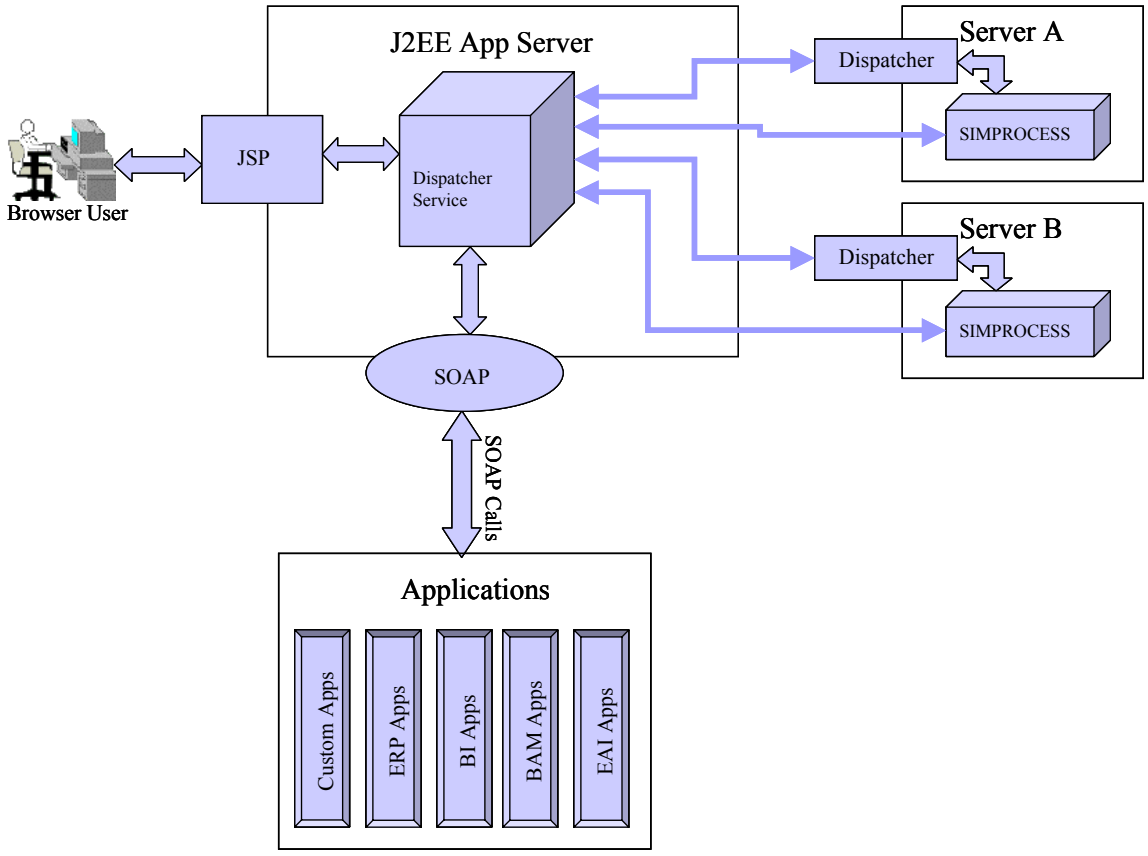

Figure 2. SIMPROCESS Web Services Architecture

This opens up the ability for any application to utilize validated business process models and discrete event simulation. It provides context-sensitive predictions for business activity monitoring (BAM), business process management (BPM), and decision support solutions. The predictive analysis capability adds a significant improvement and business performance dimension to traditional BAM, BPM, and decision support technologies. Not only are the predictive capabilities easily available to these technologies as a service, the performance metrics are within context of the customer's business process (utilizing the SIMPROCESS models).

On-Demand Simulation Services

On-demand simulation services bring a new dimension of business performance measurements to traditional BAM, BPM, and decision support solutions. The performance metrics are easily integrated into executive dashboards with commercially available business monitoring products such as Intersystems, Business Objects, Information Builders, Cognos, SeeBeyond, and Hyperion, to name a few.

Business Activity Monitoring

Business activity monitoring is a concept where key business performance objectives are tied to measurements in an organization's information technology solutions and monitored over time. BAM measurements are similar to, and often aligned to, business performance measurements in a balanced scorecard (BSC) methodology. The performance measurements are presented in

high-level business terms using graphical gadgets such as pie charts, line graphs, histograms, and various graphical meters.

BAM technologies are implemented using various schemes including data mining, application monitoring, and middleware solutions. Performance is monitored by tracking changes in data, transaction processing in applications, and exchanges of information between applications and data. Regardless of how the BAM measurements are captured, the resulting output is reported using executive dashboards and graphical gadgets. Most commercially available BAM solutions fall into the categories of business intelligence, enterprise application integration, and workflow automation technologies. These technologies have the infrastructure and awareness of data, transactions, and integration to easily provide BAM dashboard metrics.

The business measurements captured in BAM technologies provide valuable insight to where a business is relative to its performance objectives. Performance trends can be deduced from the measurements and critical thresholds can create alarms and notifications for management action. However, the measurements do not provide any insight into how the performance situation will look in the future.

Simulation adds predictive measurements to the traditional BAM measurements and provides management lead-time to resolve performance issues before they reach crisis mode. For example, gradual changes in performance may go undetected in traditional BAM technologies. Only when simulation is applied to rapidly predict performance days, weeks, or months in advance can some of the gradual changes start to become evident. Just as important as prediction of performance from simulation is the fact that the simulation is done within complete context of a customer's business processes. Most BAM technologies (data, application, or middleware –based) don't (or can't) provide a process context of the performance measurements.

SIMPROCESS provides the predictive dimension so desperately needed to make BAM a complete performance measurement solution. The use of simulation as a service in a SOA makes integrating and using SIMPROCESS models with commercially available BAM technologies easy to do.

Business Process Management

Business process management (BPM) is most often viewed as a continual cycle of business analysis, improvement, and measurement. Business analysis reveals opportunities for improvement, business process changes are implemented based on "To Be" analysis models, and implemented changes are measured and monitored to gain insight for additional analysis and improvement. This cycle continues indefinitely for high-performance organizations.

Historically, SIMPROCESS has been a contributor to this type of business process management lifecycle. However, until recently, SIMPROCESS like all its competitors was focused mostly on the up-front business analysis phase and provided little help on the monitoring phase. To assist in BPM, process analysis tools have traditionally required an analyst to "drive" the modeling and simulation. This is not a bad thing but it falls short of truly supporting a BPM lifecycle.

The latest version of SIMPROCESS solves this problem by providing simulation of the business models as a service. As described earlier in the BAM section, the models can be simulated on-demand to provide continuous and periodic predictions of how a customer's business is performing. The simulation is based on the customer's processes (context sensitive) as well as continuously primed with the actual performance data from the operational applications. By priming the simulation with real data (as opposed to only using probability distribution functions commonly used in simulations), the simulation is continually improving its accuracy and prediction based on recent changes in business performance. The simulation results are saved in databases and used by analysts to re-enter the business process analysis phase of the BPM lifecycle. The key distinction is that valuable data has been captured and simulations have

already been done based on the dynamics of the business operations. This reduces the time the analysts have to spend in looking for opportunities to improve the business in the next improvement cycle.

Decision Support

Decision support technologies are used to provide management with key information to make business decisions. Decision support solutions are similar to the BAM solutions described above except that they tend to focus more on operational level decisions unique to a specific component of a business operation. Similar to the BAM concept, simulation on-demand with SIMPROCESS can add another dimension to the decision support solution. For example, rather than monitoring overall business performance against the high-level processes in a SIMPROCESS model, a decision support solution could call on a SIMPROCESS simulation to provide alternative solutions based on alternative process flows. An alternative could be chosen directly from the decision support tool based on predicted performance from the simulation.

An Implementation

An example of using simulation-on-demand is to provide predictive analysis to a Business Activity Monitoring (BAM) dashboard for a hospital emergency room. Traditional BAM dashboards provide feedback to management in terms of key business performance metrics. In a hospital example this might include average patient treatment cycle time, arrival rate of patients, treatment room utilization, and patient profiles. The BAM dashboard determines the metrics by mining intelligence from the operational systems and databases. The metrics are valuable in monitoring the situation of the business by providing up-to-date performance measurements that are based on the business' performance objectives.

However, the BAM dashboard may not detect gradual changes in the key measurements in time to give management the lead-time needed to affect the outcome. When the BAM dashboard solution calls on a simulation service to look ahead, valuable lead-time is gained for management to avoid impacts to the business performance. Figure 4 provides a visualization of this concept. The dashboard in this example is showing both the real time data that a traditional BAM would provide in the top half of Figure 4. The bottom half is a simulation of five days into the future using the validated business process model. The prediction of the future metrics provides anywhere from 36 – 48 hours advanced notice to management to address developing performance problems.

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Figure 3. SIMULATION with a BAM Dashboard

Another example of using simulation may be a supply chain planning system for a manufacturing company. As raw materials from suppliers, customer orders, and operational resources fluctuate the planning application can routinely call the simulation service to peek into the future weeks or months in advance to predict key performance bottlenecks. Management can make adjustments to manufacturing schedules, seek alternative sources for materials, or augment manufacturing resources to address the predicted performance problems before they are realized.

Yet another example might be for a call center that receives unexpected spikes in customer calls and/or unexpected demand on available resources resulting in poor service response times. On-demand simulations of various alternative answering processes, resource allocations, or prioritization methods could provide management with instantaneous information to make adjustments and avoid customer impacts.

In each of the three examples above, the simulation is done on-demand using validated models that represent how each customer's processes work. In other words, the simulations are in complete context of a particular customer's business. Additionally, the simulation gathers up to date operational and historical data to ensure the simulation is increasingly accurate.

The choices for using simulation as a service is limited only by the imagination of how to use SIMPROCESS models as part of any type of application in the enterprise. It can add value to ERP, EAI, BAM, custom built, and decision support applications by simply developing a process model, and calling it via a SOAP message.

Conclusion

SIMPROCESS provides companies with the ability to create a whole new class of very valuable applications. It allows companies to extend existing applications, using a Service Oriented Architecture, so that they include a process simulation capability that is available "on demand."

The key benefits of using SIMPROCESS as a simulation service in an SOA are:

- This concept extends the usefulness of analysis models beyond the up-front business process analysis phases. A greater return on investment is achieved when developing business process analysis models since long-term use of the models is achieved. It provides the capability for the business process models to transition from a passive role to an active role in business process management.

- Simulation provides valuable business performance insight above and beyond the current situational data presented in traditional BAM and BSC-type dashboard solutions. Most BAM-type solutions only look at past data and provide key business metrics based on what has already happened in the business. None of the BAM solutions on the market use process simulation to provide predictive performance metrics.

- SIMPROCESS simulations provide a context for the business performance metrics. Most BAM solutions that rely on data, transaction, and system integration techniques do not have a good way to correlate the performance metrics directly to a customer's business process model.

- This concept closes the loop for customer's business process improvement lifecycle by automatically simulating business performance and using the results of the simulation to feed back into continual business process analysis. In other words, it reduces the need to constantly "drive" the simulation for business process analysis.

Simulation-on-demand can significantly extend current ideas about process monitoring, decision support and BAM, facilitating a new generation of monitoring systems that not only report current data, but provide projections to assist managerial decision making.

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