

Process Modeling and Simulation

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A business process is the sequence of activities required to accomplish an operational objective. Examples include fulfilling an order, manufacturing a product, fielding a technical support phone call, or even launching a rocket. A *process model* provides a framework for describing the activities and their relationships at the desired level of detail. The model codifies the process and provides a common understanding of how a current or future system behaves. A typical process model can be illustrated with a flowchart, however, it will usually contain a lot of additional information including business logic, sequencing rules, flow rates, and perhaps even statistical equations that describe the role of uncertainty in the process.

Process modeling can be a part of so-called Business Process Reengineering (BPR). BPR seeks to redesign business processes so that they can be more efficient, less costly, more profitable, or more customer friendly. Process modeling can also be used to help design and specify processes that do not yet exist. While some consider BPR to be a buzz-phrase, it provides a convenient handle to describe a generic process improvement function that can provide real benefits. For example, the Supply Chain Operations Reference (SCOR) Model recently developed by the Supply Chain Council (<http://www.supply-chain.org>) provides a framework for best practices in supply chain management. It breaks down the operations of supply chain dependent organizations into five major business processes: Plan, Source, Make, Deliver, and Return. The SCOR Model includes the use of Business Process Reengineering as a key step in moving an organization to “best-in-class” performance.

A typical business process improvement project will involve the steps shown below:

1. Define performance metrics
2. Capture the “as-is” process
3. Measure process performance

4. Identify process improvements (“to-be” process)
5. Implement improvements (in model or actual system)
6. Measure process performance
7. Repeat steps 4-6 as necessary

By comparing the performances of “as-is” and “to-be” systems we can measure the level of change, and thereby, the value of the improvements. In the case where the process does not yet exist, we would be comparing alternative “to-be” systems, skipping steps (2) and (3). One potential problem with all of this is that implementation of proposed changes in an *actual* system can be costly. We often don’t have the time, means, or ability to implement multiple “to-be” systems and try each of them out (pilot programs might be one exception). There may not be a way of going back either. But in the case of a single implementation, what if the changes do not lead to the expected level of

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improvement? This is where *business process simulation* can play a role. The process model can be implemented in the form of a *process simulation*. A simulation can be developed for the “as-is” process, which can then be modified into a “to-be” simulation, usually with some relatively minor tweaking. In the case of processes that do not yet exist, we can go straight to the “to-be” simulation. By running the simulation models of the alternative processes we can compare their performance ahead of making any changes to the actual business process. This reduces project risk by helping to identify flaws or misconceptions in design of the proposed process.

A second advantage to using simulation in process modeling is its ability to quantify uncertainty. There are very few business activities that always take a fixed time to complete, the steps followed are all known in advance, and the outcome is always known with certainty. A simulation can capture variable and uncertain behavior in the form of statistical equations known as probability distributions. The effect of these uncertainties is variations in the process performance measures from one “run” of the simulation to another. By running the simulation many times, we can build up a profile of the different possible outcomes and establish confidence intervals on the results. Variability in individual activities can also change the entire dynamic of a process. For example, a system can be designed to easily handle expected average throughput (parts, orders, documents, calls, etc.). However, a series of higher than average processing times at a single bottleneck activity could cause “upstream” effects where processing is delayed or blocked, and “downstream” effects where processing is “starved” for work. In supply chain analysis, a related phenomenon known as the “whiplash effect” occurs when unusually large demands occurs at the retail end of the chain and the effects compound upstream as organizations attempt to maintain desired stock levels. This dynamic can also be captured in a process simulation. A simulation model that correctly captures variability can help determine the likelihood of these system-wide effects, measure their impact, and assess the effectiveness of corrective changes.

A variety of software tools have been developed to automate process modeling. The tools tend to support specific process modeling techniques. Some of the tools are purely “process mappers” that capture and describe a process, but have no built-in automated means to analyze process behavior. Examples include the IDEF family of tools and techniques and basic flowcharting approaches. Most modern software tools provide some type of built-in analysis; however, they vary greatly in their capabilities. The ProcessModel™ simulation system is one example of a software tool used for business process simulation. (Interested readers can download a Systems View simulation case study from their website - http://www.processmodel.com/pdfs/stories/Qwest-Sys_View.pdf). ProcessModel™ is also one of several simulation software systems with a built-in optimization capability. Through optimization, the system can automatically identify the combination of inputs that provide the best output, making the identification of process improvements much faster.

Process modeling is as much art as science. While sophisticated computer-based analysis tools make the job faster, it requires considerable experience and judgment to translate a real-world system into a compact yet unambiguous process model description. The trick

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is to capture just the right amount of detail so that the generated performance measures provide a reasonable approximation to real-world behavior. Only in this way can you be assured that your processes will be truly improved.