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SIMPROCESS III: OBJECT-ORIENTED BUSINESS PROCESS SIMULATION

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ABSTRACT

SIMPROCESS III combines the principles of business process re-engineering, the power of simulation, and the clarity of animated graphics to help understand and predict the consequences of proposed changes to business systems. SIMPROCESS III is designed to answer questions quickly — with no programming. You pose a question, graphically configure a model, run the simulation, and reach conclusions. You then run the model with proposed changes to close in on the system configuration that best suits your needs. This paper describes who should use SIMPROCESS III, the types of systems SIMPROCESS III can model, and how a model is constructed.

1 SIMPROCESS III AND PROCESS PLANNING

In today's challenging business climate, managers are being asked to cut costs while maintaining or even increasing production. This often requires organizations to dramatically change how they operate. Inefficient ways of doing business, that may have evolved over many years, must be streamlined to improve performance.

However, because of the difficulty in predicting the effect of major changes, such changes are often viewed as risky and avoided. Now there is a way to test proposed changes before implementing them— computer-based simulation.

Simulation allows detailed analysis before incurring the risk of making major changes to existing processes or implementing new processes. Experimenting with an off-the-shelf, computer-based simulation model, lets you experiment with alternatives while it is still easy and inexpensive. Furthermore, the credibility gained from presenting easily understood graphical results, such as animation and plots, ensures that your recommendations are understood and supported.

The magnitude of time, cost, and skill needed to set-up a realistic simulation model has, in the past, discouraged its use. SIMPROCESS III, a graphical tool for business process planning, overcomes this objection.

With SIMPROCESS III you create a model by selecting activities and processes from the palette bar, and customize their behavior through parameters presented in a dialog box. To describe the flow of information and goods, you link activities with arcs. You then describe and specify the tokens that flow between them and the required resources.

A business process can be viewed in two ways: static and dynamic. The static view captures the sequence of activities, the flow of tokens, and the resources. The dynamic view captures behavior (durations, release rates, usage rate). Simulation is used to execute the business process model and collect measurements of its performance (cost, cycle time, defect rates).

SIMPROCESS III is a dynamic, in addition to a static, modeling tool. It lets you observe the flow of items through a process. This contributes greatly to understanding and also makes candidates for improvement obvious. These items could be proposals, orders, or invoices. In a factory, they could be raw materials, work-in-process, or finished goods— anything that a process receives, acts upon, or produces. The items flow from process to process with a task performed at each step. The resources, such as the people, machines, or information required to complete the tasks can also be included.

SIMPROCESS III generates valuable information on the processes, entities, and resources in the business model. From this, you can confirm that the process under study has been accurately described. Then you can identify candidate changes. Finally, you can try alternatives and choose those that give the best results.

With SIMPROCESS III you describe process characteristics that are relevant to redesign. First, you can represent changes in the process, such as eliminating activities that do not add value, minimizing rework, consolidating process steps, and reducing the time it takes to perform some activities. Second, changes related to routing jobs in the process and regulating the output of an activity as a function of its input can be

modeled. Finally, because resource allocation issues are very important, you can model resource requirements for activities, processing rates for resources, number and mix of resources, resource capacity, and resource availability schedules.

In the following sections we describe the three main building blocks that you use to construct a SIMPROCESS III model: Resources, Tokens, and Processes.

A process represents behavior that may require some amount of time to be performed. Resources represent the objects that are needed to perform a task. Tokens flow through and, possibly, are transformed by processes. For example, parts (tokens) may flow into a process that uses people and equipment (resources) to make products (tokens).

2 RESOURCES

A resource may be used to represent things like people, tools, computers, trucks, manufacturing equipment, floor space—anything that is required to perform tasks associated with an activity. The limited availability of resources often constrains the performance of a business process. Associated with a resource is a capacity which specifies the amount of work that can be performed. For example, a gas station may have 10 pumps (a capacity of ten) or a person can perform only one task at a time (a capacity of one).

Advanced functions for resources are available in SIMPROCESS III. You can schedule planned incapacitation, or time periods during which resources are known to be unavailable. Unplanned unavailability, such as random equipment failures, can also be modeled. You can also reserve resources so that only one activity can use the resource at a given time. Finally, you can specify the resources that are needed to perform an activity.

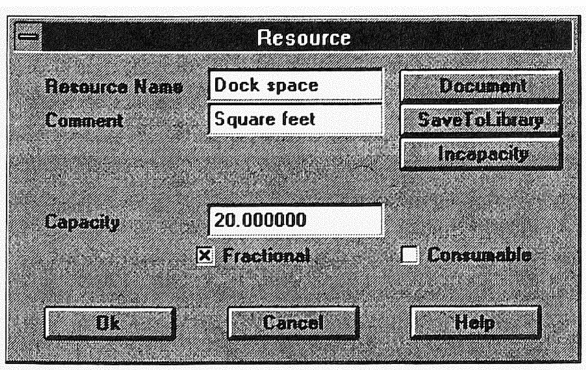

Figure 1: Resource Dialog Box

SIMPROCESS III contains two hierarchies built upon resources: departments and workgroups. Departments represent collections of resources and other departments. Departments are used to group resources in a hierarchical manner as they are in most business organizations. On the other hand, workgroups represent collections of resources, departments, and other workgroups that are required to perform a task. Any resource, department, or workgroup may take part in more than one workgroup. Using the department and workgroup structures to arrange resources provides a realistic and versatile way to model business processes.

3 TOKENS

Tokens represent the objects that flow though a business process. They can represent the physical units (parts, products, etc.) and informational units (orders, signals, etc.) that trigger the behavior of activities. They can also be transformed into some other token by the work performed at the process. An order, for example, may be tracked through a business process, operated upon, or trigger some behavior in a process and can have data collected on the cost and time associated with fulfilling it.

Tokens are also hierarchical. A token may contain other tokens that retain their original identity. For example, a shipping palette may contain personal computers. The palette may travel as a single unit during transportation but get separated into its constituent parts when it reaches its final destination. Alternatively, a token can have a count that signifies the number of such identical tokens that it contains. In this case the identity of the individual units is not kept. This feature is used to model large numbers of identical tokens with no need to distinguish one token from one another, for example, a shipment of capacitors.

You can define tokens that are relevant to your business. SIMPROCESS III lets you define the attributes of these tokens. Using this capability, you can associate attributes with tokens and can monitor the values of these attributes, change their values and make decisions based upon their values during the simulation. For example, you can define a Token called PC, and associate an attribute called COST with it. The attribute can then be used to accrue costs, and action can be based on its value. Its final value is available at the end of simulation.

4 PROCESSES AND ACTIVITIES

A powerful feature of SIMPROCESS III is its hierarchical process. This capability greatly enhances the ability to describe a process by decomposing it into subprocesses. There are two constructs used to create models in SIMPROCESS III: Processes and Activities.

Activities model events which cannot be decomposed any further. Source, delay, transform, and sink nodes are examples of activities. The Process allows you to create hierarchical process models. Processes are built from Activities or other processes.

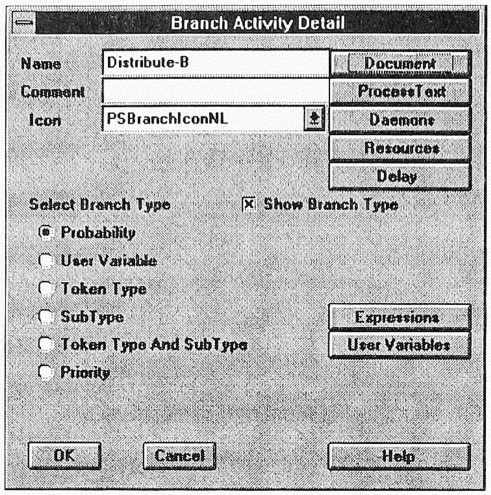

Figure 2: Defining an Activity

SIMPROCESS III's hierarchical modeling ability lets you hide the internal complexity of a Process from your layout. The full modeling detail is still there, ready to be examined and modified when necessary, but the hierarchical display lets you focus on the whole system without being distracted by the fine details. If you wish to view both the large structure and the fine details at the same time, SIMPROCESS III provides a 3-D view so that you can see everything at once. This combination of hierarchical processes and 3-D viewing work in tandem to clarify model building, analysis, and presentation.

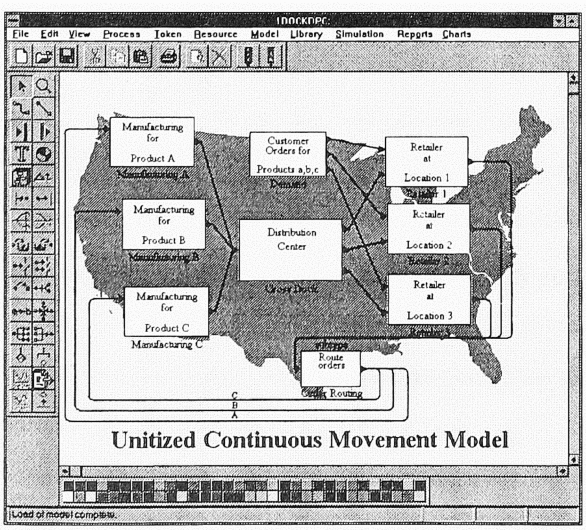

Figure 3: Layout of a Model in SIMPROCESS III

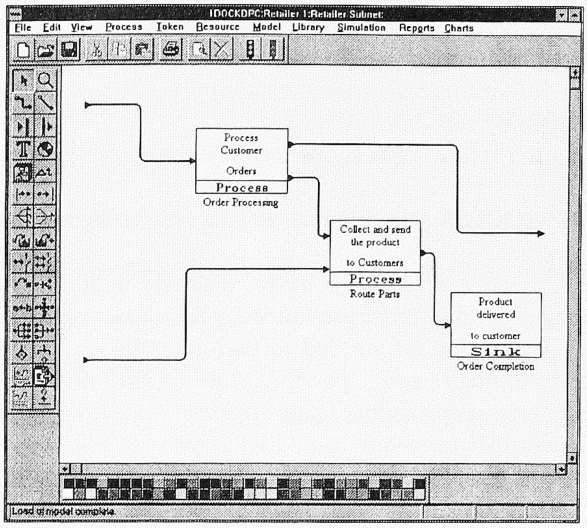

Figure 4: Internal Detail of Retailer at Location 1

Here are some of the Activities that are built into SIMPROCESS III:

A source generates tokens (orders, parts, etc.) at specified intervals of time.

A sink accumulates all relevant statistics on the tokens that flow into it and then disposes of the tokens.

A delay models the passage of time and usage of resources.

A branch routes tokens through alternative paths based on probability or token characteristics.

A batch aggregates tokens based on batching parameters.

An unbatch unbundles a batch into the tokens which comprise it.

A clone duplicates the arriving token and releases copies.

A transform converts one type of token into another type.

A gate stores arriving tokens and holds them until a trigger signal is received.

A synchronize releases tokens when one of each type is available.

A merge funnels tokens from different paths through one process.

Assign sets a value to a user specified attribute.

You set the parameters for activities and connect them with arcs to define processes.

5 SIMPROCESS III LIBRARIES

It is important to retain and reuse the knowledge gained with each study. Business processes that deliver equivalent products (or services) tend to share many

components across various enterprises. For example, many of the same principles and designs form the basis of the order fulfillment process even for companies that are in dissimilar industries. By taking the knowledge gained in one study and using it in subsequent studies you leverage your time and other resources.

Libraries can be your own process libraries or system defined process libraries. You can define your own libraries and populate them with customized activities, processes you have created, and processes you select from other libraries and applications. This enables you to conveniently organize and reuse processes. System defined process libraries contain tested, domain specific processes that are developed programmatically.

6 USER EXTENDIBILITY

There are unique aspects to every business, and some customization may be necessary to accurately represent its processes. SIMPROCESS III provides you with this flexibility through its interpreter. User-defined fields and variables let you extend the the elements of the model.

An expression accesses both built-in fields and your own new fields and, based on its value, the behavior of modeling elements can be modified. The interpreter evaluates the expression at the appropriate time during the simulation. For example, if you add an "AcceptToken" expression to an activity node, the expression will be evaluated whenever the node accepts a token, that is, every time a token enters the node. In the expression, you can access fields of the node as well as fields of the token. You can use built-in constructs in an expression to augment the behavior of the model.

7 PRESENTATION OF RESULTS

While modeling a process is a critical step in BPR, effective presentation of the results to others often determines the success of a re-engineering effort. With SIMPROCESS III you can specify exactly which reports you desire—this allows you to focus on what's important to you. SIMPROCESS III monitors only those processes, activities, tokens, and resources necessary to produce those reports. SIMPROCESS III's time series reports show cycle times, token counts, and the various states of resources. They are continually updated while the simulation is running. Other reports such as the cycle time distribution, average, and peak, the token count distribution, average and total, as well as the resource capacity utilization are plotted using graphs such as histograms, bar charts, and pie charts. These reports can be selected for display at the end of a simulation, or the charts can be viewed in tabular format and saved to files for further processing.

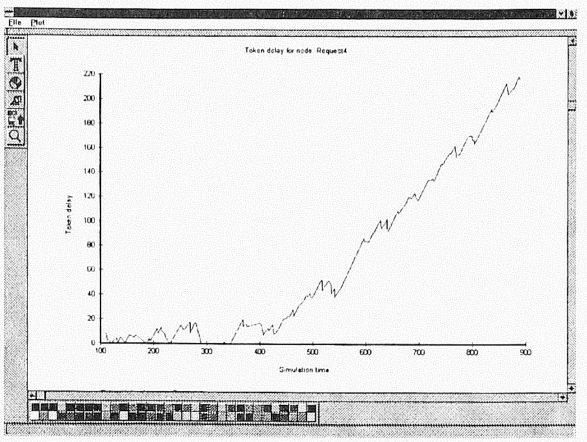

Figure 5: A Delay Plot Generated by SIMPROCESS III

8 COST REPORTING

The study of business processes usually requires analysis of the costs. The design of cost reporting in SIMPROCESS III is modeled after Activity Based Costing, but, additionally, it takes advantage of the benefits of simulation. To get process cost information from a SIMPROCESS III model, you need only define the costs of the model's resources and the cost periods to be analyzed. SIMPROCESS III will distribute these costs to activities and tokens as the simulation proceeds and provide extensive reporting of the results based on your cost reporting periods.

Besides minimizing the data to be gathered and calculated for input to a cost analysis, SIMPROCESS III accommodates different types of fixed and variable costs, multiperiod analysis, different resource pricing and costing schemes, and definition of costing periods. SIMPROCESS III helps to bridge the gap between a financial planner's view and a manager's view of a business process.

AUTHOR BIOGRAPHY

JEFFRY JONES was educated at the University of Virginia and The Johns Hopkins University where he received Bachelor of Science degrees in Applied Mathematics and Nuclear Engineering and a Master of Science in Electrical Engineering. He has built a wide variety of simulation models ranging from analytical studies of reactor fuel elements to theoretical models of satellite communications to discrete event simulation of the Space Station Information System. He is currently an Executive Associate in the Simulation and Modeling Department of CACI Products Company.