WebSphere Education

Introduction to simulation and analysis

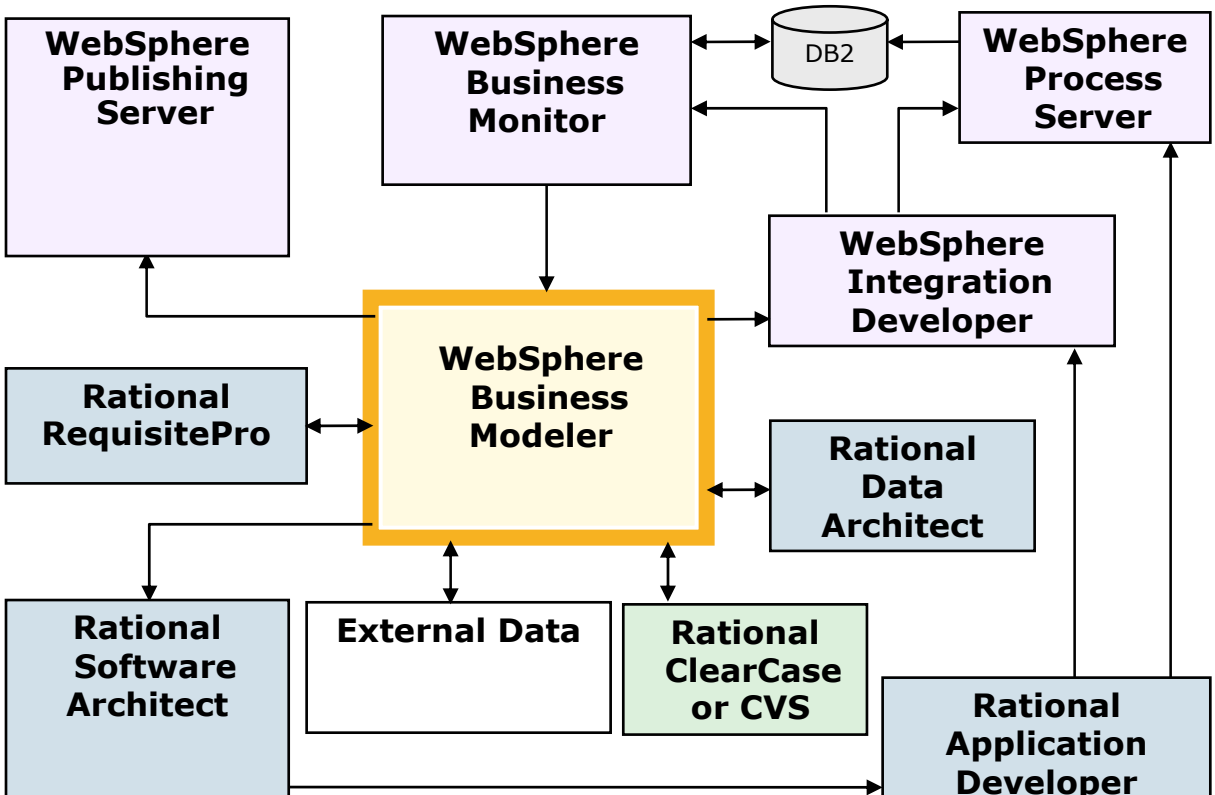
Unit 17

Unit objectives

After completing this unit, you should be able to:

- Explain business process analysis
- Explain the purpose of running simulations
- Define relevant simulation terminology

Simulation and analysis are core Modeler features



Business process analysis

- An analysis discipline focused on how an organization:
  - Reduces overall costs
  - Effectively uses its resources
  - Supports its customers better
- Takes an end-to-end view of the business
- Closely related to requirements definition
  - Changes to polices, processes, and information systems
- Key to business process management
  - Making process more efficient, effective, and adaptable
- Based on simulating a process under real-life conditions
  - Varying times, costs, schedules, and resources

What is process simulation?

- Simulation:
  - The imitative representation of the functioning of one system or process by means of the functioning of another (a computer simulation of an industrial process). — Merriam-Webster

- Process simulation:
  - Using a computer program based on a set of mathematical formulas to imitate the behavior of a business process to determine how it behaves under different conditions.
  - If the model behaves in the same manner as the real process:
    - There is a good chance that the underlying variables are correct.
    - The model can be used to test the impact of changing conditions.

- Process simulation is a simulated performance of a real-world business process in a virtual environment.
  - The business process might be a model of:
    - An existing business process.
    - One that is planned for the future.

The value of simulating business processes

- Simulation is a core component of WebSphere Business Modeler.
  - Can run simulations of non-business processes with limitations
- Simulations can be used to:
  - Observe a process in action
  - Examine the statistics generated by a process as it runs
  - Perform analysis on the simulation results (dynamic analysis)
- Changing a diagram or other model elements allows comparative analysis.
  - Quantify the effects of the changes
    - Assess the costs and benefits of changing your business processes
  - Observe how a process will perform in response to variations on inputs to the process
    - Vary process input volume over time

Simulation terminology (1)

- Simulation snapshot:
  - A record of the model that will be simulated
- Simulation profile:
  - A record of the model plus the simulation attributes
- Statistics and results:
  - The information produced by the simulation
- Probabilities or expressions:
  - The way decisions are handled during a simulation
- Tokens:
  - Representations of units of work passing through the process

Simulation terminology (2)

- Process instances:
  - Each execution of a process simulation
- Process cases:
  - Each path through a process
- Random number generation:
  - The introduction of real-life variability into a simulation

Simulation snapshots

- A record of the complete process model at the moment you ran a simulation of the process.
  - A copy of all the elements in the project that the process uses
    - Business items, resources, and global tasks
- Need to create multiple snapshots for each set of changes to compare the effects of those changes.
- Elements created by a snapshot:
  - Simulation snapshot settings
  - Simulation profile
- Once a snapshot is created, the changes to the original model will not be reflected in the snapshot.
  - To include changes, a new snapshot needs to be generated.

Simulation profiles

- A simulation profile is a copy of a process model augmented with simulation attributes used to run the simulation.
  - The profile is based on the process model at the time the snapshot was created.
- Attribute values you set in a simulation profile are used when you analyze the profile or run a simulation.
  - Attributes are copies of snapshot settings: token creation, cost, revenue, duration, and resource requirements.
  - Attributes can override values inherited from the simulation snapshot.
- Multiple simulation profiles can be created for a single simulation snapshot.
  - Compare the results of your process in different “what-if” business scenarios
    - For example, increase in volume
- You can add breakpoints and interrupts to a simulation profile to cause a process to pause in the middle of a simulation run.
  - Breakpoint pauses the simulation run when that activity is activated by an incoming token.
  - An interrupt pauses the simulation run when a specified condition occurs.

Statistics and results

- Simulations provide two kinds of information about processes:
  - Simulation statistics are generated while the simulation is running.
  - Simulation results are compiled when the simulation has completed.
  - You can enable or disable the collection of statistics and results in the simulation control panel.

- Simulation statistics are details about the instances of processes, tasks, and connections.
  - The simulation control panel displays simulation statistics on the Processes, Tasks, and Connections tabs.
  - Statistics are constantly updated while the simulation is in progress.
  - Choose to display either:
    - Statistics for individual process instances
    - Collected statistics based on all process instances

- Simulation results are sets of data recorded during each simulation run and are used in dynamic analyses.
  - Results are stored in a database.
  - A results node is added to the Project Tree as a child of the simulation profile.
    - Each run produces its own simulation results node.

Probabilities and expressions (1)

- Profiles can be set up to use one of two different methods of selecting a path:
  - Probabilities are specified in the attributes as percentages.
  - Expressions are created with the expression editor.

- Probabilities:
  - Probabilities allow you to set up and run a simulation more quickly.
    - Relatively little data setup in a model
  - Specify probabilities on decision choices, loops, and task outputs.
  - Sufficient to perform most simulations.
    - Except for very detailed low-level analysis
  - Use probability-based simulation for current state modeling and possible future state analysis.

Probabilities and expressions (2)

- Expressions:
  - The expression editor is required to create an expression for each possible path.
  - Used for:
    - Low-level future state business models
    - Models that clearly define the interfaces in and out of tasks and other elements

- Expressions specify how specific data will be treated as it passes through the process.
  - For example, an order might be handled differently depending on the customer type or depending on the total cost of the order.
    - Business item creation rules could be used to determine the specifics of each order.
    - Expressions on decisions and activities evaluate the incoming order and handle it according to the specific details it contains.

Tokens

- A token represents a unit of work that is received by a process and transferred between different activities in the process flow.
  - Some tokens represent the transfer of data between activities, while other tokens represent only a transfer of control.

- Token creation settings define the quantity and rate of inputs that the process receives in a simulation run.
  - The frequency can be generated at a constant rate or a statistically distributed rate.
  - The number of tokens can be generated individually or in bundles.

- A large number of tokens may have to be run through a process to achieve a statistically significant simulation result that can be used for dynamic analysis.
  - One formula that can be used to determine the minimum number of tokens to use in a probability based simulation is:
    - Number of cases times (highest case probability / lowest case probability)

Process instances

- A process instance is a unique occurrence of the process during simulation.
- Arrival of tokens initiates a process instance defined by a model.
  - The process run either completes successfully or fails.
  - For example, in a model of a call center, a process instance represents the handling of a call from an individual customer.
- Instance analysis looks at the activities within a particular instance of a process that is created during a simulation run.
- Aggregated analysis looks at specific elements within a process aggregated across all process instances in a simulation run.
- A task instance is the execution of a specific task within a process instance.

Process cases

- A process case is a path a process instance can take.
- In a process case, units of work follow a particular pattern of connections and activities through a branching process flow.
  - The path followed during simulation is determined by probabilities or expressions.
- Cases include both the main paths and all the exception paths.
- The greater the number of cases, the larger the number of tokens that need to be generated for a statically significant result.
- Analyzing the process cases helps identify the variations in performance between different patterns of process flow.
  - Individual cases may have a significant effect on the overall process.

Random number generator

- A **random number generator** is a computational or physical device designed to generate a sequence of numbers that lack any pattern.
- Random numbers are used to drive the variation in frequencies, times, and costs.
- Statistical distributions can be used to generate the values used in the model calculations.
- A random number seed is used to start the random number generation.
  - You can control the random number seed.
- The random pattern makes the model more realistic.
  - For example, you may say an order comes on average of 1 every 5 minutes, but in reality the time between orders is continually varying.

Random number seed (1)

- The random number seed is the starting point for a series of numbers.
  - This setting defines a random number, which determines a fixed starting point for the sequence of random values that are used in a simulation.
    - Setting a random number seed other than zero makes it possible to precisely reproduce a simulation run for each simulation with an identical profile.
  - Setting a value of zero causes the system to generate the random number seed.
    - This means that multiple runs of an identical profile may result in different simulated behavior because random decisions are made differently from run to run.

- When to use zero:
  - Use zero when trying to understand how a process behaves under normal conditions.
  - Each time it runs there are slight statistical variations which is very realistic.
  - Use zero to understand the effect of variations on the performance of a process.

Random number seed (2)

- When to use a fixed number:
  - Use fixed numbers when trying to compare two different processes under similar conditions.
  - Use fixed numbers to hold the statistical variation constant while comparing two processes.

- When to use multiple fixed numbers:
  - Use multiple fixed numbers to compare two different processes under varying statistical conditions.

Checkpoint: Simulations

Your instructor will review these questions with you as a group. If time permits, the instructor may provide you time to answer the questions on your own before the group discussion.

1. What is the difference between a simulation profile and a simulation snapshot?

2. What two methods can be used to determine a path in a model?

3. What is the purpose of the random number seed?

4. When would you use a fixed random number seed instead of zero?

Checkpoint solutions: Simulations

1. A simulation snapshot is a record of the model that will be simulated. A simulation profile is a record of the model plus the simulation attributes.

2. Probabilities and expressions.

3. The random number seed is the starting point for a series of numbers. This setting defines a random number, which determines a fixed starting point for the sequence of random values that are used in a simulation.

4. Use fixed numbers when trying to compare two different processes under similar conditions. Use fixed numbers to hold the statistical variation constant while comparing two processes.

Unit summary

Having completed this unit, you should be able to:

- Explain business process analysis
- Explain the purpose of running simulations
- Define relevant simulation terminology