Extending Palladio by Business Process Simulation Concepts

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Agenda

- Mutual Impact of Business Process and IT
- Open Issues and Requirements
- Extensions to Palladio
Business Processes and IT Systems mutually impact each other in several non-trivial ways

- Process impact on IT system performance
  - Business process design
  - Business process workload
- IT System impact on process performance
  - Overload of IT system
  - IT system response time may increase the process execution time
- Mutual impact of actor steps and system steps on workload distribution
There is little integration between process and IT in current simulation approaches

- Simulation is a powerful approach to predict the mutual impact in terms of performance.
- Based on the predicted impact, business process design and IT system design can be adapted to enable alignment.

- Process simulation $\rightarrow$ process performance and financial impact
- Computer network simulation $\rightarrow$ performance of network topologies
- Software architecture simulation $\rightarrow$ IT performance and utilization
If we abstract from the different semantics of process simulation and IT simulation, there are several analogies

Both kinds of simulations:
- Can be built upon queuing networks
- Simulate the utilization of resources
- Use a specification of a workflow of actions to be processed
- Use actions that can be composed hierarchically
- Use a specification of workload
- Acquire and release shared passive resources

→ Palladio is an adequate foundation to be extended by business process simulation concepts
Agenda

Mutual Impact of Business Process and IT

Open Issues and Requirements

Extensions to Palladio
There are several open issues in Palladio in order to enable an integrated simulation

- **O1**: Actor steps are not included in simulation.
- **O2**: Time-variant arrival distribution is not supported

```
  time  07:00  09:24  11:48  14:12  16:36  19:00
  0    20    40    60    80   100    120
requests per minute

  time  07:00  09:24  11:48  14:12  16:36  19:00
  0     1000  1500  2000  2500  3000   3500
avg queue length
```

- **O3**: Systems steps cannot be included in the simulation of business process scenarios
- **O4**: Workload distribution is only influenced by IT system steps in simulation.
- **O5**: Steps are stochastically independent in terms of their parameters.
Palladio has to fulfill the following requirements to represent the mutual impact of processes and IT:

- **R1**: Execution time of actor steps are determined by simulation instead of using assumptions.
- **R2**: IT resources are demanded directly from the process simulation without deriving an IT usage profile.
- **R3**: In process performance prediction the response time of system steps are determined by simulation.
- **R4**: In simulation the workload distribution is influenced by actor steps as well as system steps.
- **R5**: Probabilistic parametric dependencies of actor steps and system steps are considered in simulation.
Agenda

Mutual Impact of Business Process and IT

Open Issues and Requirements

Extensions to Palladio
Palladio is extended by business process simulation concepts.
Usage Model is extended by business process elements

- ScenarioBehaviour
  - (from usagemodel)
  - scenario: 1
- AbstractUserAction
  - (from usagemodel)
  - successor: 1
  - predecessor: 0..1
  - 0..*
- EntryLevelSystemCall
  - (from usagemodel)
- ActorStep
  - processingTime
  - idleTime
  - restingTime
  - transportTime
  - responsibleRole
- Activity
Process Workload is derived from the Open Workload

- Workload (from usagemodel)
- UsageScenario (from usagemodel)
- OpenWorkload (from usagemodel)
- ProcessWorkload
- ProcessTriggerPeriod
  - periodStartTimePoint
  - periodEndTimePoint
  - interArrivalTime

processTriggerPeriods
PCM is extended by the organization environment model which represents the organizational context of the process.

Diagram:
- **OrganizationEnvironmentModel**
  - **Role** (0..*)
    - **actors** (0..*)
      - **roles** (0..*)
    - **workingPeriods** (1..*)
  - **DeviceResource** (0..*)
    - **DeviceResource**
      - **capacity**
  - **ActorResource** (0..*)
    - **actors** (0..*)
      - **roles** (0..*)
Simulation behavior is extended based on the new model elements

- We decided to extend the EventSim simulator

- ProcessWorkloadGenerator enables time-variant workload
  - Execution time of actor steps is determined in simulation
    - ActorResources included in simulation
    - WorkingPeriods of human actors are considered
  - Workload distribution is influenced by actor steps and system steps
  - Passive process resources impact on workload distribution
  - Probabilistic parametric dependencies of actor steps as well as system steps are considered on usage level
There are still open questions

- Different granularities of events in terms of their duration may limit the feasibility of the simulation
  - Short running demands (milliseconds for IT events)
  - Long running demands (minutes for actor steps)
  - Different time intervals (e.g. working time or breaks)
  → Simulation may take a long time to reach confidence

- We focus on IT response times that may impact the business process performance
  - fine-grained events do not necessarily need to be considered

- “Smart” simulation strategies will be useful to circumvent the problem
  - perform isolated fine-grained IT simulations prior to the integrated simulation for a set of representative classes
  - During simulation, look up results from an equivalent class
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