3D Support for Business Process Simulation

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Seattle, July 21, 2009

Overview

- **Introduction and Motivation**
- **3D Representation of Data and Process Objects**
- **Forming Data and Process Objects in 3D Simulation Environment**
- **Analysis of Simulation Results**
- **Conclusion and Future Work**

Introduction

- **About simulation:**
  - key technique for design and redesign of business processes,
  - way to test decisions prior to their implementation in real business environment.

- **What simulation allows:**
  - integration of variability and uncertainty,
  - introduction of dynamic process parameters,
  - measurement of process performance [ABGK06][FNSE99].

Motivation

- **What tools provide:**
  - a variety of analysis possibilities for simulation runs based on standard process performance metrics [JaNe06].
- **What is the problem yet:**
  - increasing complexity of business processes hampers quick visual allocation of weak points.
- **What is our aim:**
  - compact visualization of business process simulation and result by adding a third dimension.

Motivation

- **Why third dimension:**
  - supports users to quickly identify weak points of modeled business processes,
  - supports the human visual intuition [BaES00].

- **How to get there:**
  - enhance concept for spatial visualization of Petri net diagrams with a third modeling dimension,
  - enables interactive 3D animations of business process models,
  - statistical analyses of simulation results based on volume changes of 3D process and data objects.

3D Representation of Data and Process Objects

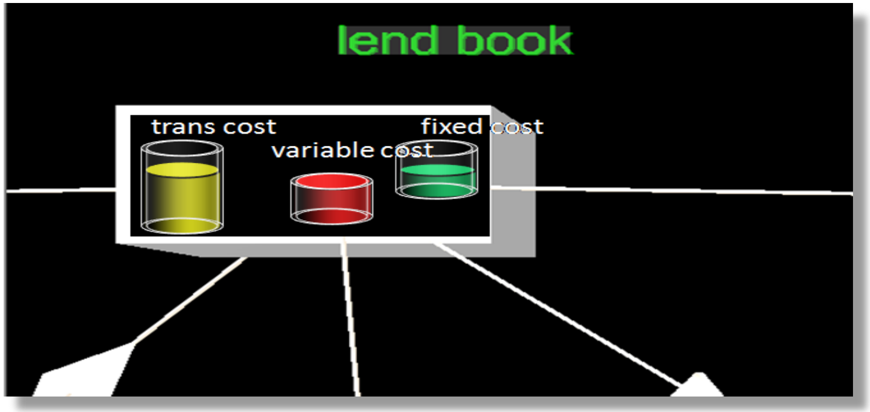
- objects in business processes are classified into data objects and process objects [AaBe01].
- *data objects* refer to flowing objects conveying data that are manipulated and delivered across a process net.
- *process objects* are non-flowing objects used to construct the control flow or serving as parameterized indicators.
- discuss following process objects:
  - transition cost, transition time, resources, and place capacity.

3D Representation of Data and Process Objects

- **Transition Cost:**

  $C_{trans}(t,i) = C_{fix}(t) + C_{var}(t,i)$ with $t \in T$, $i \in J$

- height of the cylinder varies according to current values of its corresponding cost indicators.
- cost cylinder is included in a transparent cylinder that controls the increase/decrease of cost factors.

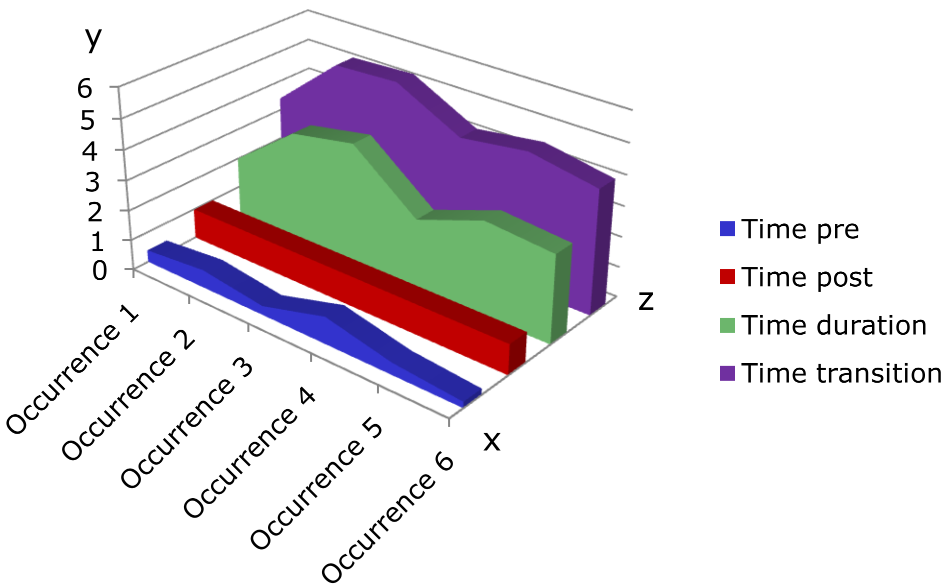


3D representation of costs

3D Representation of Data and Process Objects

- **Transition Time:**
  $T_{trans}(t,i) = T_{pre}(t,i) + T_{dur}(t,i) + T_{post}(t,i)$ with $t \in T$, $i \in J$

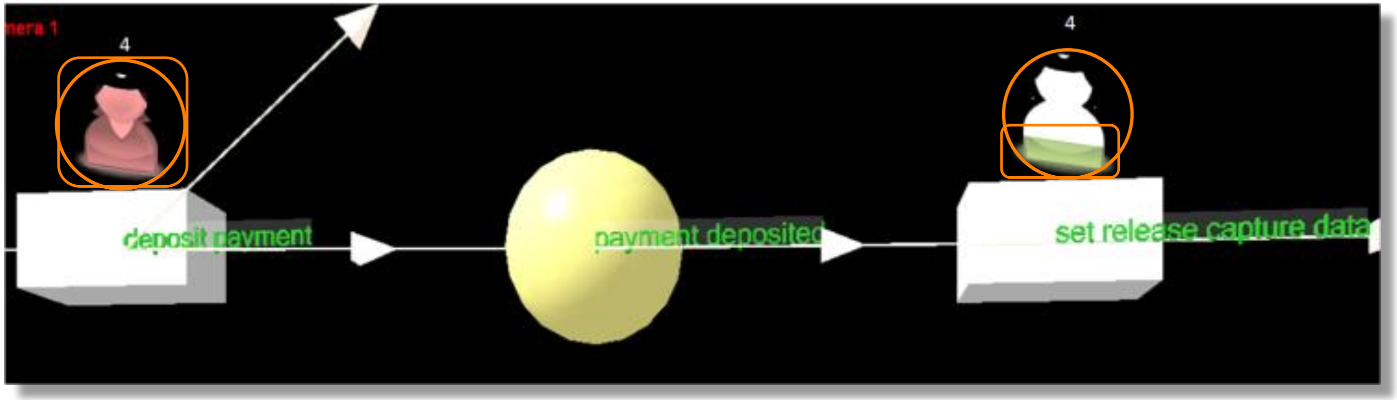
- area diagrams can be rotated for different view perspectives.



3D representation of transition time

3D Representation of Data and Process Objects

- **Resources:**

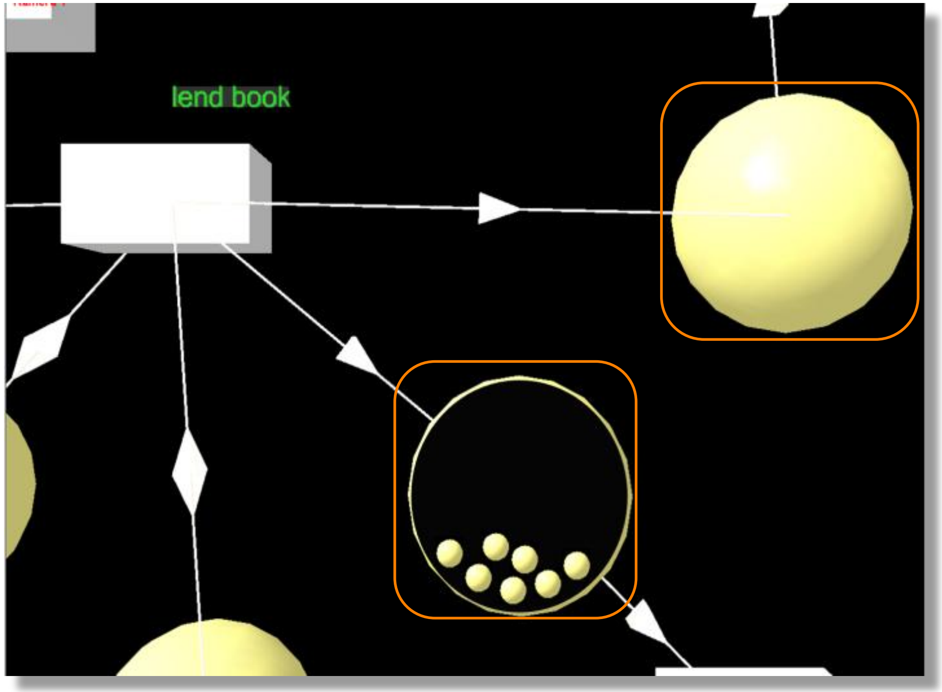


Assignment of Resources to Activities

  - are displayed over each transition icon, representing resources with their time attributes,
  - size of the icon is proportional to the value of available time for a transition and remains constant in a simulation.
  - each icon is filled with colors for warning purpose,
  - filling level varies according to load of the resource.

3D Representation of Data and Process Objects

- **Place Capacity:**
  - Place capacity restricts number of tokens that are allowed to be contained in a place.
  - Infinite capacity places are displayed as non-transparent spheres.
  - Transparent places are filled with tokens that are displayed as small balls.
  - for alerting capacity bottlenecks, tokens are colored green, yellow or red.



3D Representation of Capacity

Forming Data and Process Objects in 3D Simulation Environment

- **Size and Volume**
- **Monitoring**
- **Metrics**

Forming Data and Process Objects in 3D Simulation Environment

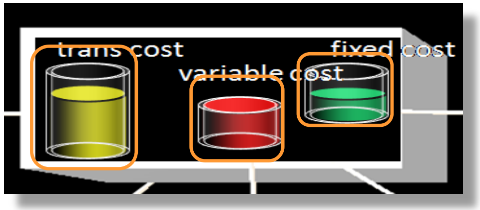
- **Size and Volume**
  - visualize weak points of the process design by changing volume *v* or size *s* of the representation of the objects.
- **Monitoring**
- **Metrics**

Forming Data and Process Objects in 3D Simulation Environment

- Size and Volume
- **Monitoring**
  - each formula defines changes *s* or *v* of the figures in simulation.
  - each figure has a default size and volume computed from its corresponding default *parameters* (e.g., height, length). The modification for each *p* is defined by:

$$\text{modification } p = \frac{c * \Delta \text{ objectUnit}}{\text{objectUnit}}$$

  - current status of an objectUnit is monitored with three colors for the size or volume:
    - Green: the value is performing well,
    - Yellow: warning that a value indicates a critical degree,
    - Red: alarming that a value indicates an impact problem.



- Metrics

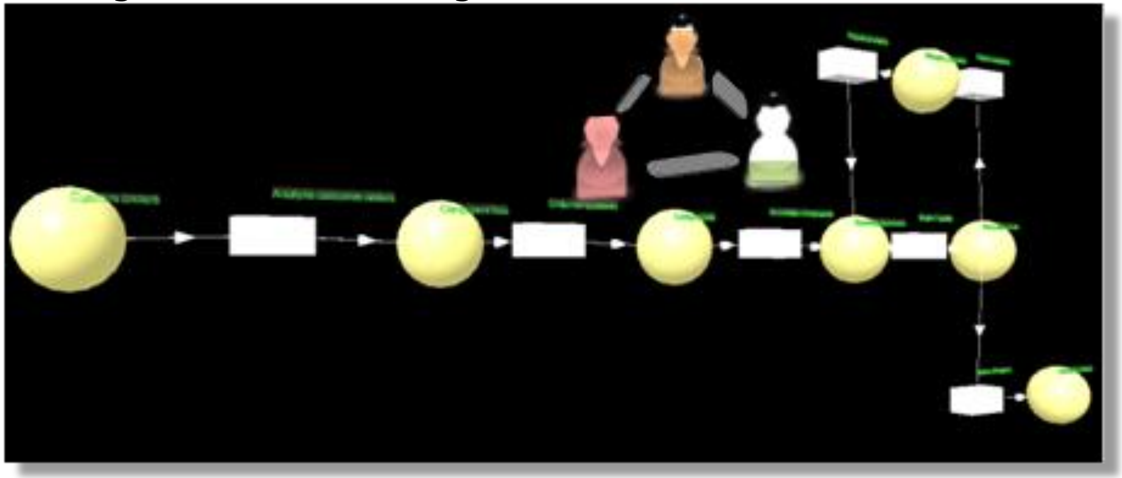
Forming Data and Process Objects in 3D Simulation Environment

- Size and Volume
- Monitoring
- **Metrics**

Data/Flow Complexity

- the degree depends on the amount of data and process objects,
- cognitive weights measures the effort required to comprehend a simulation result[ShWa03].
- *Information flow complexity(M) = length(M) × (fan-in(M) × fan-out(M))²*
- $\frac{\text{assigned roles}}{\text{all roles}}$
- resource metric computes the degree between assigned resource and all available resources:

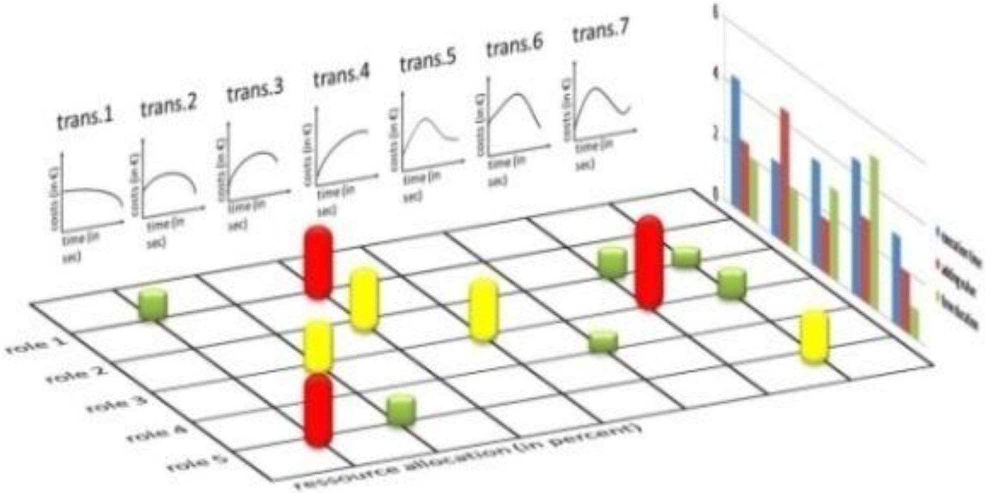
$$\frac{\textit{assigned resources}}{\textit{all resources}}$$



Highlighting of relationships between roles

Analysis of Simulation Results

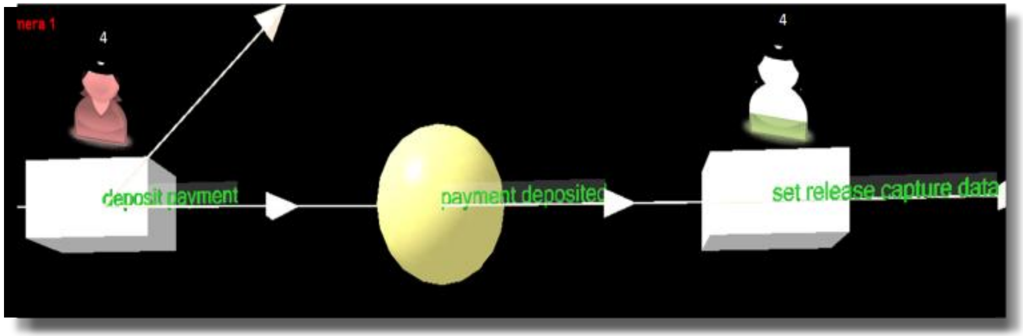
- **Analysis and Monitoring**
  - the aim of a 3D representation of analysis results is a quicker understanding of the simulation data set.
- **Customization of Analysis Results**
  - possibility to display the right diagram in the middle for a better recognition of the details.



3D Analysis of Role Performances

Conclusion

✓ added a third dimension into the graphical representation of process objects.



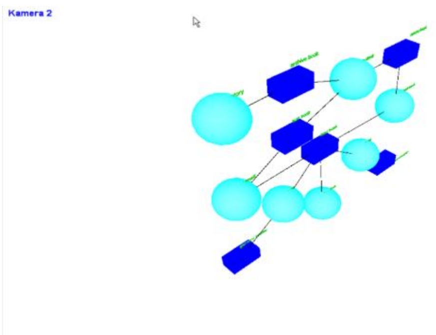
✓ benefit is a statistical analysis of simulation results based on volume and size changes.

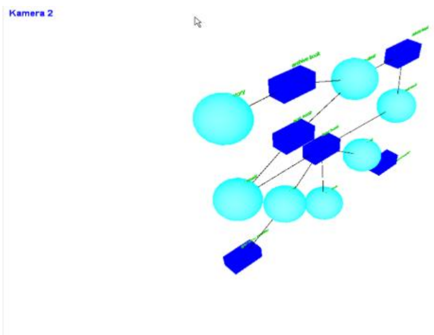
✓ by 3D environment, different views can examine and gather easily process-specific information.

=> visualizing of weak points is more easy.

Future Work

- integration of the implemented prototype into HORUS,
- execution of simulation runs of different process models,
- analysis of the results,
- discussion of our approach with selected test users,
- 3D visualization and animation of other process objects,
- 3D representation concerning the data flow of processes (e.g. XML documents in high level Petri nets).





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Thanks for Your Attention

Questions?