Collaborative Tool for Model-Based Systems Engineering: Pilot for Evaluating Students’ Expectations

Kohen, H., Wengrowicz, N., Lavi, R., & Dori, D – NARST 2019, Baltimore, MD
OPM – Object Process Methodology

- A visual and textual language for modeling systems and phenomena of all kinds:
  - Natural
  - Human–made
  - Any combination of the above
- Recognized as ISO 19450
Only two OPM Things: **Objects** and **Processes**

**Object:** A thing that exists or might exist physically or informatically.

**Process:** A thing that transforms or might transform one or more objects.

Charging changes Battery from depleted to charged.
OPM = OPD + OPL

**OPM**

**OPD - Object Process Diagram**

**OPL - Object Process Language**

**OPL**

- Global Warming is physical and systemic.
- Global Warming changes Quality Of Living of Human Group from high to low.
- Global Warming changes Temperature of Earth from low to high.
- Global Warming requires Greenhouse Gas Set.
- Global Warming affects Atmosphere and Earth.
- Solar Heat initiates Global Warming, which consumes Solar Heat.
- Global Warming yields Escaped Heat.
- Industrial & Private Activity is physical and environmental.
- Human Group handles Industrial & Private Activity.
- Industrial & Private Activity yields Greenhouse Gas Set.
OPCloud

Web-based tool for modeling in OPM
OPCloud

https://www.opcloud.tech/

Collaboration

OPD - Object Process Diagram

OPD tree

Things list

OPL - Object Process Language
OPCloud main features

Cloud-based Application
Ability to work from anywhere, any time

Collaboration
Simultaneous work of multiple distributed users, one editor at a time with built-in edit right transfer

Connectivity
with to other systems (DOORS, ARAS, PTC...) using OSLC

Latest Web Dev. Technologies:
Firebase, Angular, Rappid...

Correctness-by-Construction
via context sensitivity for choice of links and other features

Backward Compatibility
for OPM models prepared with OPCAT
Collaboration

Collaboration is a key concept in the twenty-first-century skills.
Collaboration

- **Collaborative learning** includes two or more learners who engage in a **common task** where everyone depends on and is accountable to each other.
- Developing students’ collaboration requires **tools** and **training**.
- Collaboration
  - Provides opportunities to experience **multiple perspectives** of other learners
  - Develops **critical thinking skills** through judging, valuing, supporting, or opposing different viewpoints
- **OPCloud** enables students to practice and develop their **modeling** and **collaboration** skills while constructing system models together
Purpose of the study

- Evaluate how students view the collaborative aspects of OPCloud – a Cloud-based modeling software environment
- Examine the evolution of students’ views before and after a short professional course
- Use the results to improve OPCloud’s collaborative features
Methodology

- A pre-course online questionnaire was administered to the students of a week-long professional education course.
- Students carried out a project collaboratively during the course.
- A post-course questionnaire about collaborative modeling was administered to the students at the end of the course.
- Data analysis: Items were classified and categorized.
Research Questions

Research Question 1
What features should a collaborative modeling tool have?

Research Question 2
What features promote and improve collaborative modeling work?
Preliminary Findings and Analysis

For Research Question 1
Analyzing students’ pre- and post-questionnaire responses, we found three feature categories:
Modeling Work
Communication
User Experience

For Research Question 2
The most common category in both the pre- and the post-responses is Modeling Work
Preliminary Findings and Analysis

pre
- Modeling Work features: 53%
- Communication: 37%
- User Experience: 10%

post
- Modeling Work features: 57%
- Communication: 25%
- User Experience: 18%
# Preliminary Findings and Analysis (N=14)

<table>
<thead>
<tr>
<th>Category</th>
<th>Sub-Category</th>
<th>Pre</th>
<th>Post</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td># items</td>
<td>%</td>
</tr>
<tr>
<td>Modeling Work</td>
<td>General e.g., “version control”</td>
<td>2</td>
<td>10.5%</td>
</tr>
<tr>
<td></td>
<td>“Traditional” collaboration e.g., “merging tool”</td>
<td>6</td>
<td>32%</td>
</tr>
<tr>
<td></td>
<td>“New approach” collaboration e.g., “adopting from other collaborative environment”</td>
<td>2</td>
<td>10.5%</td>
</tr>
<tr>
<td>Communication</td>
<td>“Traditional” communication e.g., “comments”</td>
<td>3</td>
<td>16%</td>
</tr>
<tr>
<td></td>
<td>“New approach” communication e.g., “chat: A view that allows the entire group to review the model and discuss it to agree on changes”</td>
<td>4</td>
<td>21%</td>
</tr>
<tr>
<td>User Experience</td>
<td>e.g., “Examples and directions of how the tool is used/easy to understand for the uninitiated”</td>
<td>2</td>
<td>10%</td>
</tr>
</tbody>
</table>
Conclusions

- OPCODE framework enables students to migrate from using “traditional” collaborative features to newer approaches.
- This collaboration facilitates joint Cloud-based modeling and opens the door for online systems engineering courses that feature project-based learning characteristics.
- We obtained a “wish list” of new collaboration features to be developed in the upcoming OPCODE versions.
OPM Resources


• **ISO Standard** ISO 19450 OPM

• **edX Course:**
  [https://www.youtube.com/watch?v=l9RFM4ybDGg](https://www.youtube.com/watch?v=l9RFM4ybDGg)

• **Website:** Enterprise Systems Modeling Laboratory contains
  • journal & conference papers,
  • free OPCAT software, upcoming OPCloud
  • presentations
  • projects
  • more...

• **OPCloud:** [https://www.opcloud.tech/](https://www.opcloud.tech/)
Thanks for listening!

Visit our [Lab site]; http://esml.iem.technion.ac.il/

Experience [OPCloud], Cloud-based OPM modeling: https://www.opcloud.tech/

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