

**[ ]Where do you work?**

Please choose **only one** of the following:

- ☐ Research/Academia
- ☐ Industry
- ☐ Other

**[ ]In which sector?**

**Only answer this question if the following conditions are met:**  
Answer was 'Research/Academia' at question '1 [work]' (Where do you work?)

Please choose **only one** of the following:

- ☐ Software development
- ☐ Energy Systems
- ☐ Heating, Ventilation and Air Conditioning
- ☐ Automotive Industry
- ☐ Robotics
- ☐ Maritime
- ☐ Agriculture
- ☐ Systems-on-Chip
- ☐ Integrated Circuits
- ☐ Other

**[ ]In which sector?**

**Only answer this question if the following conditions are met:**  
Answer was 'Industry' at question '1 [work]' (Where do you work?)

Please choose **only one** of the following:

- ☐ Energy System (Smart Grids, Power Systems, District Heating, etc.)
- ☐ Software development
- ☐ Control
- ☐ Mathematics
- ☐ Physics
- ☐ Mobility
- ☐ Other

**[ ]What is your field of expertise?**

Please write your answer here:

**[ ] Please mark which properties apply to the simulators that you have worked in co-simulation:**

Please choose **all** that apply:

- ☐ The simulator approximates the solution to sets of differential equations.
- ☐ The simulator is a dedicated piece of hardware (e.g., a SCALEXIO).
- ☐ The simulator specializes in finite element modelling.
- ☐ The simulator receives input from a human-machine interface (e.g., a flight controller).
- ☐ The simulator specializes in networks.
- ☐ The simulator specializes in software controllers (e.g., Overture Tool).
- ☐ Other:

# Description of the SWOT Analysis

This part comprises a SWOT analysis. For each group, i.e. strengths, weaknesses, opportunities, and threats, three factors are proposed. The factors are based on the answers to a previous expert survey.

We kindly ask you to compare pairs of these factors and rate their relative importance for using co-simulation for applications in industry and applied research in various engineering fields such as automotive, biomechanics, control, energy system, logistics, mechatronics, robotics or thermodynamic.

Comparison of Strengths of co-simulation

How important do you consider the following three factors? Please compare the pairs of factors in the group "Strengths"and rate their relative importance.

9 = much more important; 1 = equally important

\*

Please choose the appropriate response for each item:

	<div>much more important 9</div>	7	5	3	<div>equally important 1</div>	3	5	7	<div>much more important 9</div>	
<div>It supports cross-discipline developments</div>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<div>It supports cross-company cooperation (e.g., suppliers and system integrators can exchange virtual "trial components" before signing contracts)</div>
<div>It supports cross-company cooperation (e.g., suppliers and system integrators can exchange virtual "trial components" before signing contracts)</div>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<div>Every sub-system can be implemented in a tool that meets the particular requirements for the domain, the structure of the model and the simulation algorithm</div>
<div>It supports cross-discipline developments</div>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<div>Every sub-system can be implemented in a tool that meets the particular requirements for the domain, the structure of the model and the simulation algorithm</div>

[]

**Do you consider any other factor than the above as being more important? If yes, please name it:**

Please write your answer here:

# Comparison of Weaknesses of co-simulation

This part comprises a SWOT analysis. For each group, i.e. strengths, weaknesses, opportunities, and threats, three factors are proposed. The factors are based on the answers to a previous expert survey.

We kindly ask you to compare pairs of these factors and rate their relative importance for using co-simulation for applications in industry and applied research in various engineering fields such as automotive, biomechanics, control, energy system, logistics, mechatronics, robotics or thermodynamic.

[ ]

Please **compare the pairs of factors** in the group "Weaknesses" and **rate their relative importance**.

9 = *much more important*; 1 = *equally important*

\*

Please choose the appropriate response for each item:

	<div>much more important 9</div>	7	5	3	<div>equally important 1</div>	3	5	7	<div>much more important 9</div>	
<b>Computational performance</b> of co-simulation compared to monolithic simulation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<b>Robustness of co- simulation</b> compared to Monolithic simulation.
<b>Computational performance</b> of co-simulation compared to monolithic simulation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<b>Licenses for all programs are required</b> to couple different simulation programs
<b>Robustness of co-simulation</b> compared to Monolithic simulation.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<b>Licenses for all programs are required</b> to couple different simulation programs

[ ]

**Do you consider any other factor than the above as being more important? If yes, please name it:**

Please write your answer here:

# Comparison of Opportunities of co-simulation

This part comprises a SWOT analysis. For each group, i.e. strengths, weaknesses, opportunities, and threats, three factors are proposed. The factors are based on the answers to a previous expert survey.

We kindly ask you to compare pairs of these factors and rate their relative importance for using co-simulation for applications in industry and applied research in various engineering fields such as automotive, biomechanics, control, energy system, logistics, mechatronics, robotics or thermodynamic.

[ ]

Please compare the pairs of factors in the group "Opportunities" and rate their relative importance.

9 = much more important; 1 = equally important \*

Please choose the appropriate response for each item:

	<div>much more important 9</div>	7	5	3	<div>equally important 1</div>	3	5	7	<div>much more important 9</div>	
Growing co-simulation community/growing industrial adoption	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	User-friendly tools (pre-defined master algorithms...., integrated error estimation...)
Growing co-simulation community/growing industrial adoption	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Better communication between different domains
User-friendly tools (pre-defined master algorithms...., integrated error estimation...)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Better communication between different domains

[ ]

Do you consider any other factor than the above as being more important? If yes, please name it:

Please write your answer here:

# Comparison of Threats of co-simulation

This part comprises a SWOT analysis. For each group, i.e. strengths, weaknesses, opportunities, and threats, three factors are proposed. The factors are based on the answers to a previous expert survey.

We kindly ask you to compare pairs of these factors and rate their relative importance for using co-simulation for applications in industry and applied research in various engineering fields such as automotive, biomechanics, control, energy system, logistics, mechatronics, robotics or thermodynamic.

[ ]

Please compare the pairs of factors in the group "Threats" and rate their relative importance.

9 = much more important; 1 = equally important

\*

Please choose the appropriate response for each item:

	<div><div>much more important</div><div>9</div></div>	<div><div>7</div></div>	<div><div>5</div></div>	<div><div>3</div></div>	<div><div>equally important</div><div>1</div></div>	<div><div>3</div></div>	<div><div>5</div></div>	<div><div>7</div></div>	<div><div>much more important</div><div>9</div></div>	
<div><div>Insufficient knowledge/information of users in co-simulation may lead to improper use (e.g. wrong or missing error estimation, stability issues).</div></div>	<div><div></div><div></div></div>	<div><div></div><div></div></div>	<div><div></div><div></div></div>	<div><div></div><div></div></div>	<div><div></div><div></div></div>	<div><div></div><div></div></div>	<div><div></div><div></div></div>	<div><div></div><div></div></div>	<div><div></div><div></div></div>	<div><div>Incompatibility of different standards and co-simulation approaches.</div></div>
<div><div>Insufficient knowledge/information of users in co-simulation may lead to improper use (e.g. wrong or missing error estimation, stability issues).</div></div>	<div><div></div><div></div></div>	<div><div></div><div></div></div>	<div><div></div><div></div></div>	<div><div></div><div></div></div>	<div><div></div><div></div></div>	<div><div></div><div></div></div>	<div><div></div><div></div></div>	<div><div></div><div></div></div>	<div><div></div><div></div></div>	<div><div>Lack of exchange/cooperation between theoretical/numerical part, implementation and application/industry.</div></div>
<div><div>Lack of exchange/cooperation between theoretical/numerical part, implementation and application/industry.</div></div>	<div><div></div><div></div></div>	<div><div></div><div></div></div>	<div><div></div><div></div></div>	<div><div></div><div></div></div>	<div><div></div><div></div></div>	<div><div></div><div></div></div>	<div><div></div><div></div></div>	<div><div></div><div></div></div>	<div><div></div><div></div></div>	<div><div>Incompatibility of different standards and co-simulation approaches.</div></div>

[ ]

Do you consider any other factor than the above as being more important? If yes, please name it:

Please write your answer here:



## Comparison of SWOT-categories

This part comprises a SWOT analysis. For each group, i.e. strengths, weaknesses, opportunities, and threats, three factors are proposed. The factors are based on the answers to a previous expert survey.

We kindly ask you to compare pairs of these factors and rate their relative importance for using co-simulation for applications in industry and applied research in various engineering fields such as automotive, biomechanics, control, energy system, logistics, mechatronics, robotics or thermodynamic.

[illegible]

## Research fields, standards and tools

**[[ ] To which extent do you agree that the following research topics in the field of co-simulation have not received enough attention up to now?**

Please choose the appropriate response for each item:

[illegible]

made in their  
corresponding models)

Numerical stability	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Impact of coupled error controlled algorithms	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Impact of updating inputs (and the discontinuity it introduces) in the subsystems	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Parallelization	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Simultaneous events	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**[ ]Established standards for continuous time co-simulation. Please choose a widely accepted standard for continuous time co-simulation in industry and academia (choose one)**

Please choose **only one** of the following:

☐ FMI

☐ Simulink S-functions

☐ OpenMI

☐ High Level Architecture

☐ Other

**[ ]**  
**What standard do you use for continuous time co-simulation?**

Please choose **only one** of the following:

☐ FMI

☐ Simulink S-functions

☐ OpenMI

☐ High Level Architecture

☐ Other

**[ ]What tools do you use for continuous time co-simulation?**

Please write your answer here:

**[ ]Established standards for discrete event co-simulation. In your opinion, is there a widely accepted standard for discrete event co-simulation in industry and academia? (choose)**

Please choose **only one** of the following:

- ☐ FMI
- ☐ SystemC
- ☐ High Level Architecture
- ☐ DEVS formalism
- ☐ Open
- ☐ Other

**[ ]What standard do you use for discrete event co-simulation?**

Please choose **only one** of the following:

- ☐ FMI
- ☐ SystemC
- ☐ High Level Architecture
- ☐ DEVS formalism
- ☐ Other

**[ ]What tools do you use for discrete event co-simulation?**

Please write your answer here:

**[ ]Established standards for hybrid co-simulation. In your opinion, is there a widely accepted standard for discrete event co-simulation in industry and academia? (choose)**

Please choose **only one** of the following:

- ☐ FMI
- ☐ High Level Architecture
- ☐ Other

**[ ]What standard do you use for hybrid co-simulation?**

Please choose **only one** of the following:

- ☐ FMI
- ☐ High Level Architecture
- ☐ Other

**[ ]What tools do you use for hybrid co-simulation?**

Please write your answer here:

## Personal experience and assessment

**[ ]What is the main reason that you work with co-simulation?**

Please write your answer here:

[illegible]

[ ]

Please choose the appropriate response for each item:

[illegible]

[ ]

Please choose the appropriate response for each item:

	Very important	Important	Fairly important	Slightly important	Not important
Is Intellectual Property Protection important when you are using a co-simulation?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Is usability and performance important when you are using a co-simulation?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Is Simulator black boxing and IP Protection important for your work?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

[ ]

Please choose the appropriate response for each item:

[illegible]