

BMW  
GROUP



# BULK POSITIONING TOOL.

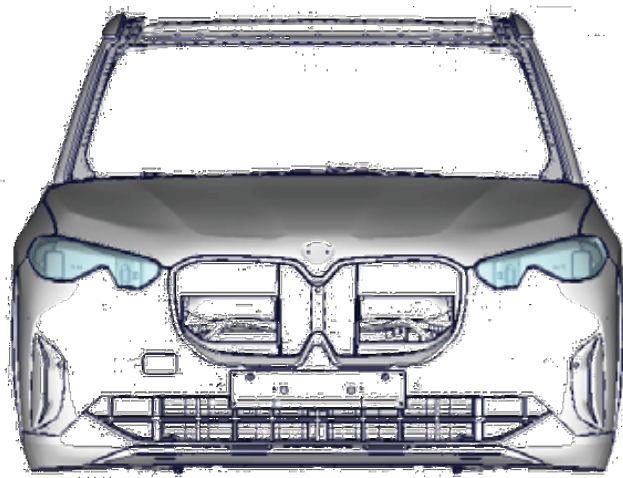
FOR POSITIONING PEDESTRIAN PROTECTION IMPACTORS AND LOW SPEED CRASH BARRIERS.

BMW Group

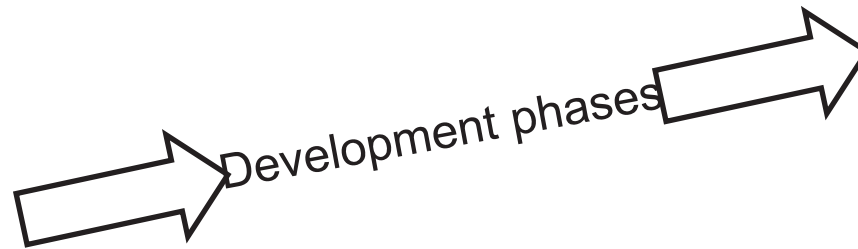
# MOTIVATION.

## Challenge:

- Short development phases require high level of automatization.
- Pedstrian Protection and Low-Speed Crash require many separate simulations.



Initial Design BMW X1

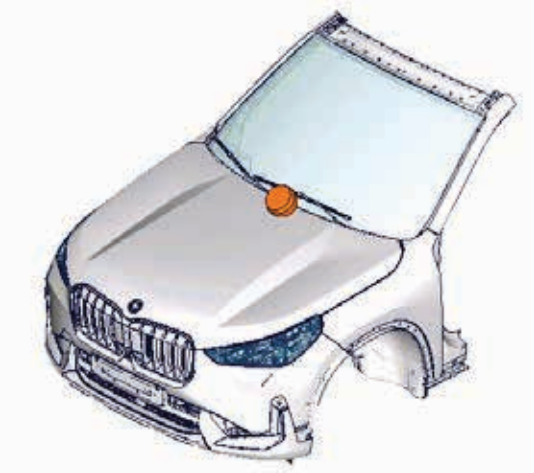


Final Design BMW X1

# MOTIVATION. PEDESTRIAN PROTECTION LOADCASES.

## Challenge:

- Multiple loadcases.
- Multiple requirements (legal, Euro-/China-/... NCAP).



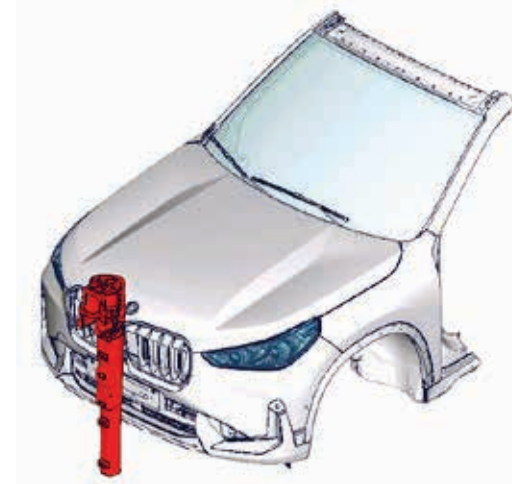
## Head Impact:

- Legal requirement.
- Consumer Protection (NCAP).
- Closed/deployed bonnet.



## FlexPLI:

- Legal requirement.
- Consumer Protection (NCAP).



## aPLI:

- Consumer Protection (NCAP).



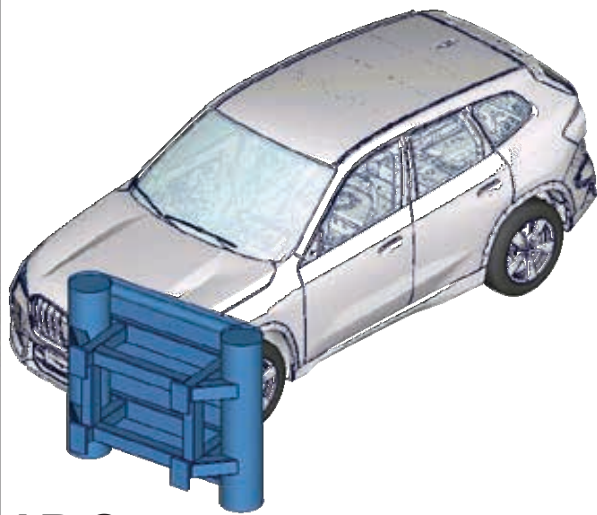
## Upper Leg:

- Consumer Protection (NCAP).

# MOTIVATION. LOW SPEED CRASH LOADCASES.

## Challenge:

- Multiple loadcases.
- Multiple requirements (RCAR: insurance rating / Pendulum: legal).



### RCAR Structure:

- Front: Left / Right.
- Rear: Left / Right.



### RCAR Bumper:

- Front.
- Rear.



### Pendulum:

- ECE R42:  
Front | Rear: Center / Offset / Corner.
- US Part 581 (with/without Extension):

Front | Rear: Center / Offset / - 4 -

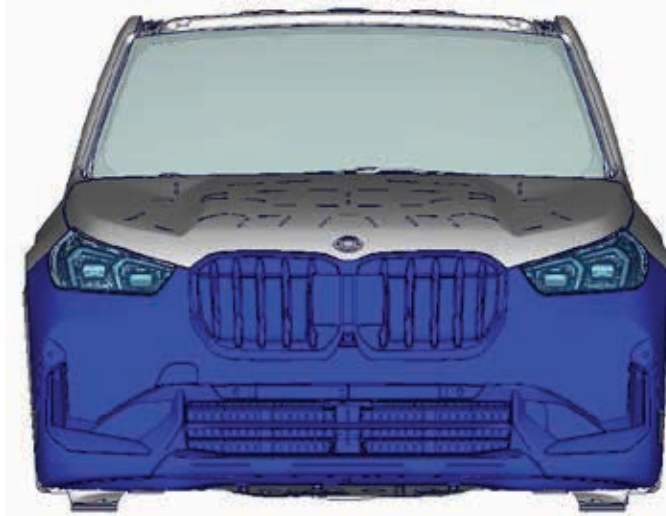
# MOTIVATION. VARIOUS TRIMS.

## Challenge:

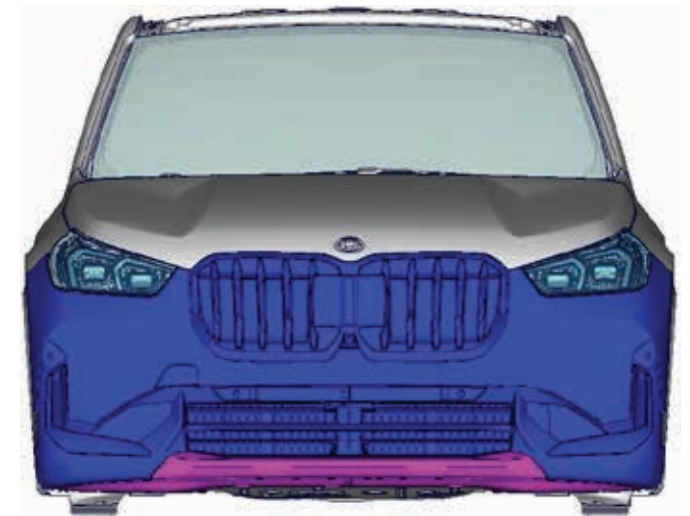
- Different trims in different loadcases.
- Legal requirements have to be satisfied for all trims.



Trim A



Trim B



Trim C

# MOTIVATION. MULTITUDE OF REQUIRED SIMULATIONS.

## Head Impact:

- Legal requirement: ~ 3 x 600 simulations
- NCAP: ~ 3 x 250 simulations.

## FlexPLI:

- Legal requirement: ~ 30 simulations x number of trims.
- NCAP: ~ 15 simulations x number of trims.

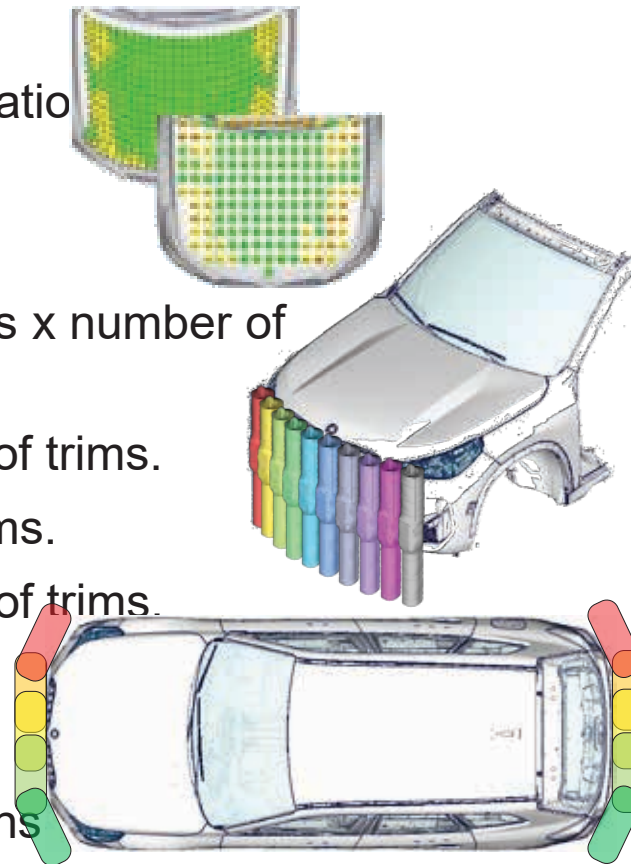
aPLI: ~15 simulations x number of trims.

Upperleg: ~15 simulations x number of trims.

RCAR: 6 simulations.

ECE R42 Pendulum: 16 simulations.

US Part 581 Pendulum: 32 simulations



BMW X1

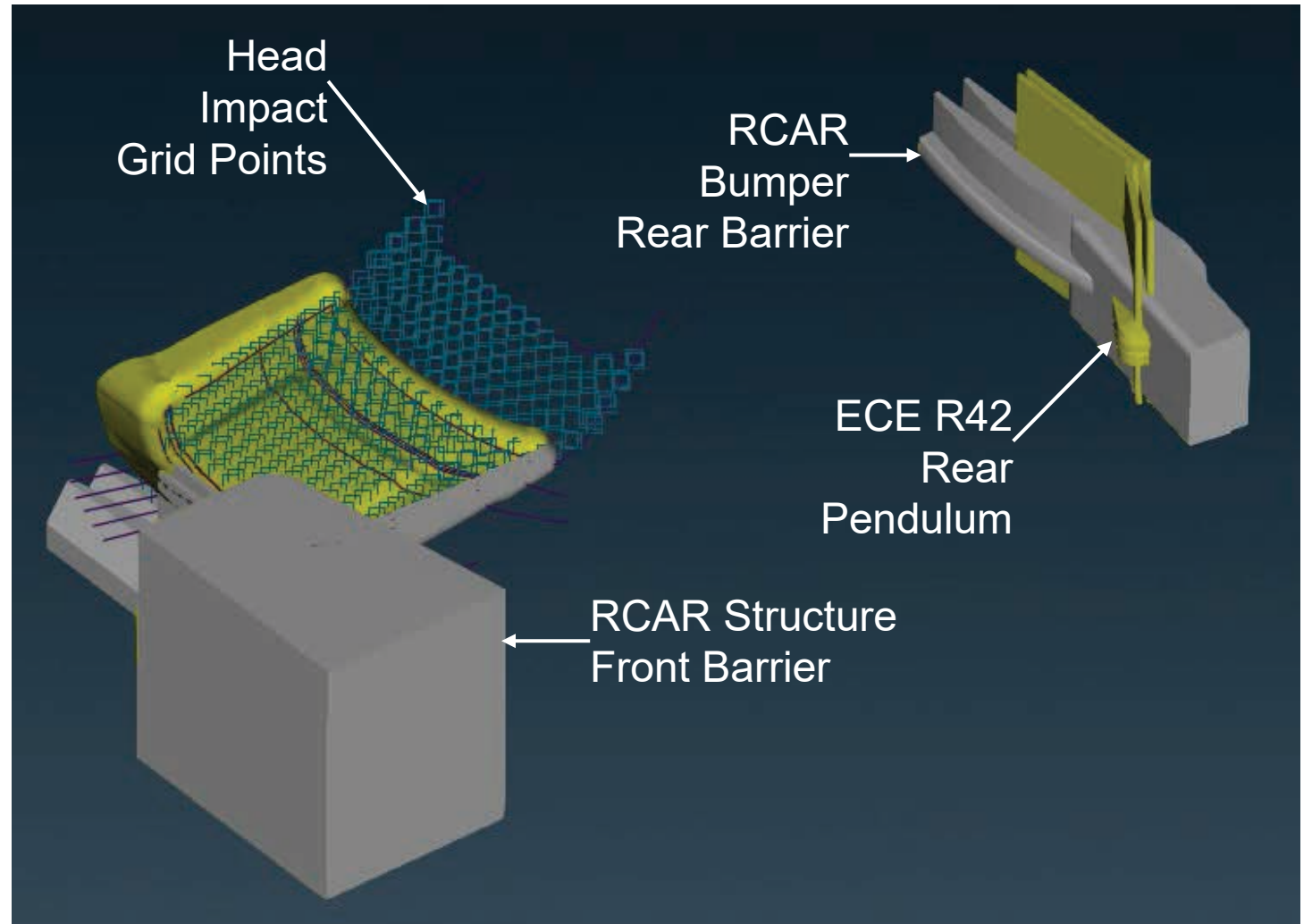
→ ~ 2700 different impactor/barrier positions for initial evaluation of a development phase\*.

(for mid-size vehicle with active bonnet)

\*excluding subsequent design optimization.

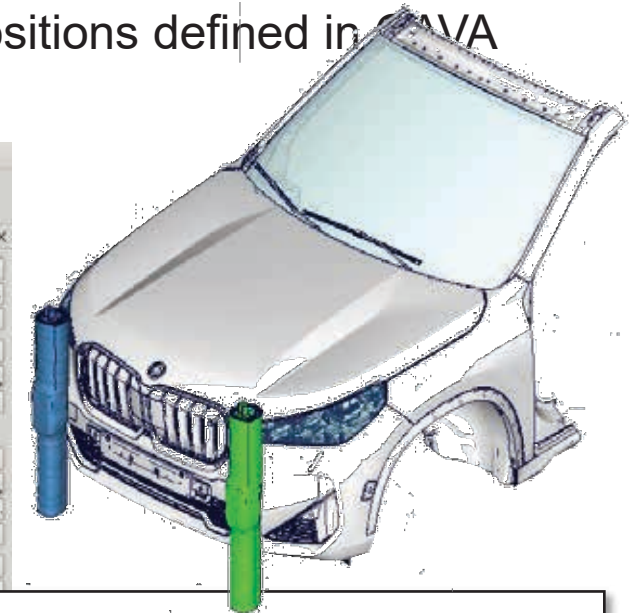
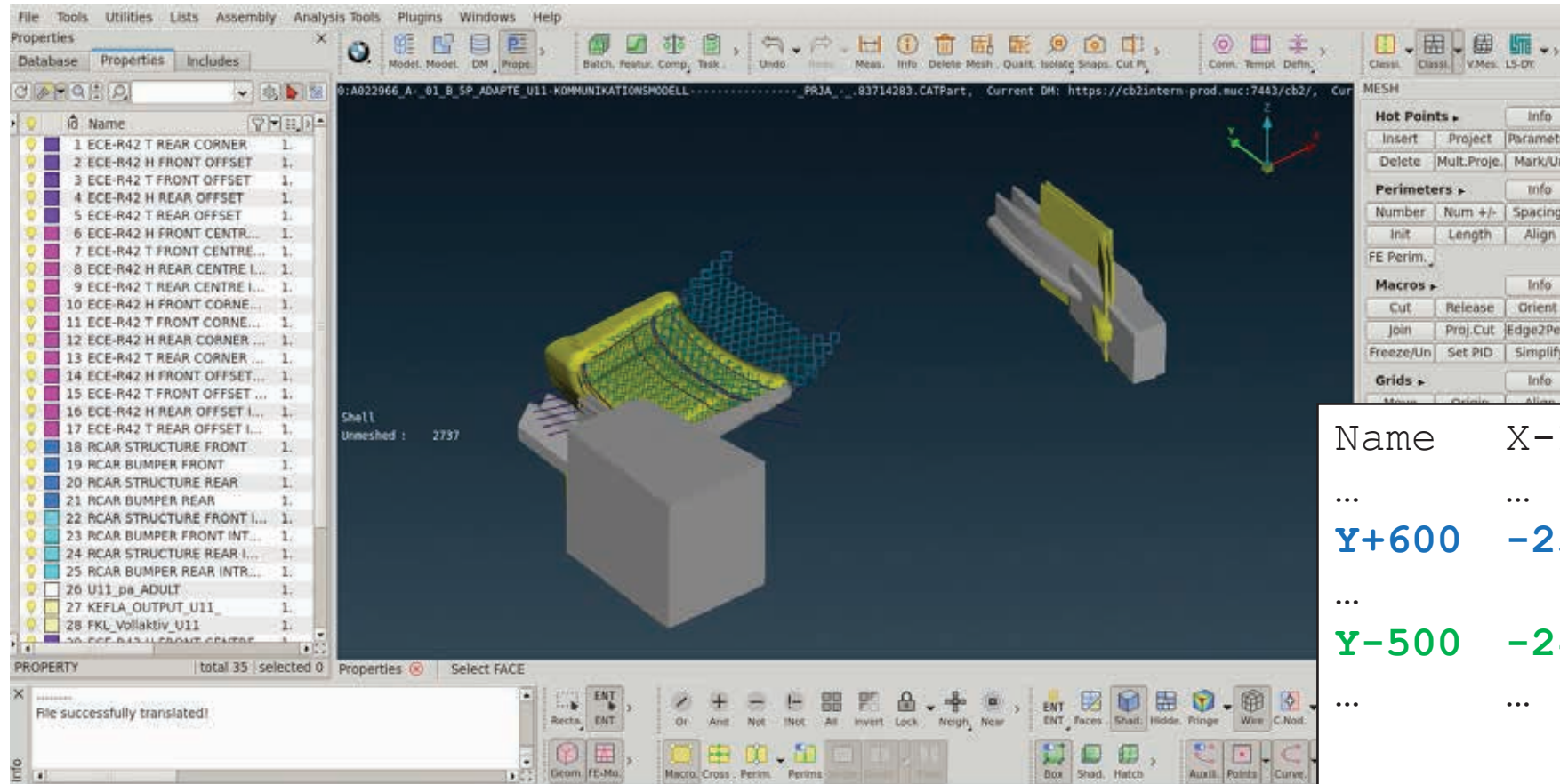
# STATUS QUO. CAVA FILE.

- CAVA process: used by various OEMs.
- CAVA file: CAD data containing
  - Testing areas.
  - Test points/grids.
  - Positioned barriers.



# STATUS QUO. POSITIONING PROCESS.

- In ANSA: move\* FE-models of barriers / impactors onto the barrier / impactor positions defined in JAVA file.



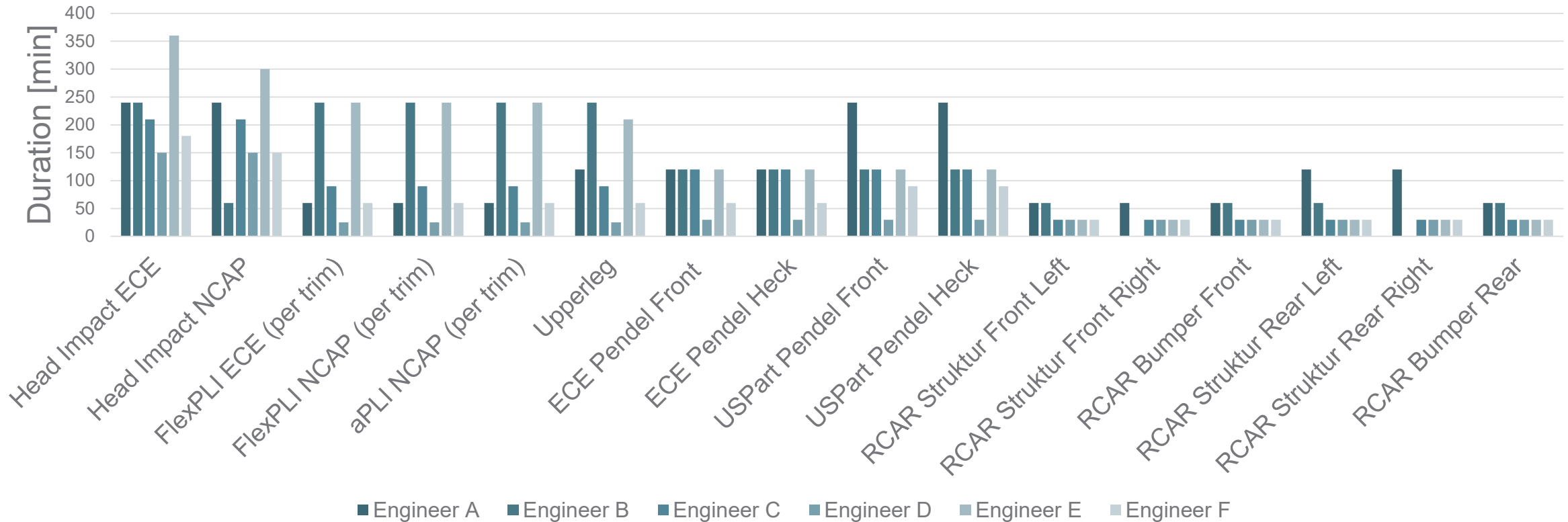
Name	X-Pos	Y-Pos	Z-Pos	...
...	...	...	...	...
<b>Y+600</b>	<b>-235</b>	<b>+600</b>	<b>-345</b>	...
...	...	...	...	...
<b>Y-500</b>	<b>-247</b>	<b>-500</b>	<b>-345</b>	...
...	...	...	...	...

\*manually or (semi-)automated.



# STATUS QUO. EFFORT FOR POSITIONING PROCESS.

Non-representative survey amongst various engineers / engineering partners:



➔ on average ~ 26h are spent on more or less manual positioning\* of barriers/impactors (for initial evaluation of a development phase).

\*only positioning (=preprocessing), not simulation.

# VISION.

Tool – with professional support (i.e. no in-house solution) - that automates the time consuming positioning process.

- Speed-up.
- Standardized, user-independent results.
- Reduction of errors.

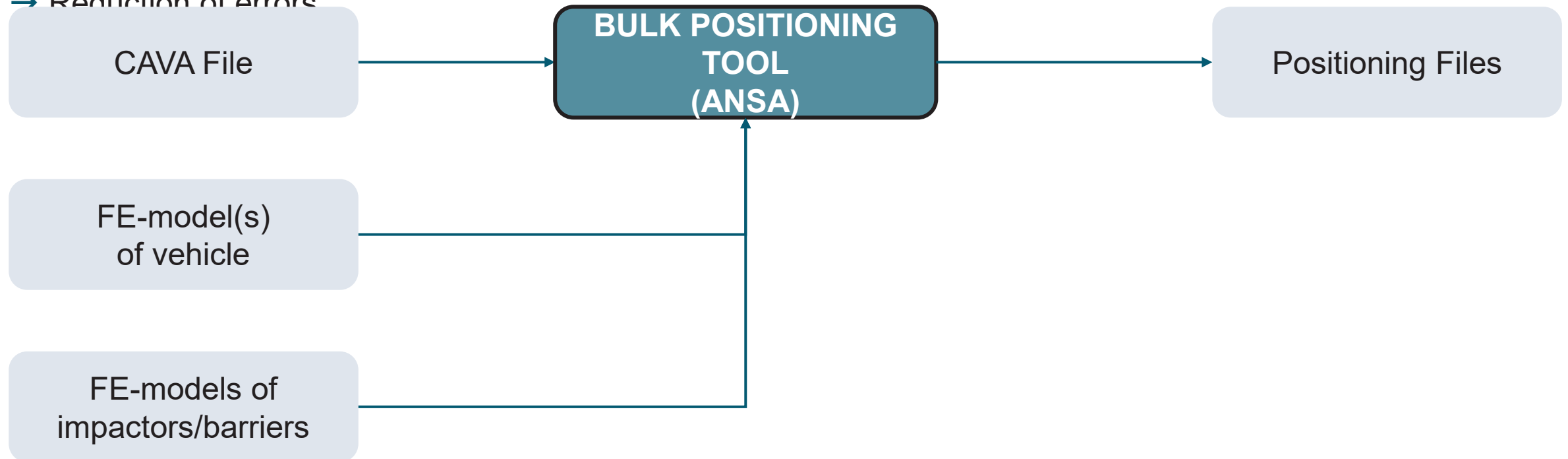
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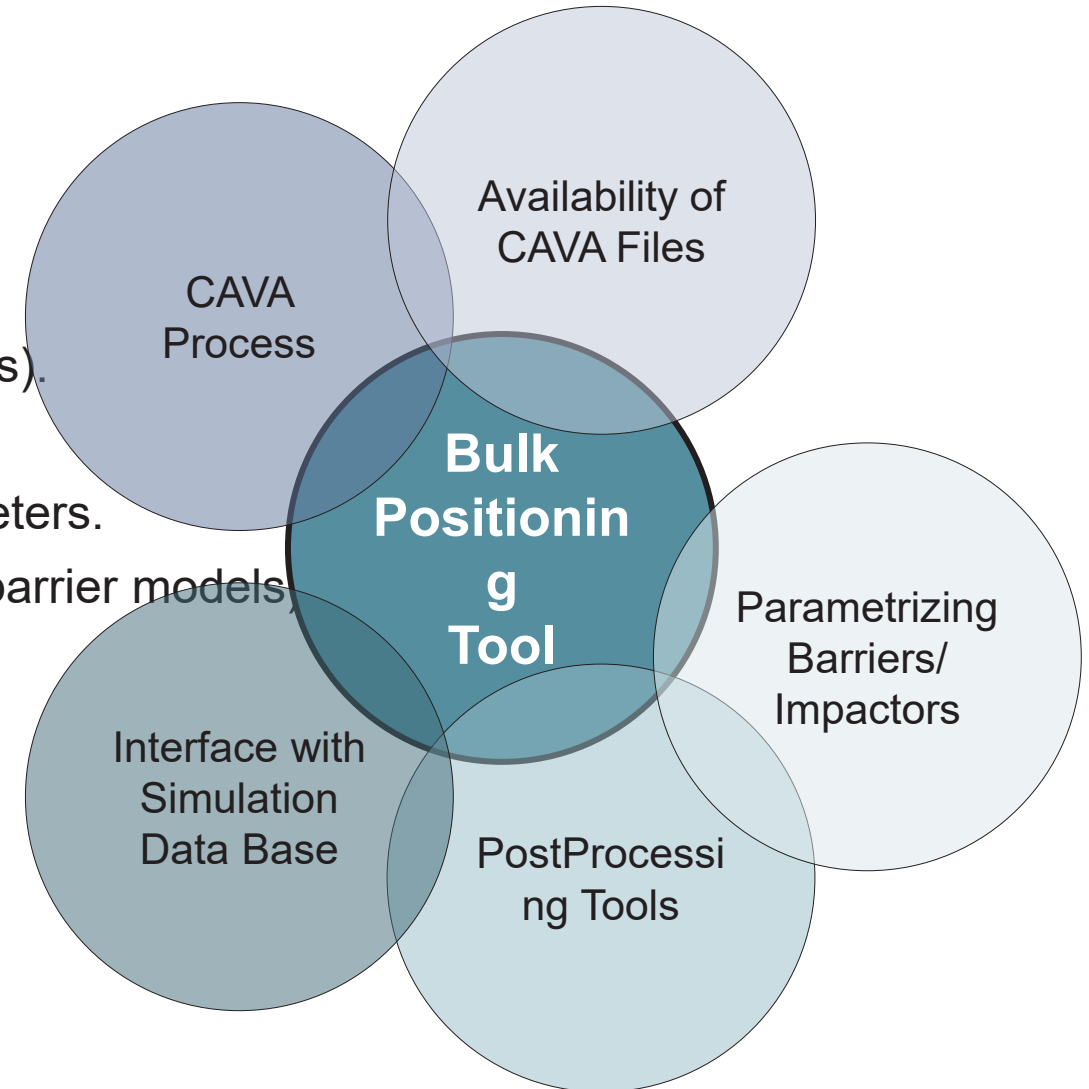


# COOPERATION WITH BETA SYSTEMS.

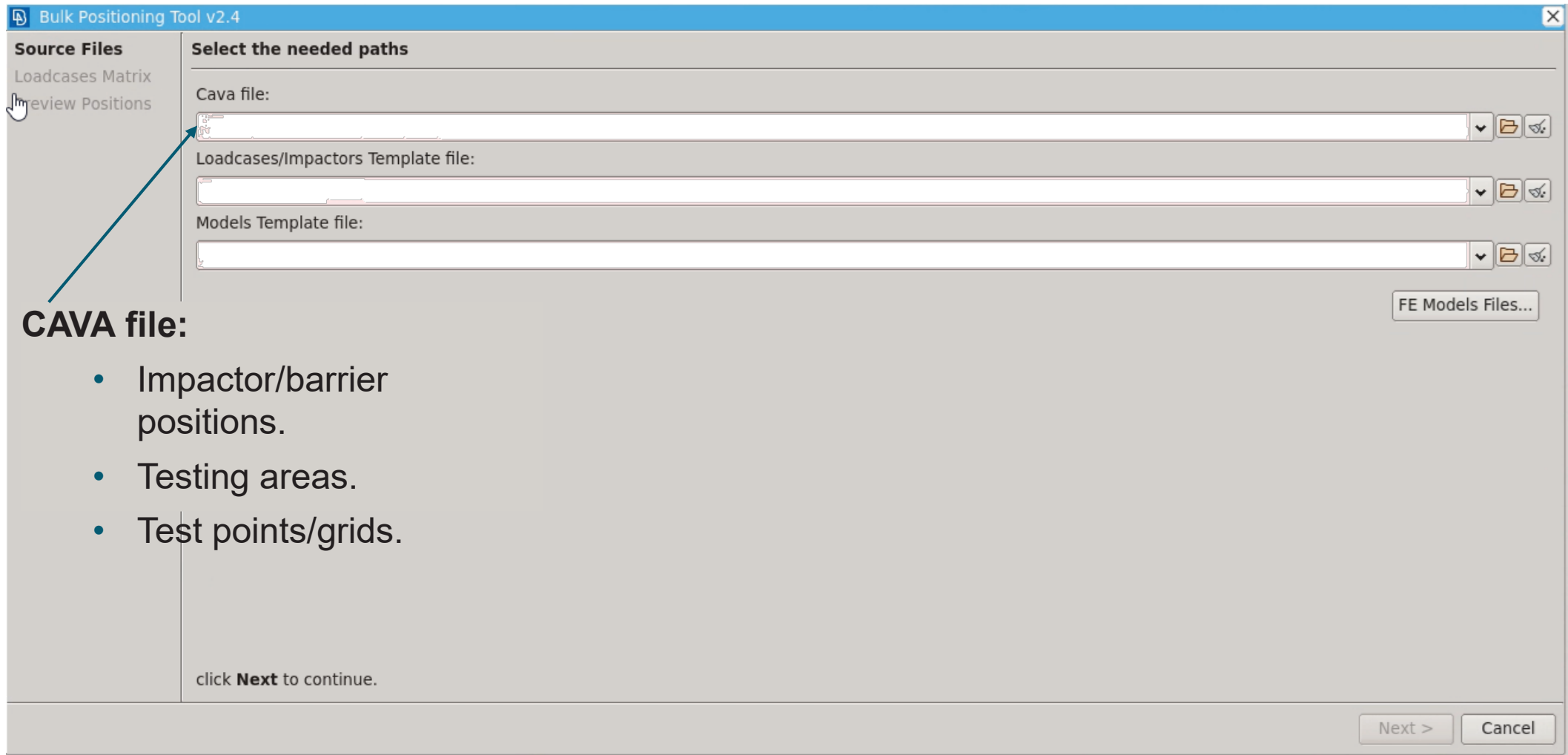
(Bi-) weekly meetings.

## Challenges:

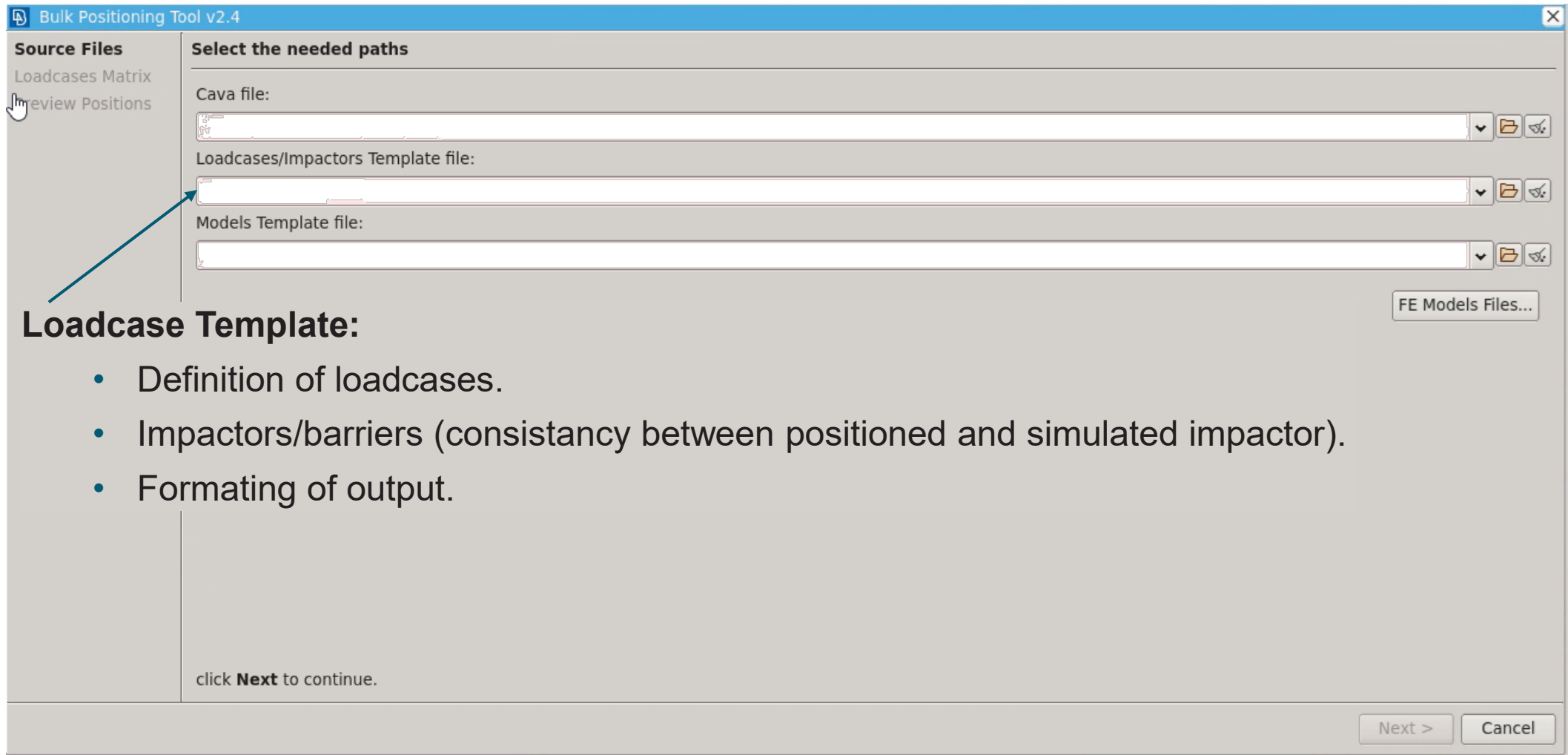
- CAVA process/standardization of CAVA file.
- Availability of CAVA files (only for new development phases).
- Standardization and parametrization of impactors/barriers.
- Adaption of postprocessing tools to new standards/parameters.
- Interface to simulation data base (to get current impactor/barrier models).



# BULK POSITIONING TOOL. GUI: SELECT SOURCE FILES.



# BULK POSITIONING TOOL. GUI: SELECT SOURCE FILES.



**Source Files**

Loadcases Matrix  
review Positions

**Select the needed paths**

Cava file:

Loadcases/Impactors Template file:

Models Template file:

FE Models Files...

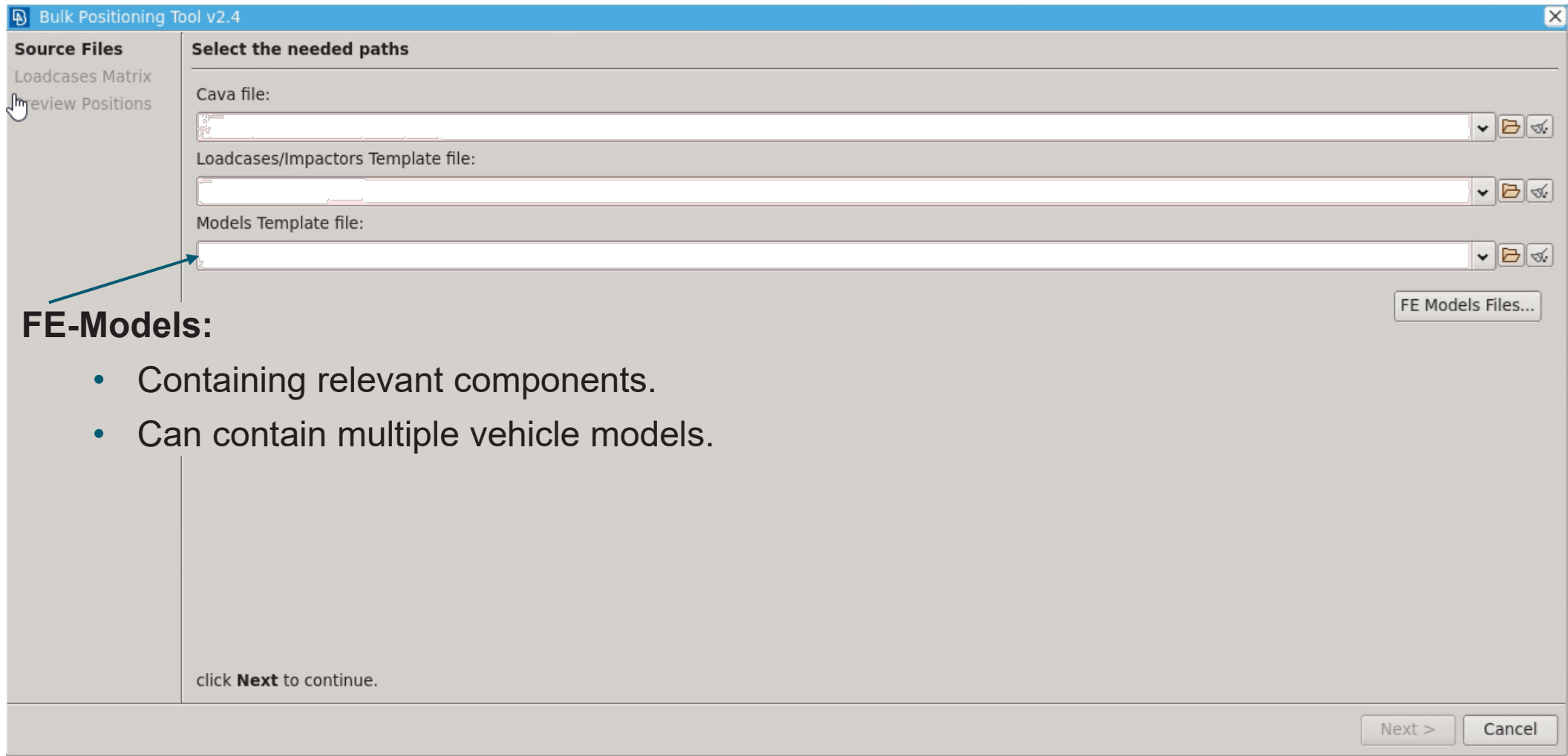
**Loadcase Template:**

- Definition of loadcases.
- Impactors/barriers (consistency between positioned and simulated impactor).
- Formating of output.

click **Next** to continue.

Next > Cancel

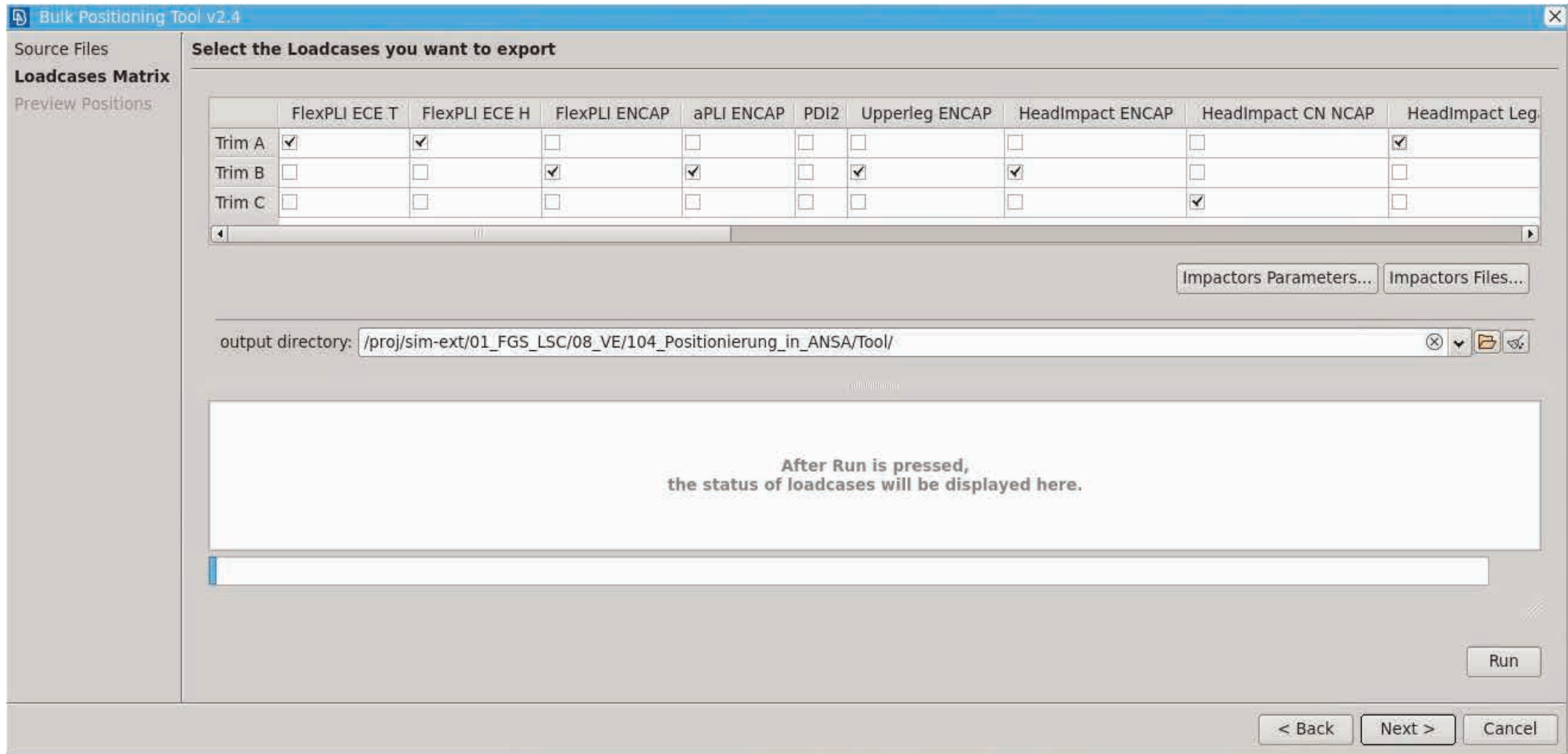
# BULK POSITIONING TOOL. GUI: SELECT SOURCE FILES.



## FE-Models:

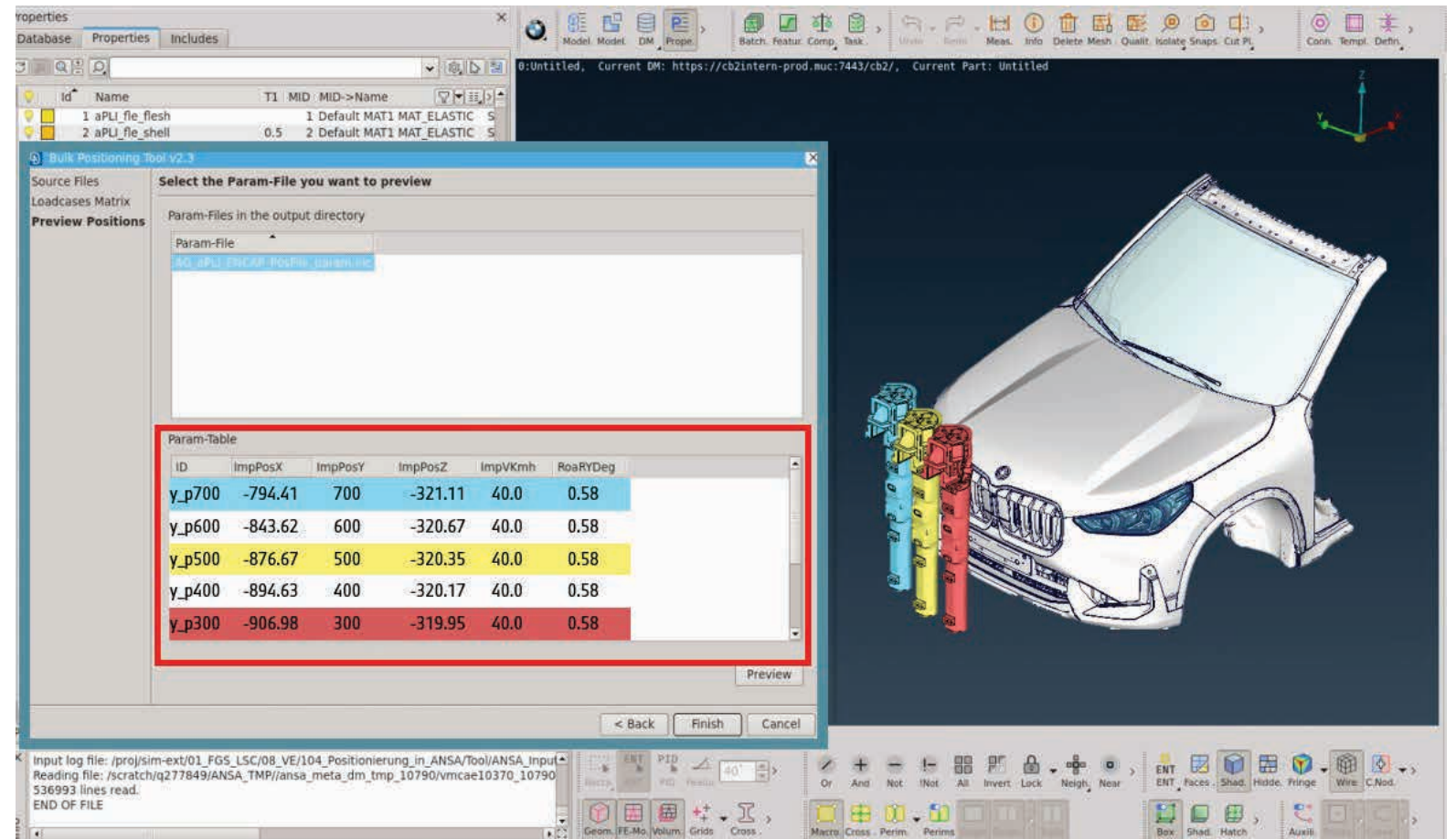
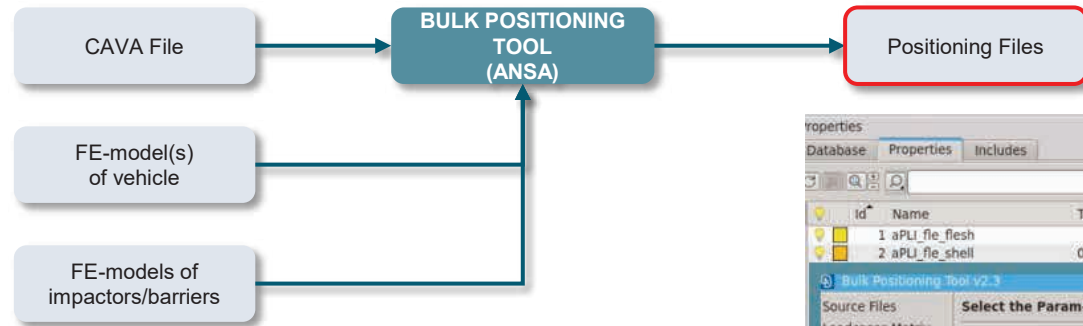
- Containing relevant components.
- Can contain multiple vehicle models.

# BULK POSITIONING TOOL. GUI: FILL LOADCASE MATRIX & RUN.

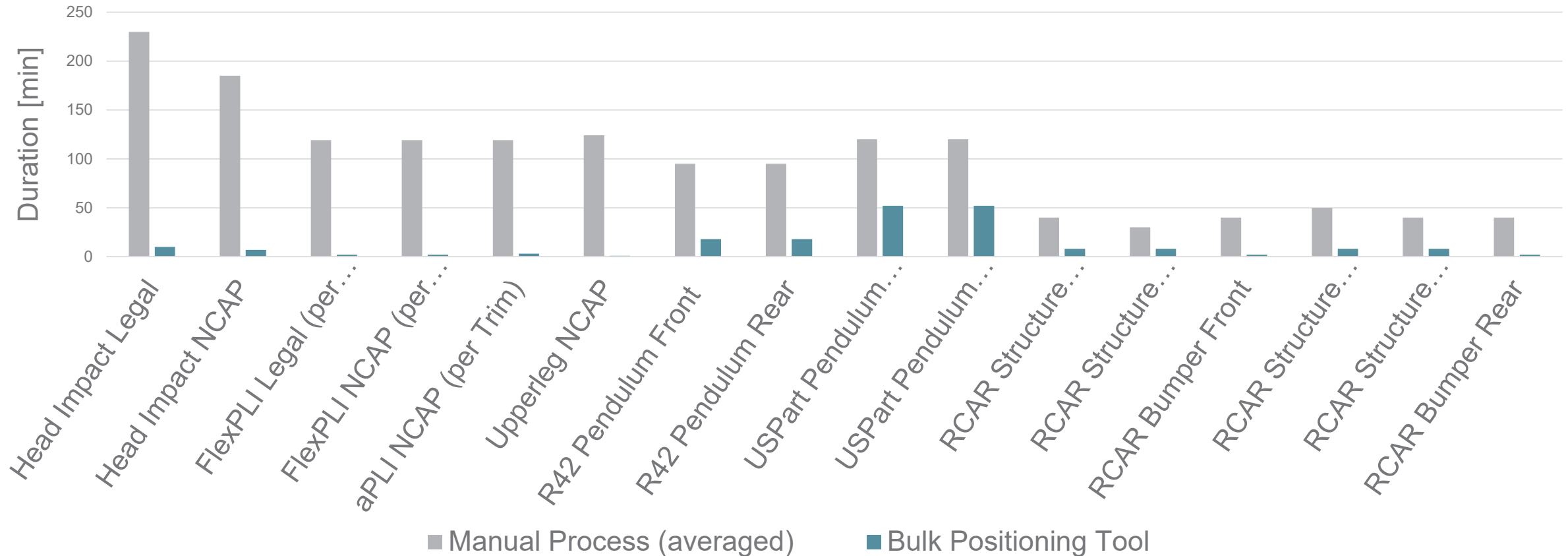




# BULK POSITIONING TOOL. GUI: PREVIEW POSITIONS.



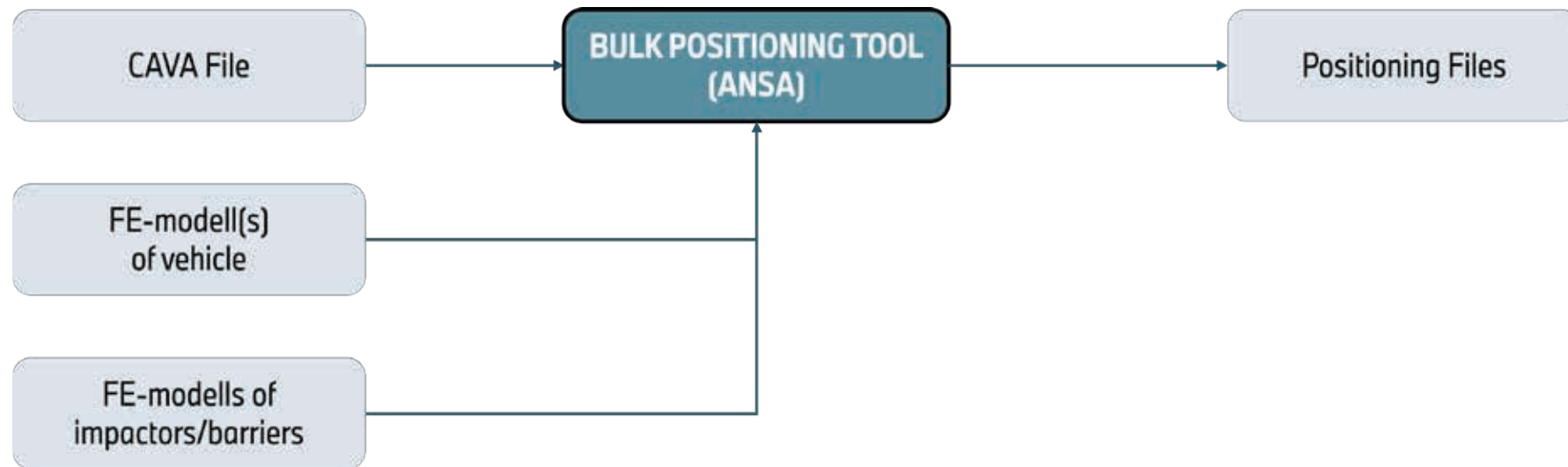
# BULK POSITIONING TOOL. SPEED-UP.



**→ ~26h of manual effort reduced to 5min manual effort and ~3,5h automated, standardized process.**

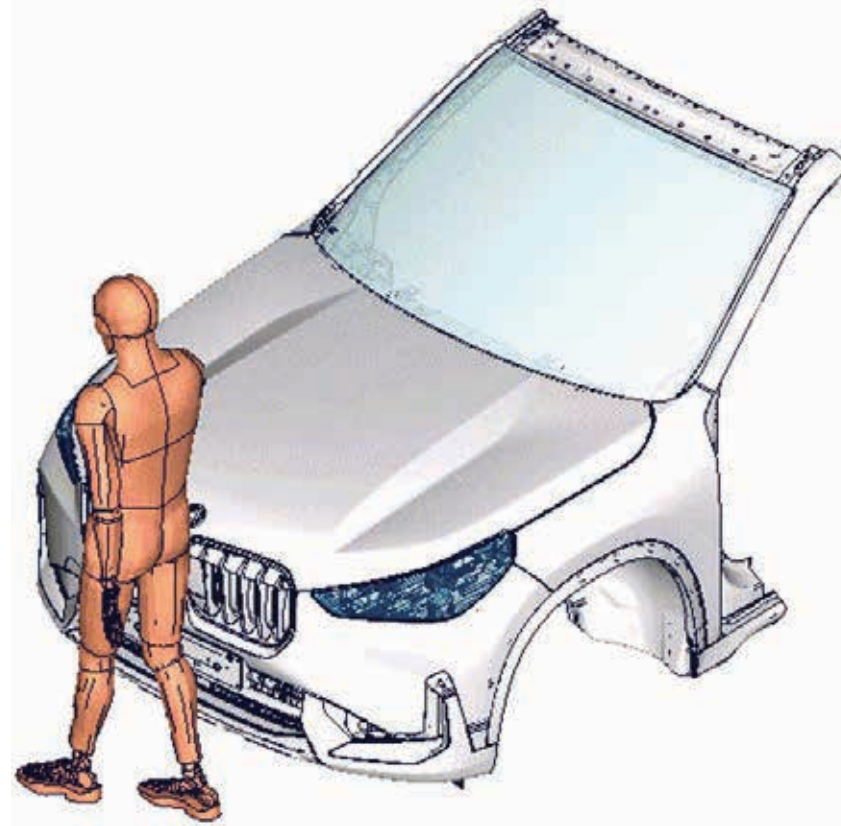
# BULK POSITIONING TOOL. SUMMARY.

- Significant time savings during time-critical development phases.
- Standardized, user-independent results.
- Reduced risk for errors.
- Simplified post-processing.
- Simplified information transfer between simulation and hardware tests.



# BULK POSITIONING TOOL. OUTLOOK.

- Incorporation of additional functionalities.
- Further speed-up for advanced options.
- Advanced quality checks.
- Add functionality for positioning THUMS.



# THANK YOU.

- Thanassis Lioras, BETA Systems.
- Berkay Atici, ARRK Engineering GmbH.
- Amaury Quesnel, ARRK Engineering GmbH.

