

## Appendix D

### Exchange of TMG thermal models via STEP-TAS

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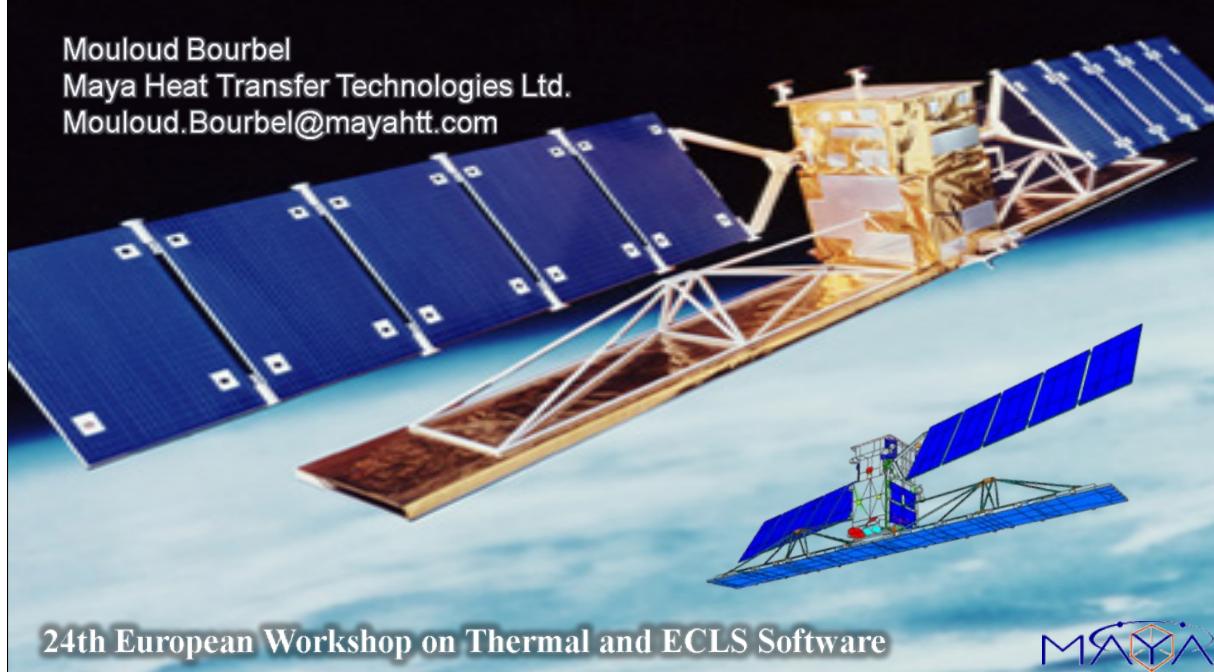
### **Abstract**

In the late 90's, the European Space Agency "ESA" started the development of an information exchange standard for space thermal analysis models. This standard was based on ISO 10303, which is informally known as STEP "Standard for the Exchange of Product model data". The new standard was named STEP-TAS "Thermal Analysis for Space". Since then, STEP-TAS development has been completed. The standard has been documented and extensively tested.

Recently, STEP-TAS has been implemented into Maya's TMG family of products, which includes NX I-deas TMG, Femap TMG and NX Space Systems Thermal. This new capability greatly simplifies thermal model exchange between Maya's TMG family of products and other thermal analysis packages.

# TASTMG project: Exchange of TMG Thermal Models via STEP-TAS

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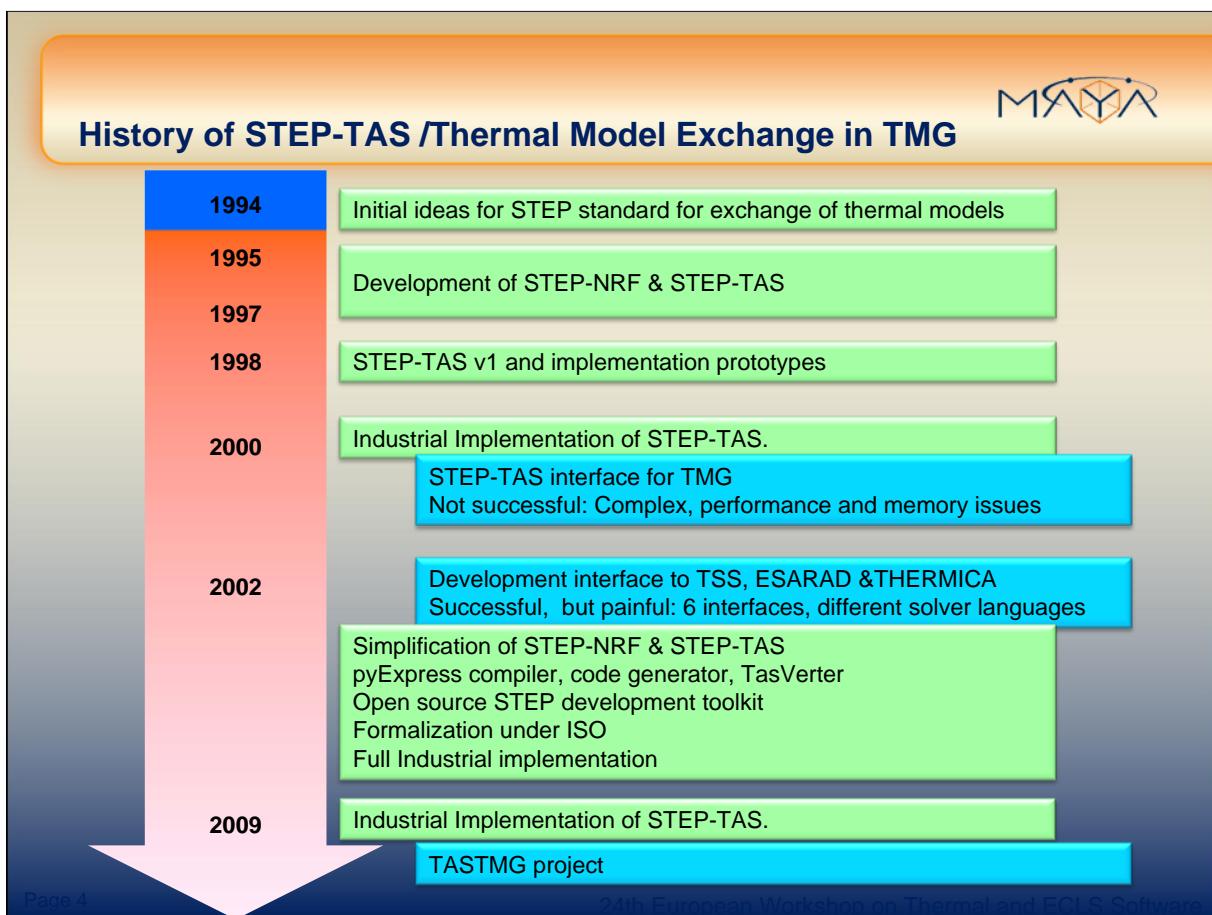


## Agenda



- Description and Implementation of TASTMG project
- Validation & Testing of TASTMG Implementation
- Demo of TASTMG Integration in NX Space Systems Thermal

Page 2      24th European Workshop on Thermal and ECLS Software



## Objectives of TASTMG project



- Implement STEP-TAS Import / export Facility with in TMG family of products.
- Validate & Test the implementation.
- Create TMG part of the public STEP-TAS acceptance testsuite.

Page 5

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## Getting Started



- Learning the STEP-TAS Standard.
- Evaluating STEP-TAS tools.
- Identifying the best implementation approach:
  - ✓ No brainer: Implement using C++ language / STEP-TAS C++ SDK.

Page 6

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## STEP-TAS C++ SDK

➤ Developed by CSTB under ESA contract.

➤ We used version 1.0 RC4.

TAS ARM classes

Page 7      24th European Workshop on Thermal and ECLS Software

## STEP-TAS C++ SDK

➤ Developed by CSTB under ESA contract.

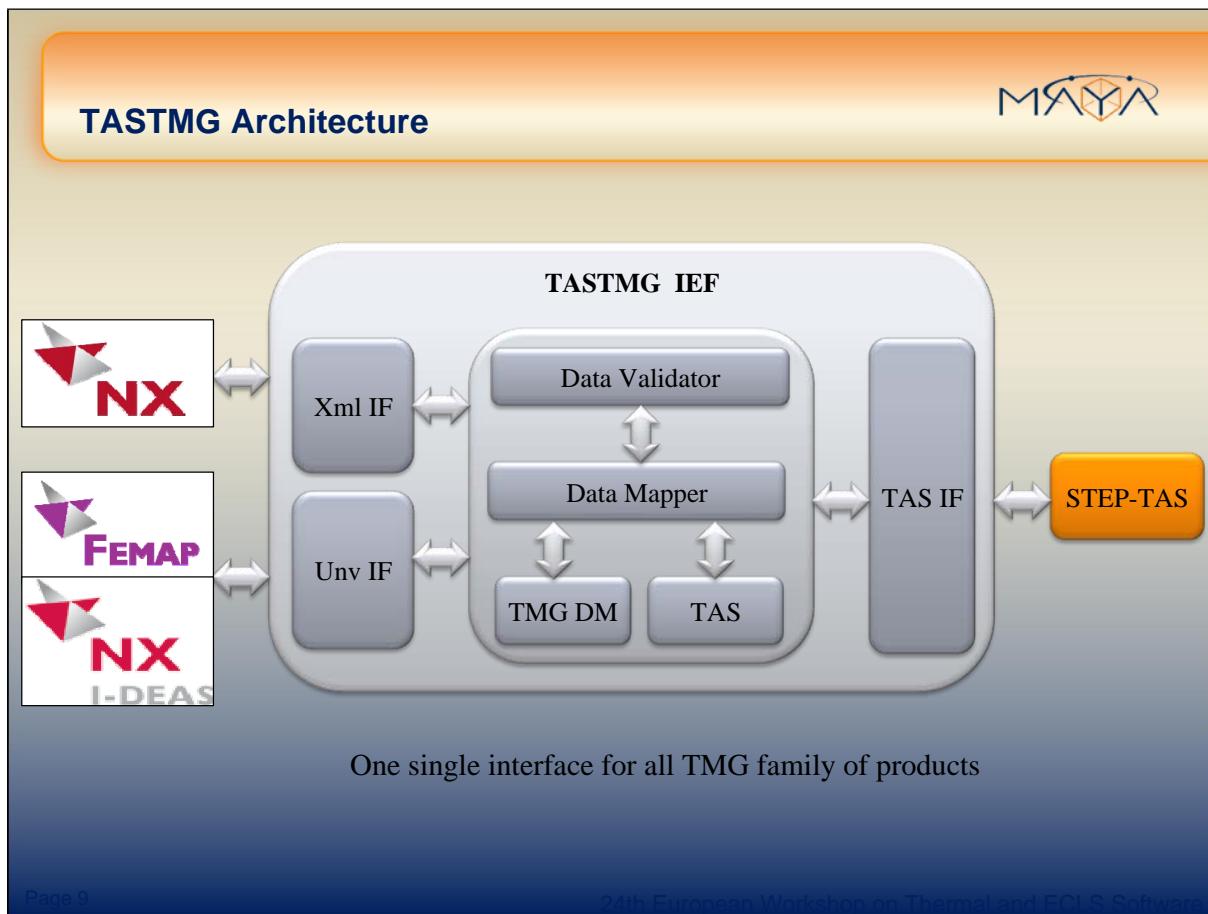
➤ We used version 1.0 RC4.

**LightCpp STEP-TAS SDK**

TAS ARM classes

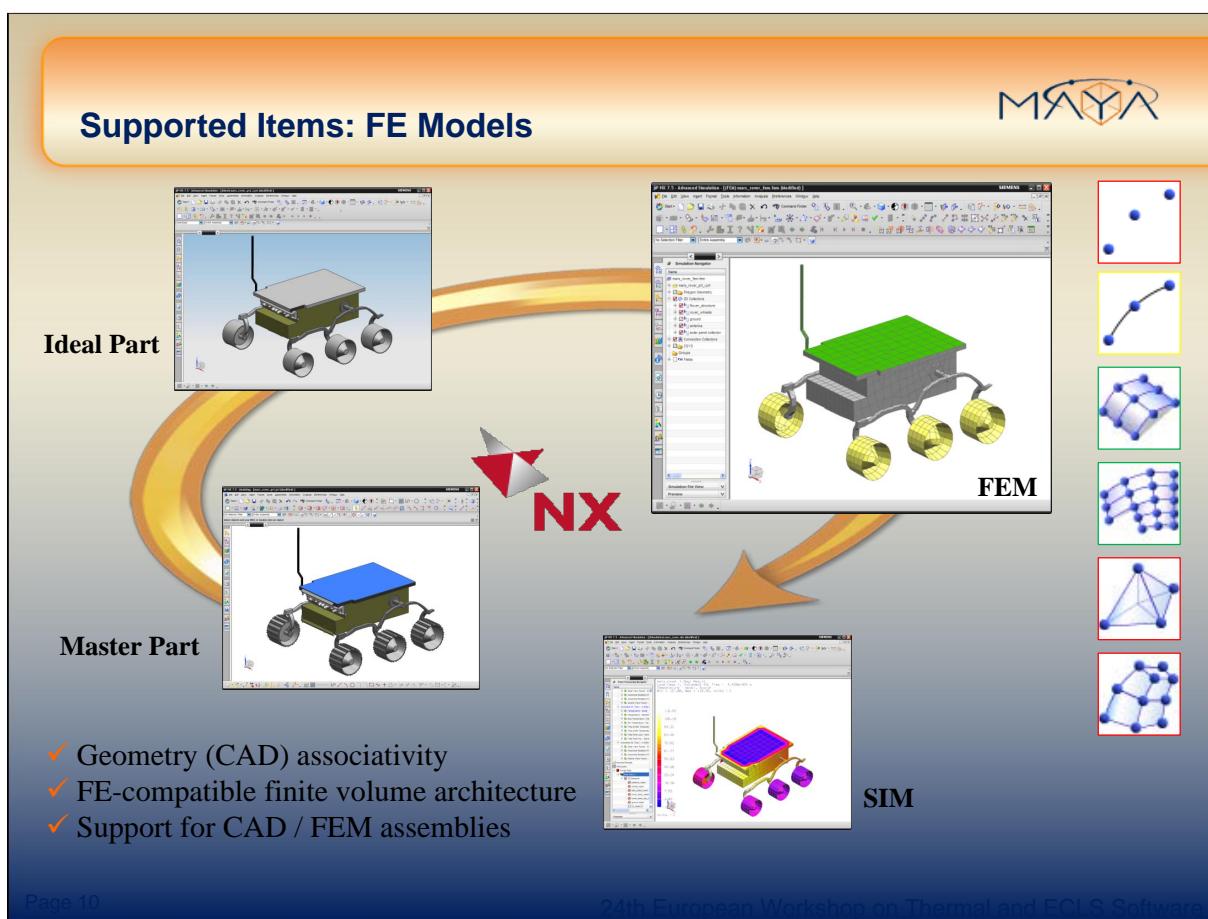
**STEP:** Common base classes.  
**TAS ARM:** Classes generated from the EXPRESS TAS ARM schema.  
**TAS ARM SUPPORT:** Convenience classes.

Page 8      24th European Workshop on Thermal and ECLS Software



Page 9

24th European Workshop on Thermal and ECLS Software



Page 10

24th European Workshop on Thermal and ECLS Software

**Supported Items: Primitive-based Models**

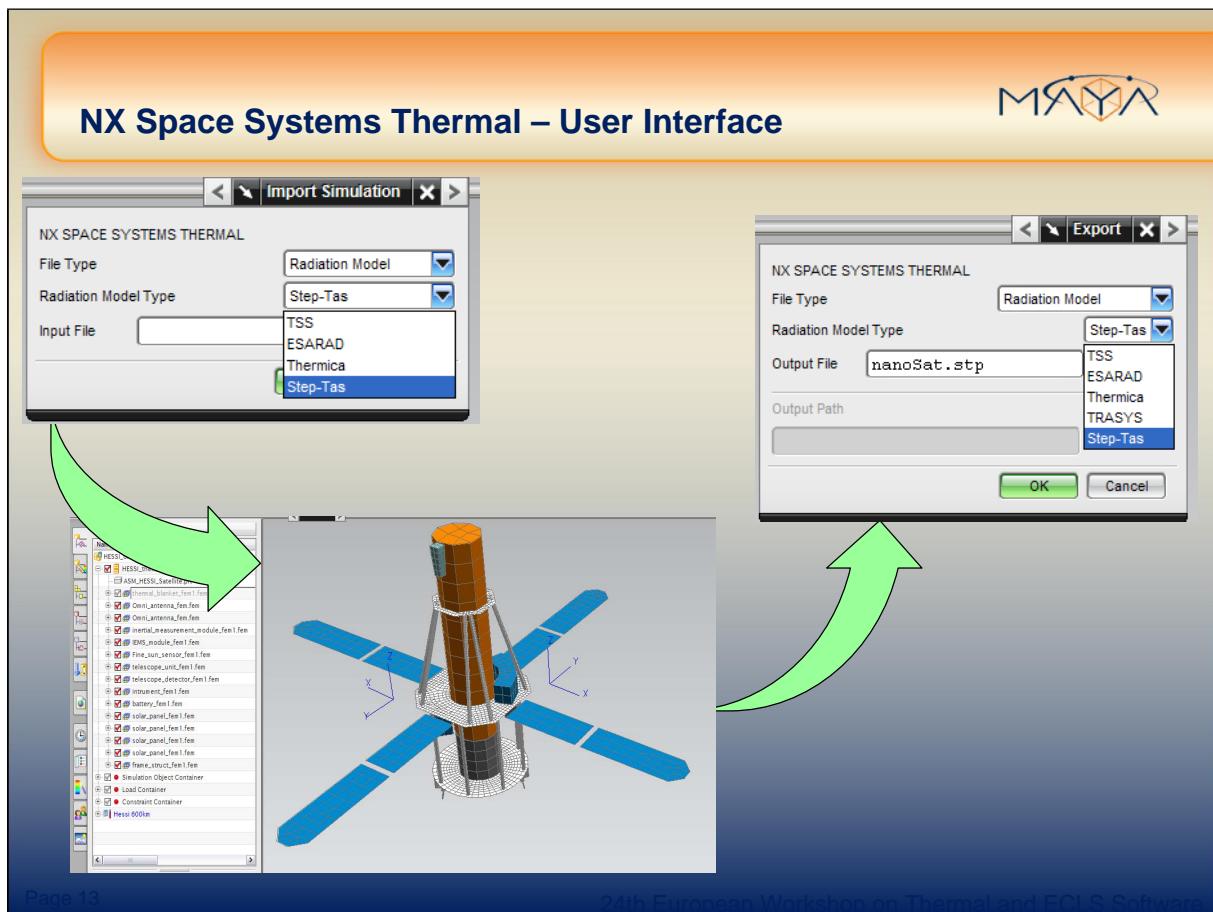
Triangle, Cone, Cylinder, Disc, Paraboloid, Quadrilateral, Rectangle, Sphere, Box, By Parameters, By Points

Page 11 24th European Workshop on Thermal and ECLS Software

**Material, physical and Thermo-optical properties**

➤ Mass Density  
➤ Specific Heat  
➤ Thermal Conductivity  
➤ IR Emissivity / Solar Absorbtivity  
➤ IR & Solar Reflectivity  
➤ IR & Solar Transmissivity

Page 12 24th European Workshop on Thermal and ECLS Software

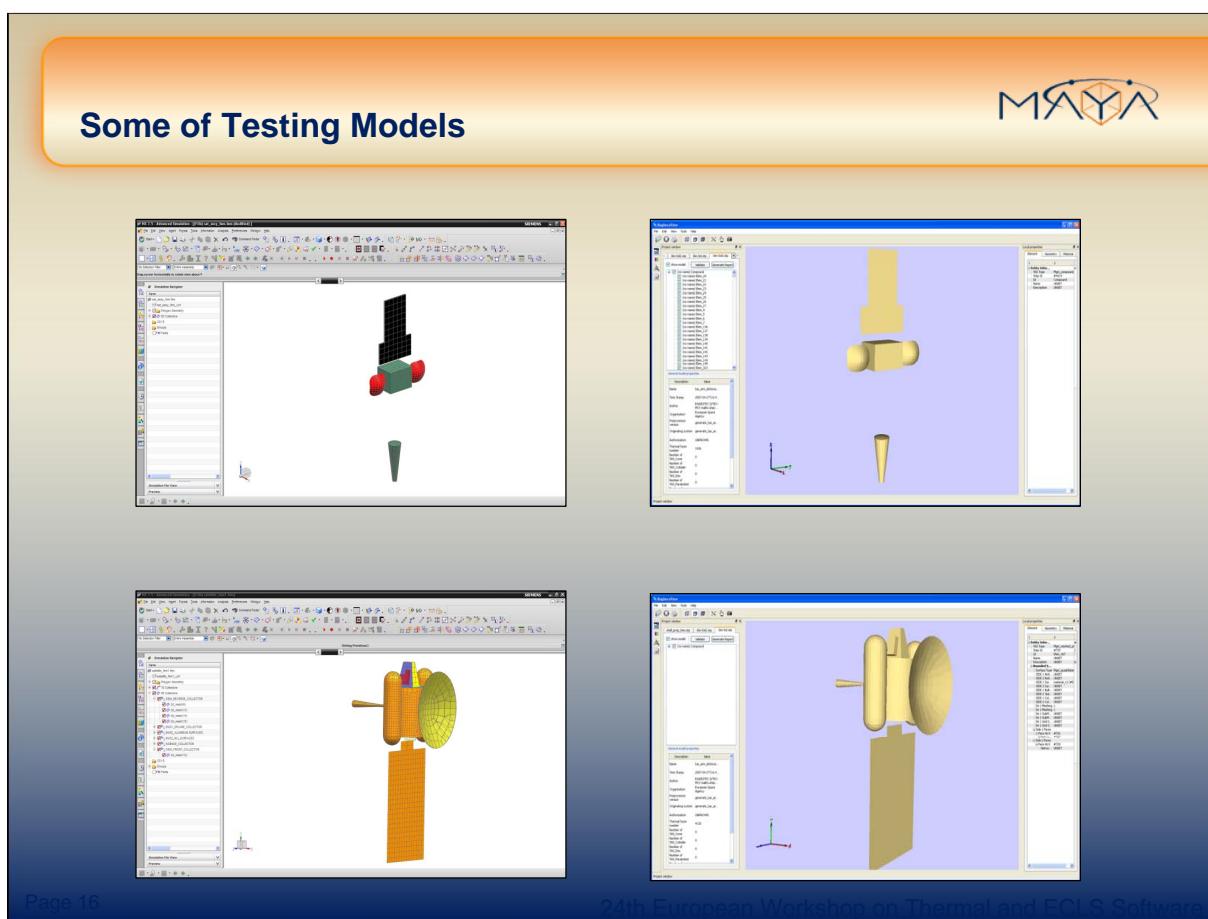
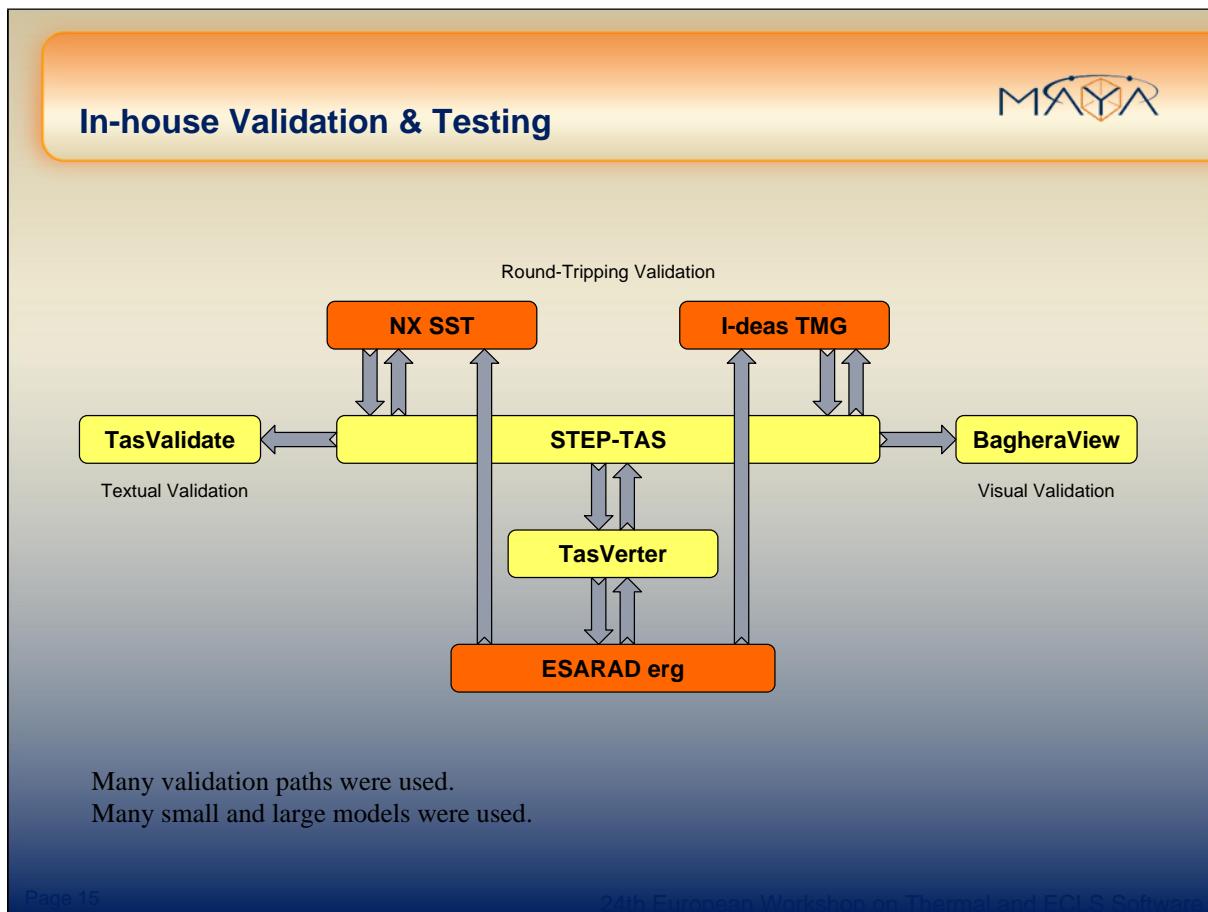


Page 13

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# Validation & Testing





### More Testing Models

The slide displays four screenshots of 3D simulation software interfaces, likely from the SIMENEX family, showing different test models:

- Top-left: A model of two rectangular blocks, one yellow and one red, resting on a blue base.
- Top-right: A model of two blue rectangular blocks resting on a black base.
- Middle-left: A model of a green cylinder with a purple cylindrical shell around it, resting on a yellow base.
- Middle-right: A wireframe model of a cylindrical object with a complex internal structure.

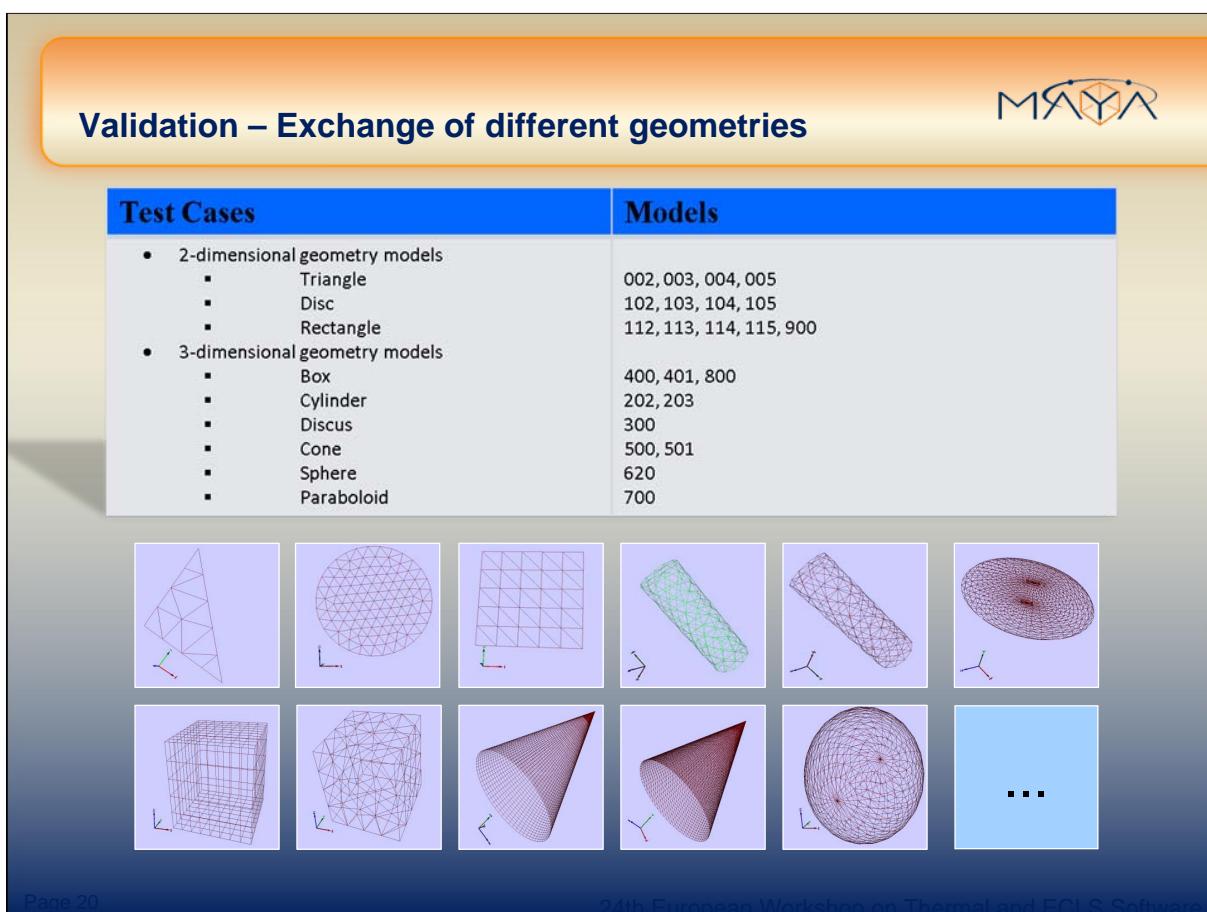
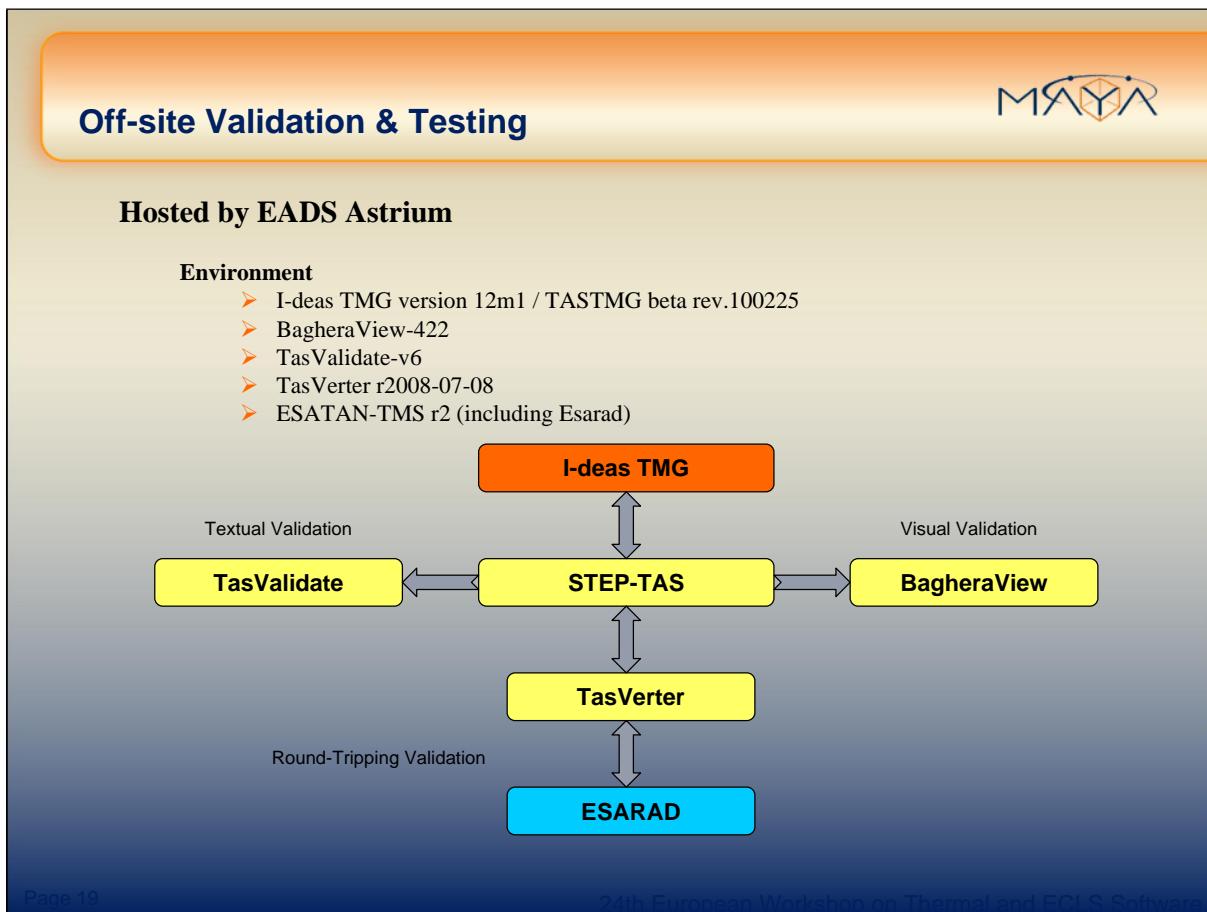
Page 17 24th European Workshop on Thermal and ECLS Software

### More testing models

The slide displays two screenshots of 3D simulation software interfaces, likely from the SIMENEX family, showing more test models:

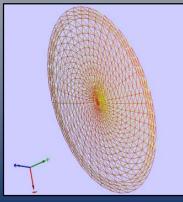
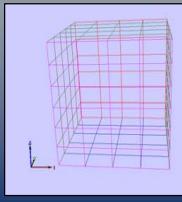
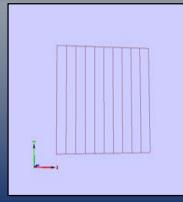
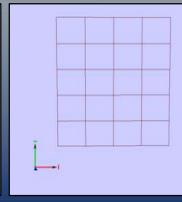
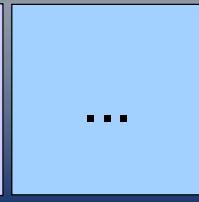
- Left: A model of a rectangular block with a green top surface and four yellow cylindrical wheels.
- Right: A model of a rectangular block with a black top surface and four yellow cylindrical wheels, connected by a vertical pipe.

Page 18 24th European Workshop on Thermal and ECLS Software



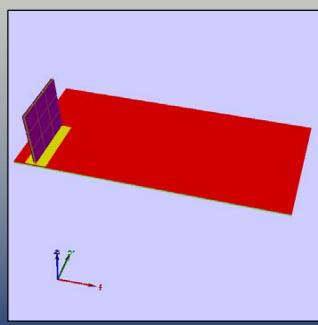
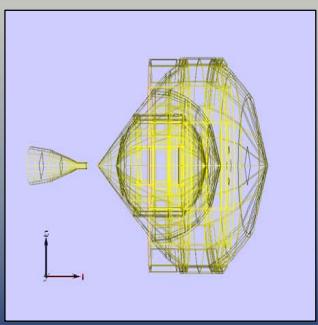
## Validation – Exchange of different Meshes



Test Cases	Models
<ul style="list-style-type: none"> <li>• Element Family           <ul style="list-style-type: none"> <li>▪ Lumped Mass</li> <li>▪ Beam</li> <li>▪ Thin Shell</li> <li>▪ Solid</li> </ul> </li> <li>• Element Order (Thin Shell)           <ul style="list-style-type: none"> <li>▪ Linear</li> <li>▪ Parabolic</li> </ul> </li> <li>• Element Topology (Thin Shell)           <ul style="list-style-type: none"> <li>▪ Tria</li> <li>▪ Quad</li> </ul> </li> <li>• Free Meshing</li> <li>• Mapped Meshing</li> </ul>	UpperStage UpperStage All models UpperStage  002, 004, 102, 104, 112, 114, 202, 300, 400, 401, 500, 501, 620, 700, 800, 900, UpperStage, PCB 003, 005, 103, 105, 113, 115, 203, 800, 900, UpperStage  002, 003, 102, 103, 112, 113, 202, 203, 300, 401, 500, 501, 620, 700, UpperStage 004, 005, 104, 105, 114, 115, 400, 500, 620, 700, 800, 900, UpperStage, PCB 002, 003, 004, 005, 102, 103, 104, 105, 202, 203, 401, 804, UpperStage 112, 113, 114, 115, 300, 400, 500, 501, 620, 700, 800, 801, 804, 900, UpperStage, PCB
    	...  Page 21      24th European Workshop on Thermal and ECLS Software

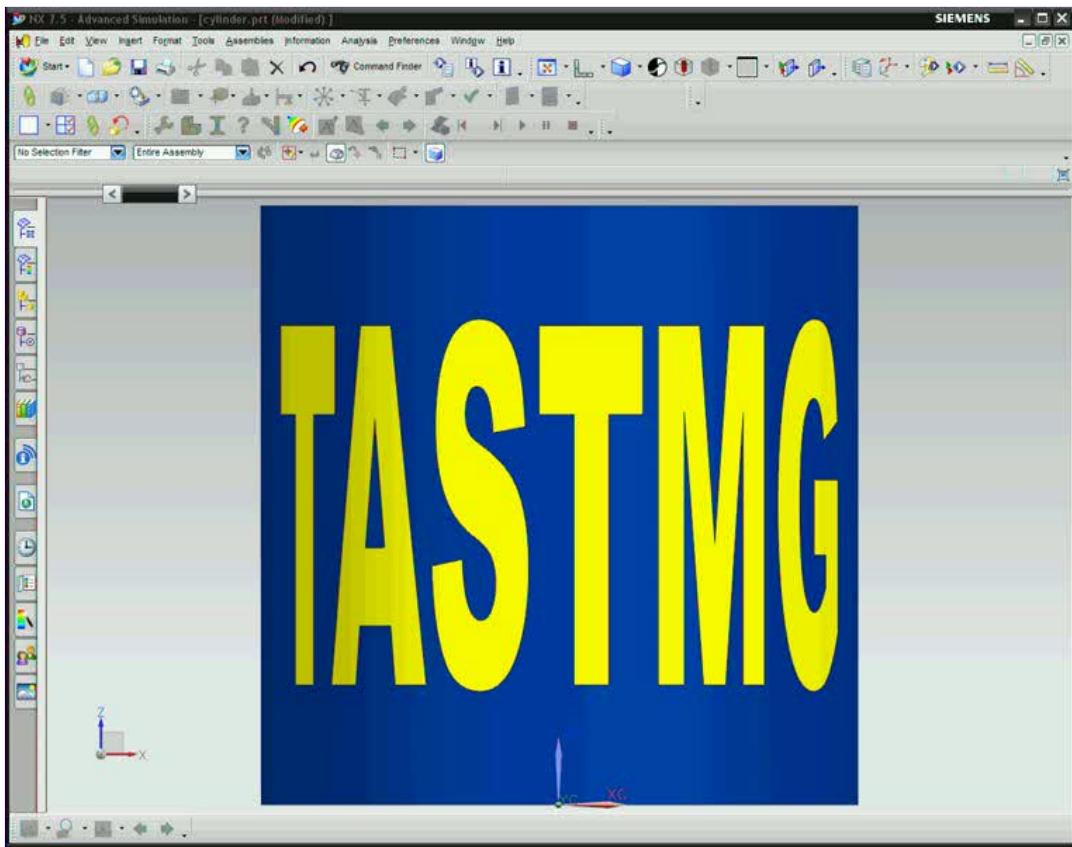
## Validation – Materials & Physical Properties



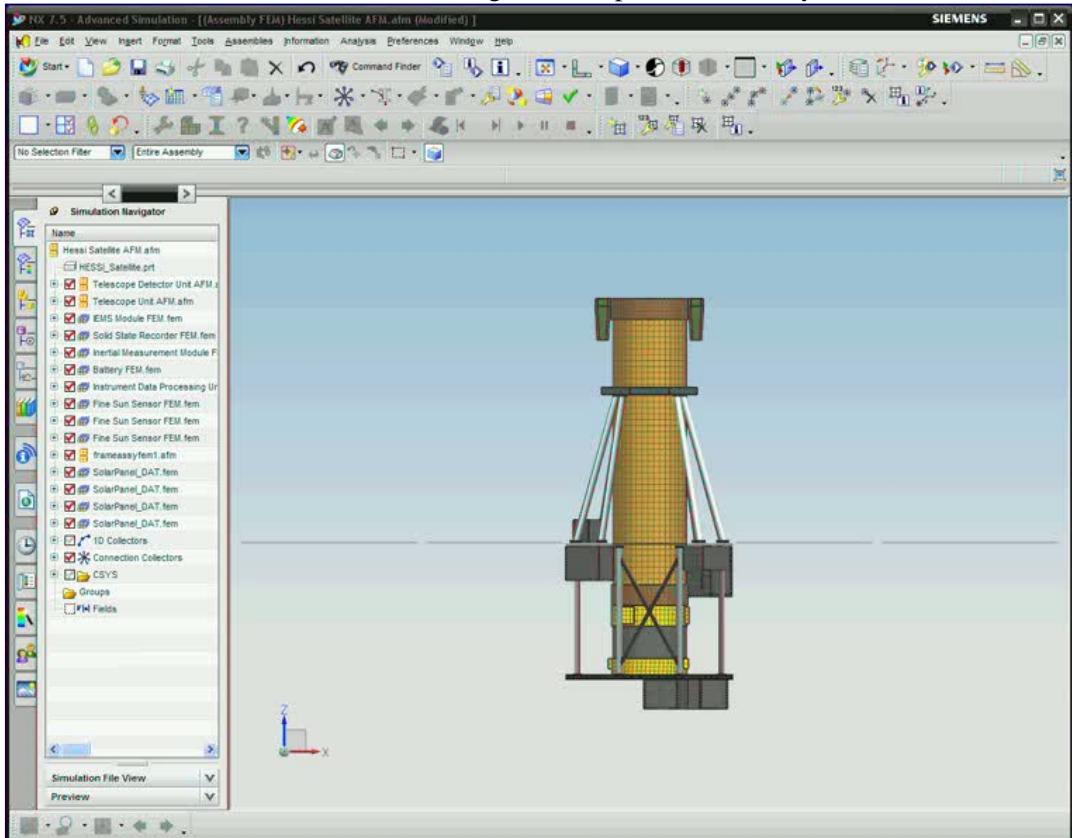
Test Cases	Models
<ul style="list-style-type: none"> <li>• Material Type           <ul style="list-style-type: none"> <li>▪ Isotropic</li> <li>▪ Anisotropic</li> <li>▪ Orthotropic</li> </ul> </li> <li>• Material Property Types           <ul style="list-style-type: none"> <li>▪ Null Property</li> <li>▪ Constant</li> <li>▪ Table</li> <li>▪ Functions</li> </ul> </li> <li>• Physical Properties</li> <li>• Active and Passive Side definition</li> </ul>	All models 800 800, UpperStage  UpperStage 800, UpperStage, PCB, all others 800, UpperStage 800 800, 801, 804, UpperStage, PCB 900
 	Page 22      24th European Workshop on Thermal and ECLS Software



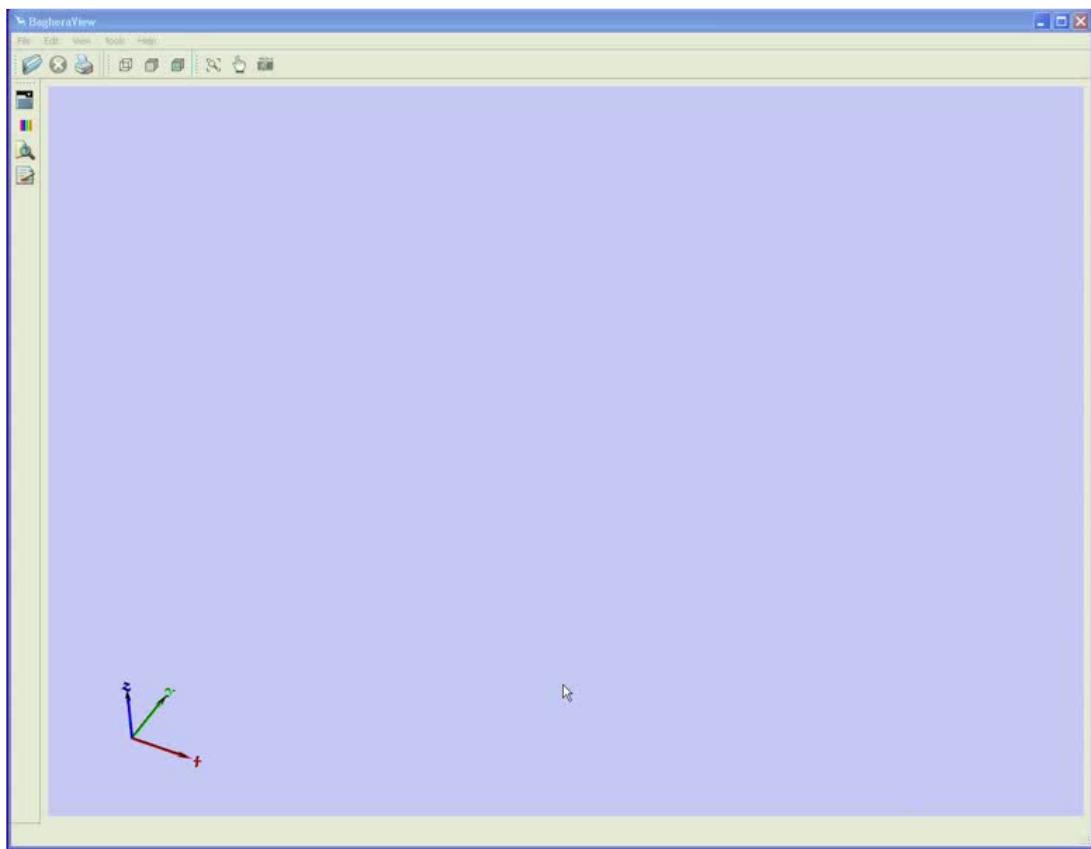
A collage of four screenshots from CAD software, likely Maya, demonstrating the modeling of various aerospace components. The top-left screenshot shows a blue cylinder with the yellow text "TASTMG". The top-right screenshot shows a satellite with solar panels. The bottom-left screenshot shows a multi-rotor aircraft model. The bottom-right screenshot shows a Mars Rover model. The top right of the collage features the Maya logo. The bottom right corner of the collage includes the text "24th European Workshop on Thermal and ECLS Software".



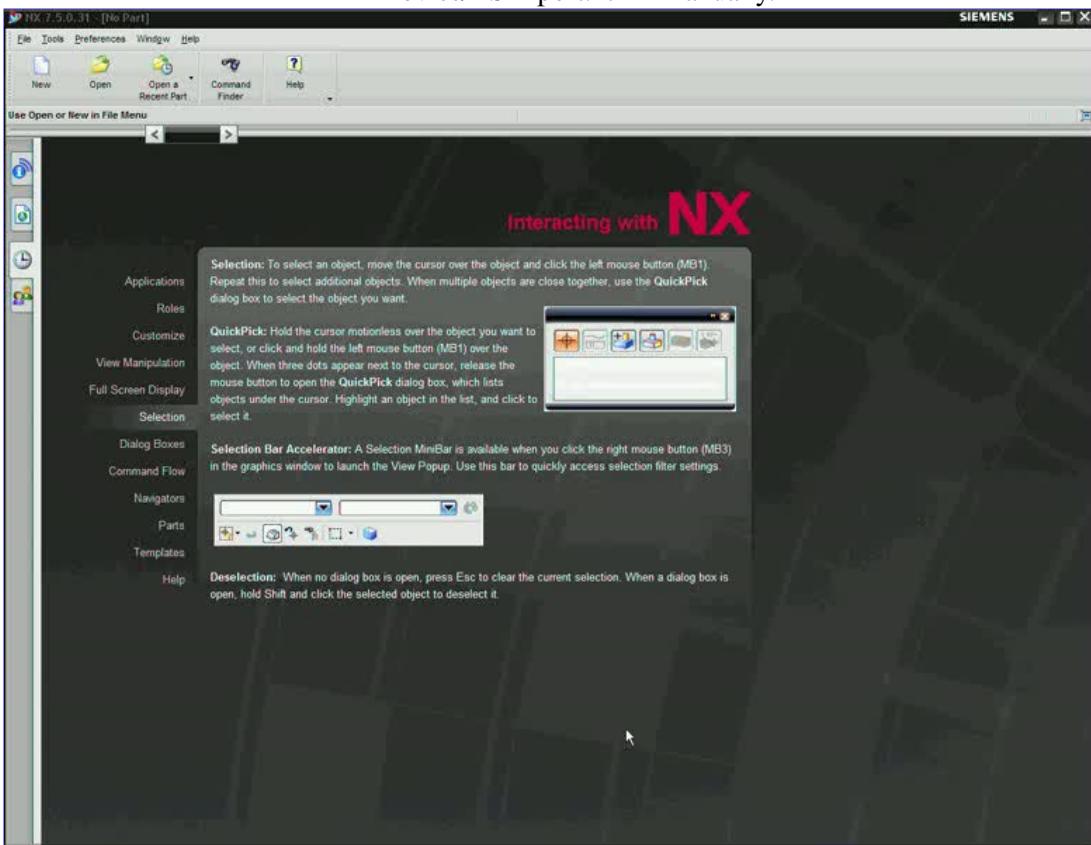
If clicking on the picture above does not run the movie then try opening the file  
'movies/TasTmgRoundTrip.html' manually.



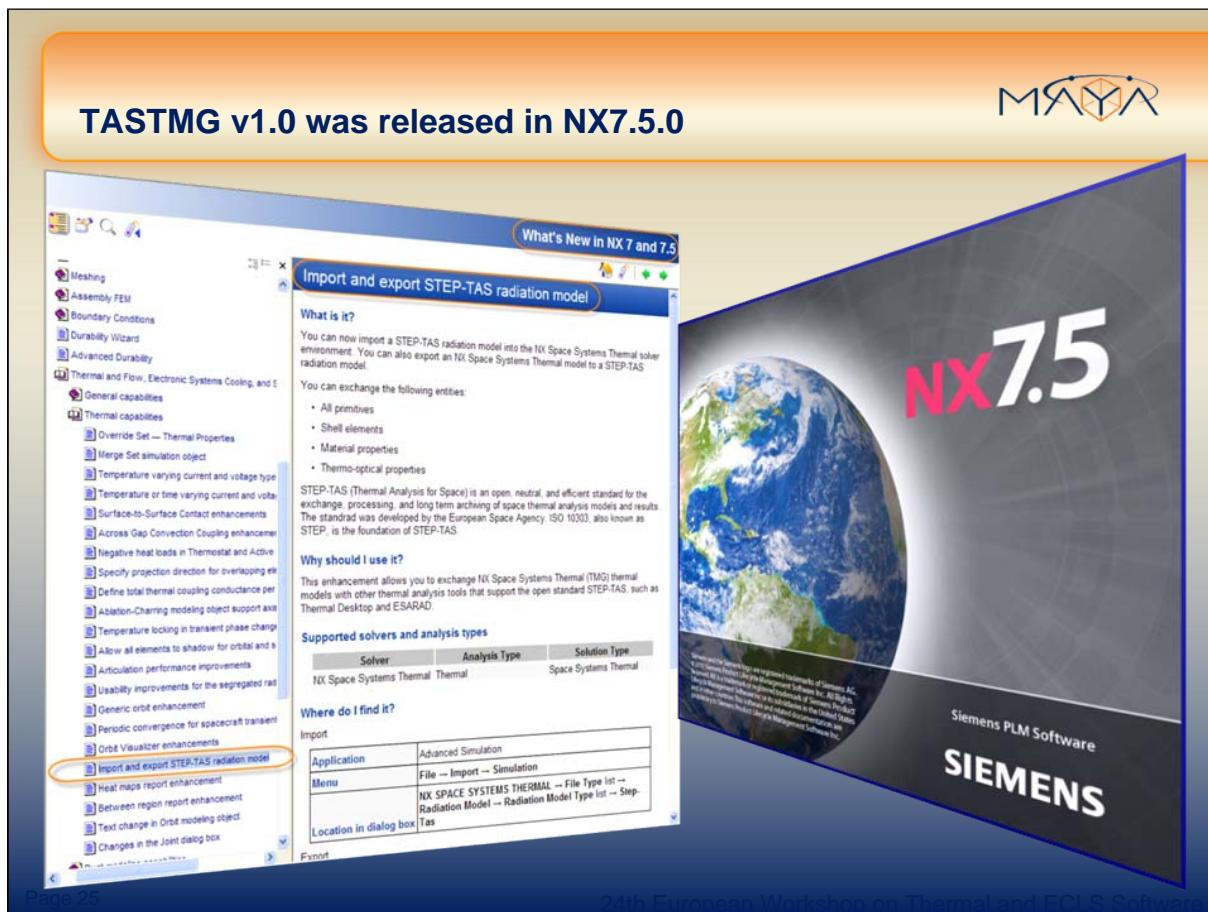
If clicking on the picture above does not run the movie then try opening the file  
'movies/HessiSatExport.html' manually.



If clicking on the picture above does not run the movie then try opening the file 'movies/IISImport.html' manually.



If clicking on the picture above does not run the movie then try opening the file 'movies/SojournerExport.html' manually.



## Acknowledgement

We do want to acknowledge **Hans Peter de Koning** from ESA/ESTEC, who was absolutely instrumental to the STEP-TAS development and provided support during the implementation of STEP-TAS interface in TMG.

A special thanks to:

**Eric Lebegue** from CSTB for providing C++ toolkit and STEP-TAS tools.

**Harold Rathjen** from EADS Astrium for conducting the validation and testing of TASTMG project.

Page 26 24th European Workshop on Thermal and ECLS Software

