AUTOMATED CHECKLIST FOR INTERMEDIATE DELIVERIES

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ABSTRACT –
During model assembly process for vehicle models (in NVH, Durability and Crash perimeters), intermediate deliverables are required. ANSA checks must guarantee their quality. These checks were manually performed and without any tool to insure the correct process and robustness.

Thanks to ANSA python scripting capabilities, we were able to automate all these checks into only one toolbox. The tools allow users either to perform checks interactively into ANSA, and then to easily correct errors, or to automatically generate an excel file that contains validation report.

This automation allows us to save time on model checks and insure that model quality is best in class. The automatic report allows an easy check and a quick overview of an ANSA model even without having to open it.

1. MESH VALIDATION

First step of model building process is mesh realization. In our current process, CAD are automatically meshed on our PLM system that is linked to ANSA. CAD files are transferred to ANSA and the Mid Surface creation is performed in batch mode. Then, all the PLM attributes are filled in ANSAPART attributes. That allow us to store PLM information (as references, materials data…) directly into the ANSA files. Once this step is performed, the ANSA batchmesher creates a preliminary mesh following our requirements and save the ANSA file directly under a specific PLM object of the part.

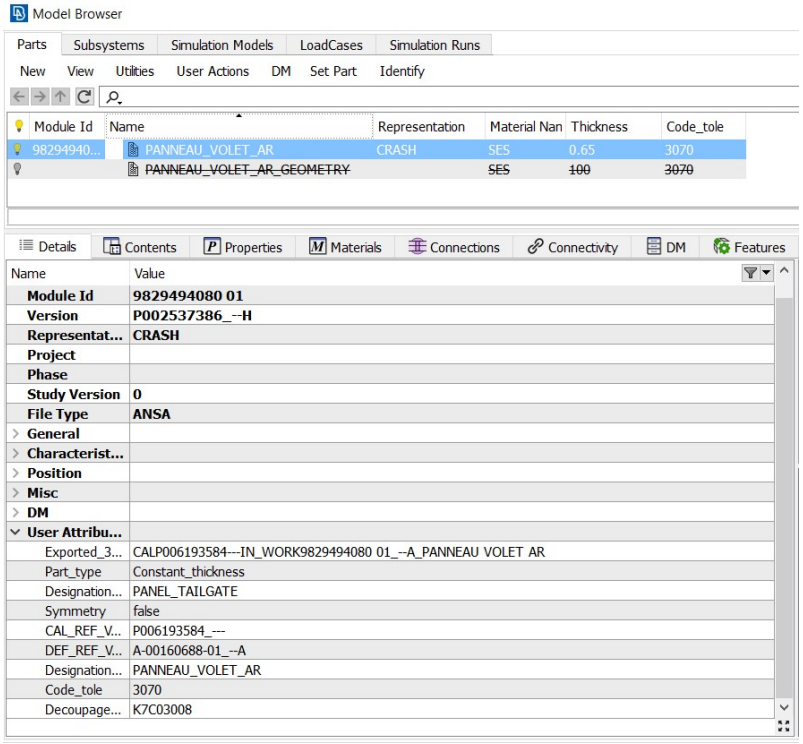


Figure 1 - Mesh File Organisation

In order to completely fulfil our mesh requirements, manual corrections are then performed on the meshes to remove all the failing elements. When meshes are finally corrected, they can replace preliminary mesh with a validated status into PLM.

Mesh validation was previously manually performed. Thanks to ANSA capabilities, we are now able to check all ansa files automatically and to generate an excel report. The only selections that must be done by the users are the meshing folder and the synoptic file selection.

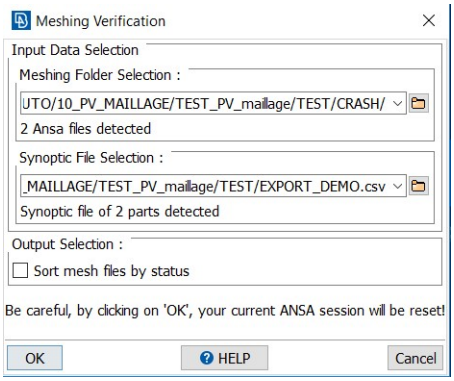


Figure 2 - Meshing Verification Input Window

After the input data selection, the tool opens all ansa files and performs the checks. The following items are checked and shown in the report:

- Number of failing Elements
- Number of Elems that do not respect the Trias/Node criteria
- Number of Litigious Elements
- Triangles %
- Number of Errors on Negative Volume
- Number of Errors on Duplicated Elements
- Number of Errors on Free Nodes
- Number of Errors on Orientation
- Number of Intersections
- Number of connectivity groups (must be equal to 1 if all elements are linked)
- Filename corresponding to attributes
- Error on Part organization (must contain one geometry part and one meshing part)
- Mesh Position (part must be meshed on part local axis)
- Thickness Definition (Thickness must not be set in elements card)
- Synoptic conformity (check if the ansapart attributes are corresponding to the PLM BOM)
- Snapshot (clicking on it will open it in a bigger resolution)

Following the checks, an excel report is output with one line by ansa file. A column “status” allows to know if the meshing files are ok or not. A snapshot of each part is present too with one annotation by PID that contain its name and thickness and material information.

File Name	Status	Nb of fail elements	% of fail elements	Nb of Elements with 3 or more trias/node	% of Elements with 3 or more trias/node	Nb of litigious elements in length (5% max)	% of litigious elements in length (5% max)	Nb of litigious elements (20% max)	% of litigious elements (20% max)	Angles % (20% max)	Negative Volume	Duplicated Elements	Free Nodes	Orientation	Internal Intersections	Number of connectivity groups	Filename Error	Error on Part organisation	Mesh Position	Thickness Definition	Check Synoptic Consistency	Middle Surface	Snapshot	REF PSA
SUPPORT_D_MOTEUR_SD_9823450580 00_----_P001589230----.ansa	Error	4	0.35%	0	0.0%	137	11.87%	71	6.15%	10.57 %	0	0	0	0	0	1	OK	OK	OK	OK	OK	OK	OK		9823450580 00
SUPPORT_JAMBE_FORCE_TRAVERSE_PL-BORD_9823515580 00_----_P001589166----.ansa	Error	1	0.19%	6	1.13%	93	17.45 %	39	7.32%	9.76%	0	0	0	0	0	1	OK	OK	OK	OK	OK	OK	OK		9823515580 00

Figure 3 – Mesh Validation Report

This tool allows to easily check and validate all our mesh files before using them into our model building process. By using it, we insure that all meshes are checked and validated with same process and that the report will be filled without any errors.

2. BODY IN WHITE COMPONENT VALIDATION

One of the deliverable of the model building team is the body in white subsystem. This subsystem is divided into several components: the bare body and one component by openings (doors, bonnet…). Its validation is mandatory before to start building synthesis models. In our previous process, its validation was manually performed by following a checklist and checking that all items are OK. This process was long and not “safe” due to the fact that it was manual and mistakes could then not be identified.

There is two different ways of using the tool, either by performing checks into ANSA and use the native check report to see the results, or performing the checks and generate an excel report.
The first way allows the user to check the model interactively and to perform auto-fix on some errors. It is more convenient to see the result in the check manager for isolating and correcting the troubles.
The second option that generates the report is used at the end of corrections in order to store the validation document with the model.

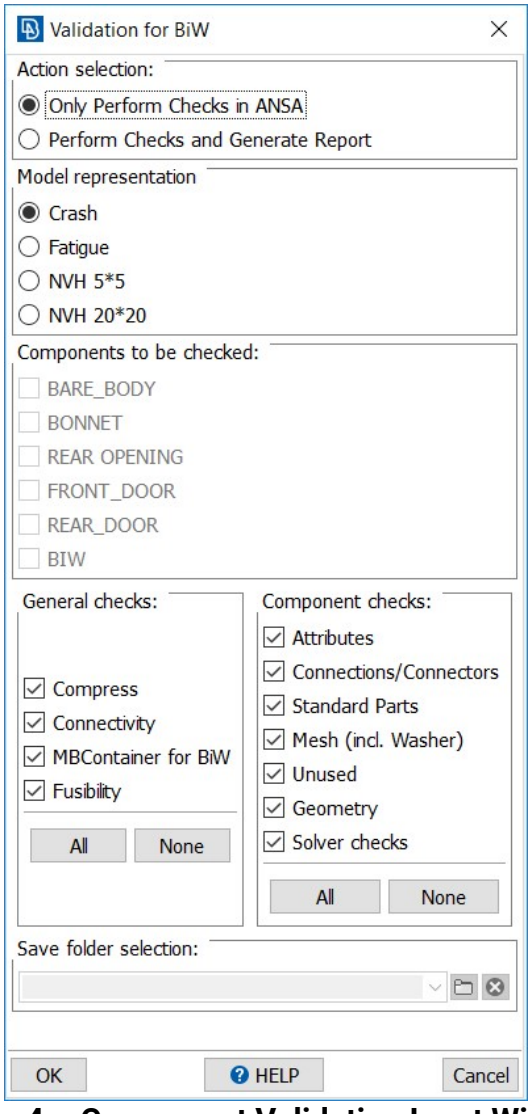


Figure 4 – Component Validation Input Window

Check contents is divided into several categories:

- Attributes
  - Check if all attributes are correctly filled for ANSAPART, ANSAGROUPS…
- Assembly
  - Check the connection settings and organisation
  - Check the connector settings and organisation
  - Check the A_Point definition and organisation
- MBContainer
  - Check the Model Organisation
- Mesh
  - Duplicated elements
  - Free nodes
  - Negative Volume
  - Mesh quality
  - Washer specific meshing
- Standard Parts
  - Check that the standard parts that have been integrated in the model stayed unmodified
- Unused
  - Undefined entities
  - Auxiliary nodes
  - Compress entities
- Geometry
  - Check of the model intersections and penetrations
- Solver Checks
  - Headers
  - Material conformity to PSA Standard Material Database
  - Properties definition compared to PSA Standards
  - Boundary Conditions
  - Rigid dependencies

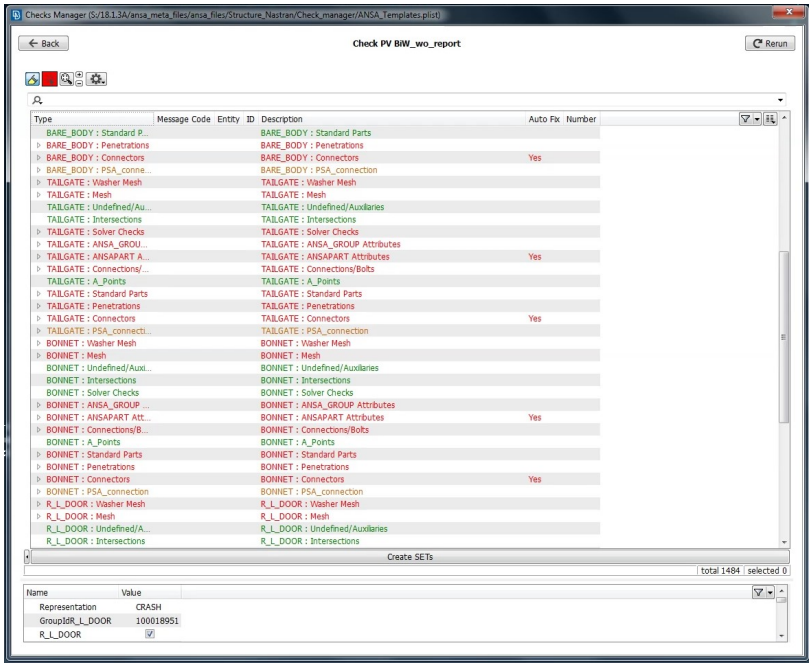


Figure 5 – Example of BIW checks results in ANSA

8 BEFORE REALITY CONFERENCE

Following the checks and correction in ANSA, an excel report can be exported. This report contains in first sheet:

- The result synthesis table (see example in Figure 6)
- A project section that contain the project name and milestone and the model name
- A picture section that contain some standard views of the checked model

Summary		Bare Body	Front Door	RL Door	Bonnet	Tailgate	Body-In-White
Number of External connectors		2				10	
Number of internal connectors		0				0	
Mass		0.24285 t	N/A	N/A	N/A	0.01641 t	0.30257 t
Check Result	Attributes	NOK	WARNING	WARNING	WARNING	NOK	NOK
	Connection Definition	NOK	WARNING	WARNING	WARNING	NOK	N/A
	Connectors	NOK	WARNING	WARNING	WARNING	NOK	N/A
	PSA Standard Connection	WARNING	WARNING	WARNING	WARNING	WARNING	N/A
	MBContainers	N/A	N/A	N/A	N/A	N/A	WARNING
	Mesh	NOK	WARNING	WARNING	WARNING	NOK	NOK
	Unused	WARNING	WARNING	WARNING	WARNING	WARNING	NOK
	Geometry	NOK	WARNING	WARNING	WARNING	NOK	OK
	Solver Checks	NOK	WARNING	WARNING	WARNING	NOK	OK
	Assembly	N/A	N/A	N/A	N/A	N/A	NOK
	Standard Parts	N/A	OK	OK	OK	NOK	N/A
	Impactors	N/A	N/A	N/A	N/A	N/A	WARNING

Figure 6 – BIW Result Synthesis

The second sheet contains the complete BIW subsystem results (if the subsystem was present in the model). This allows to check the assembly between the components (bare body, doors…). A picture of each connectivity group of the model is displayed in order to easily check what is not fully linked in the model.

Finally, one sheet by component contains the full check report. For each category, one line by check is present with its status and some comments (see Figure 7). All these information are automatically filled by the tool. Then, the user can manually fill a last column with remarks for each checks if needed.

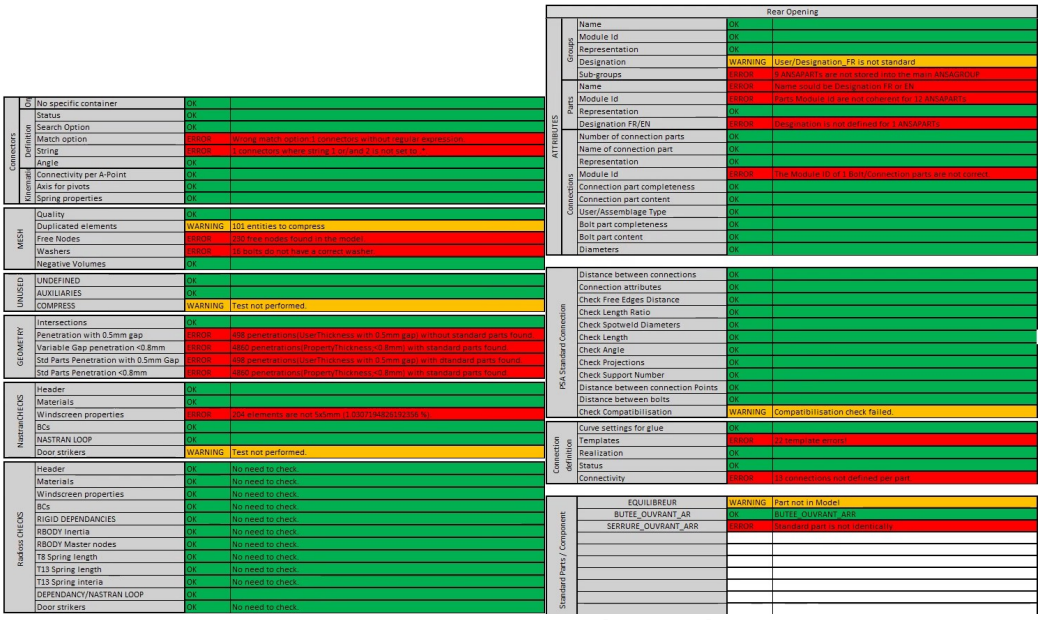


Figure 7 – BIW Result Details

3. EXTERNAL SUBSYSTEM VALIDATION

Except the body in white subsystem, all the other subsystems are imported into ANSA as “solver subsystems”. That means that we integrate them from a solver file to an ANSA model and we create an ANSA subsystem that contain all data. In this subsystem, we have to create the Assembly Points that will be used to assemble the subsystem with its environment. These Points are created either from Bolt or manually. At end of this subsystem creation process, we then have to validate it.

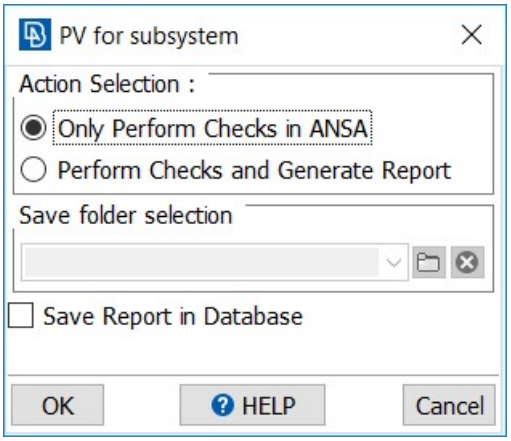
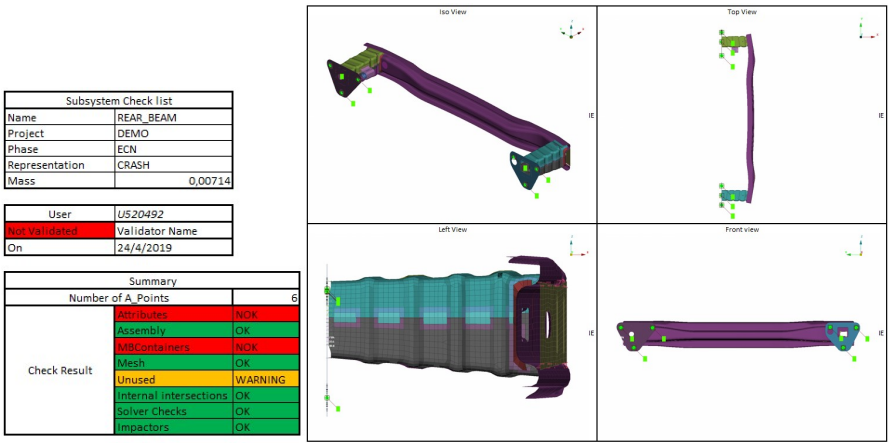


Figure 8 - Subsystem Validation Input Window

In the same way as BIW subsystem, there are several check categories:

- Attributes
  - Subsystem attributes
  - Ansapart attributes
- Assembly
  - Connections
  - Assembly Point
- MBContainers
- Mesh
  - Duplicated elements
  - Free nodes
  - Negative Volume
  - Mesh quality
- Unused
  - Undefined entities
  - Auxiliary nodes
  - Compress entities
- Geometry
  - Check of the model intersections and penetrations
- Solver Checks
  - Headers
  - Material and property solver specificities
  - Boundary Conditions
  - Rigid dependencies

On the excel report, a synthesis sheet contain some generic information about the subsystem. It allows to have a good overview of the subsystem status. Furthermore, some pictures of the subsystem are shown. On these pictures, an annotation is created on each assembly point to identify them.



Subsystem Check list	
Name	REAR_BEAM
Project	DEMO
Phase	ECN
Representation	CRASH
Mass	0,00714

User	*U520492*
Not Validated	Validator Name
On	24/4/2019

Summary		
Number of A_Points		6
Check Result	Attributes	NOK
	Assembly	OK
	MBContainers	NOK
	Mesh	OK
	Unused	WARNING
	Internal intersections	OK
	Solver Checks	OK
	Impactors	OK

Figure 9 - Subsystem Result Synthesis

On a detailed sheet, all the results and information are present regarding the check results.

ATTRIBUTES	Subsystem	Module Id	OK	
		Representation	OK	
		File Type	ERROR	Subsystem Filetype is not correctly defined. Should be Radioss
		Content Status	OK	
		Project	OK	
		Phase	OK	
		Designation	OK	
	Parts	Group Module Id	OK	
		Group Representation	OK	
		Part Module Ids	ERROR	Parts Module Id are not coherent for 1 ANSAPARTs
		Part storage	ERROR	1 ANSAPARTs are not stored into the main ANSAGROUP
		Parts Representation	ERROR	Parts Representation are not coherent for 1 ANSAPARTs
		Version	ERROR	Parts Version are not coherent for 22 ANSAPARTs. Should be ECN_---
		Designation FR/EN	ERROR	Part Designations are not coherent for 3 ANSAPARTs
		Decoupage PSA	ERROR	Part DEC_PSA attributes are not correctly defined for 1 ANSAPARTs. Should be SAC_ARR
ASSEMBLY	CONNECTIONS	Connection part	OK	
		Connection part content	OK	
		Connection storage	OK	
		Bolt part	OK	
		Bolt part content	OK	
		Bolt storage	OK	
		Status	OK	
	APOINTS	Storage	OK	
		Name	OK	
		Missing A_Point	OK	
		A_Point on free nodes	OK	
		RADIOSS -> Rigid definition	OK	
		RADIOSS -> Apoint on master r	OK	
		Status	OK	
	FUSIBILITY			To be checked on next sheet for RADIOSS
MB Containers			ERROR	1 ANSAPART without MBContainer
MESH		Duplicated elements	OK	
		Free Nodes	OK	
		Negative Volumes	OK	
		Mesh Quality	OK	
UNUSE		UNDEFINED	OK	
		AUXILIARIES	OK	
		COMPRESS	WARNING	4 entities to compress
INTERSECTIONS			OK	
SOLVER CHECKS		Header	OK	
		Materials	OK	
		BCs	OK	
		NASTRAN LOOP	OK	
		DEPENDANCY	OK	
Impactor/Connectivity groups			OK	

Figure 10 - Subsystem Result Details

4. CONCLUSION

Thanks to ANSA python scripting capabilities, we were able to automate all the checks into only one toolbox. The tools allow users either to perform checks interactively into ANSA, and then to easily correct errors, or to automatically generate an excel file that contains validation report.

This automation allows us to save time on model checks and insure that model quality is best in class. The automatic report allows an easy check and a quick overview of an ANSA model even without having to open it.