Data Management and Loadcase Composition in ANSA

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1 Abstract

It is common knowledge that simulations of virtual models hold a key role during the design process of a vehicle. Considering the continuously growing number of regulations, but also the different variants that a vehicle can have, one concludes to a plethora of similar or completely different simulations. As far as a simulation process is concerned one of the most demanding issues is its build up. The tools that a CAE analyst should have at ones disposal must be characterized by robustness and automation to deal with the numerous and really complex numerical simulations.

The most important case during the model build up is a comprehensive model organization. BETA CAE Systems has come up with new data types that facilitate the set-up for the LS-DYNA simulation run. These new data types come to fully support data management in both, ANSA and LS-DYNA Include, files but furthermore in SPDRM implementations. Moreover, advanced capabilities of version control and the storage of all attributes that a file needs to be followed during a simulation build up, ensure a productive process starting from file input, moving to the assembly, passing to the load-case set up and finalizing with a bulk LS-DYNA file output.

The current paper introduces the new ANSA techniques for a successful LS-DYNA simulation run set up that decreases the production time to its minimum and avoids errors that human interaction produces inevitably.

2 Introduction

Throughout the simulation process of a vehicle different disciplines have to validate the virtual model such as Crash, NVH and Durability. Each discipline has different loadcases. Also there are several model variants per vehicle. As a result numerous simulations have to take place. One can conclude that the use of powerful CAE tools is needed. These tools should offer first a methodized model organization during the model build up. Secondly, they should give the flexibility to maintain the model in such a way that the production of different but also similar simulation runs is easy and with the less human interaction.

A CAE system would be successful at that point if it could enable the user to work either alone on a small project or as member of a complete team. The data should be able to be accessed either by a local directory in one's machine or on a server. A small project should be feasible, so as a big one where a lot of users could interfere. The data should be exchangeable among the users and re-usable from one project to another. The tools should be automated offering the solver working way producing in the background the corresponding keywords.

BETA CAE Systems introduces new data types that organize the model in such a way that the user can have the most effective use of it. A new system has been developed named Model Browser that offers an intuitive and concise graphical user interface. This new system offers an easy handling of the data which makes them adjustable to the circumstances and needs of each LS-DYNA run file.

3 Simulation Run Composition

An important aspect is the clarification of the Simulation Run composition. The Simulation Run is actually the final output file that will be solved by LS-DYNA. During its set up one comes across two major categories as far as mainly the data but also the CAE processes are concerned. These two basic categories are the Simulation Model and the Loadcase.

The Simulation Model contains all the data that compose the vehicle. One should consider all the different components the combination of which will build the basic prototype and its model variants.

On the other hand the Loadcase contains data that actually characterize a specific solver loadcase (for example a full width EuroNCAP analysis). In particular they are data that describe the loading scenario like dummies and barriers that are loadcase specific.
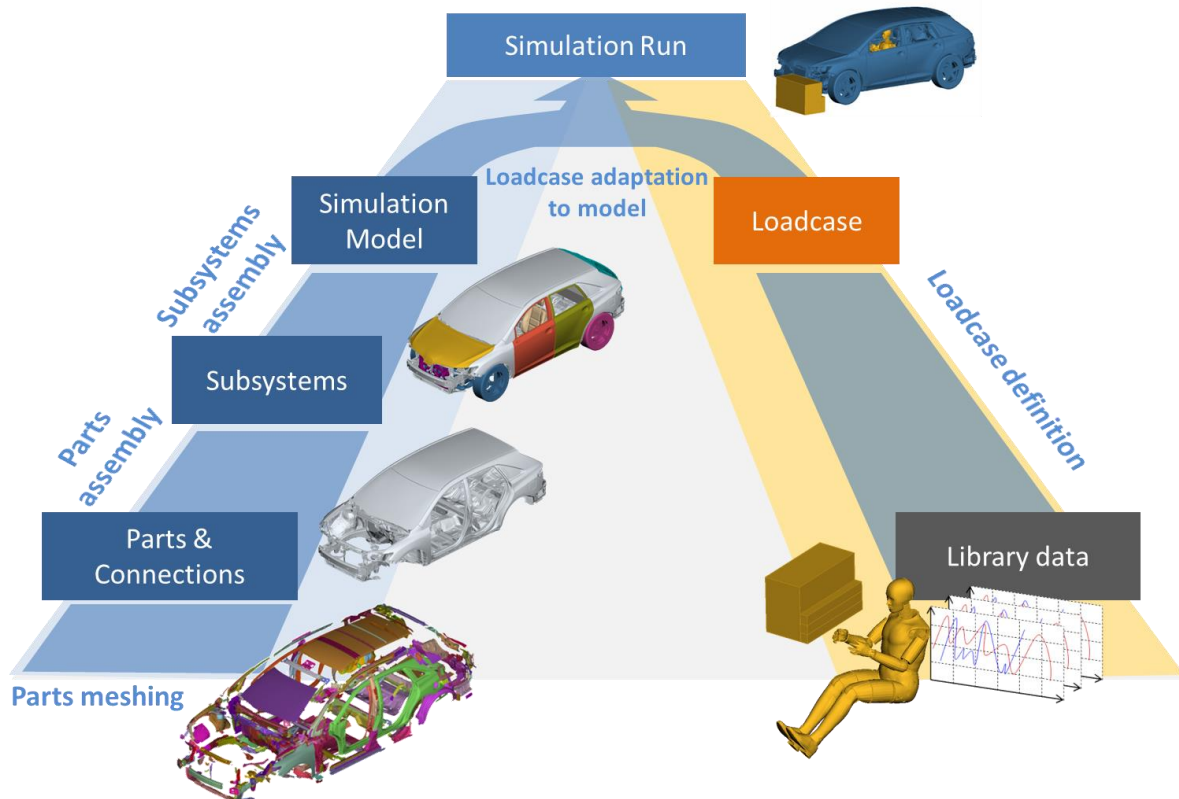

Fig.1:   Simulation Run Composition

4 Model Data and Process Organization

4.1   Subsystems handling

In a deeper level of the Simulation Model one meets the Subsystems. Each Subsystem corresponds to one sub-assembly of the model. The system can handle as subsystem either an ANSA database but also a solver file (LS-DYNA `*INCLUDE`). The main sub-processes that the analyst has to deal with in this level are the meshing of the different parts/components and the internal assembly of them (if the subsystem is built for the 1st time). Also, several solver definitions can take place like the creation of contacts, history entities and cross sections (model build).
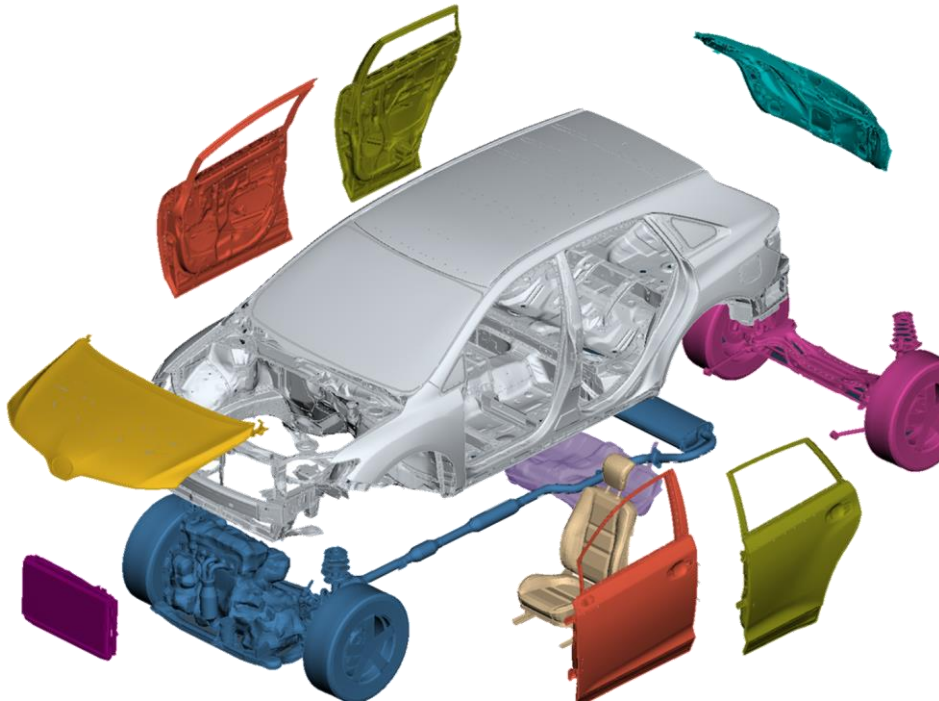
Fig.2:   Composition of a Simulation Model by its Subsystems

In the ANSA Model Browser there is a clear classification of the mentioned data. Through the Subsystem tab one can access the mesh that the subsystem consists of, the internal connections that assemble it, the interfaces that connect each subsystem with another but also the model set up entities like internal contacts. This classification offers advanced pre-processing capabilities for example the replacement of the mesh and the reapplication of the already existing connections on an updated mesh.
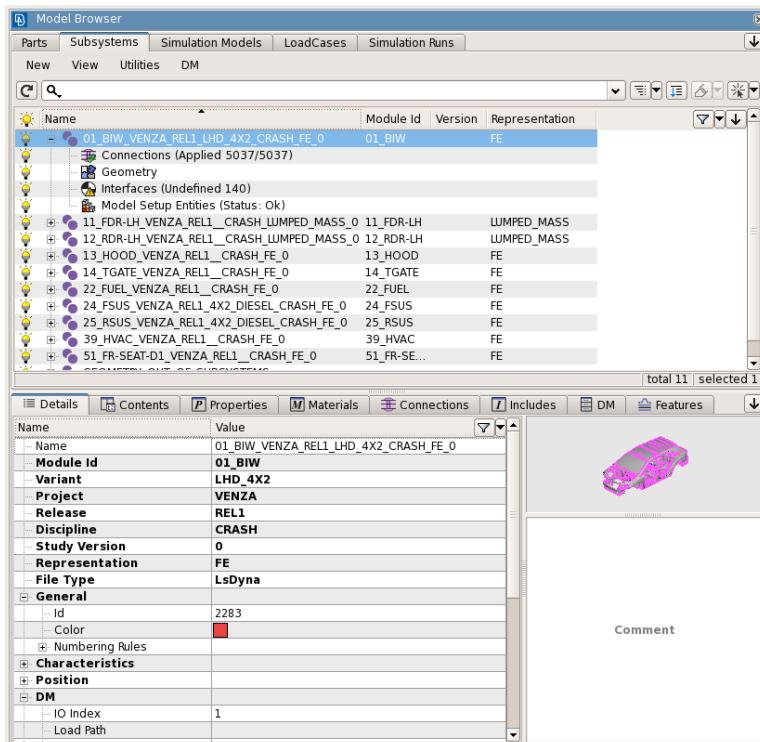

Fig.3:   Subsystems in Model Browser

4.2 Simulation Model handling

In the simulation model set up what is needed is to have an overview of the complete vehicle and of what it consists of. In a similar interface like in Figure 3, one can see all the respective subsystems that compose a Simulation Model, the connections that connect the subsystems and some model set up entities like ***DATABASE_HISTOYRY_NODEs** etc. Information such as Id ranges covered by each Subsystem in the Simulation Model is previewed.

4.3 Loadcase Data handling

As it has been mentioned above in the Loadcase, the user has to deal with data that characterize the loadcase scenario. These files are mainly read-only. Model Browser enforces the user not to change them. They will remain intact and just attributes like specific transformation matrices and Id ranges will be assigned on them. Moreover their order in the loadcase is of major importance. Depending on the order that one file is selected by the user to appear in Model Browser, this index will achieve in the build of the main loadcase file.
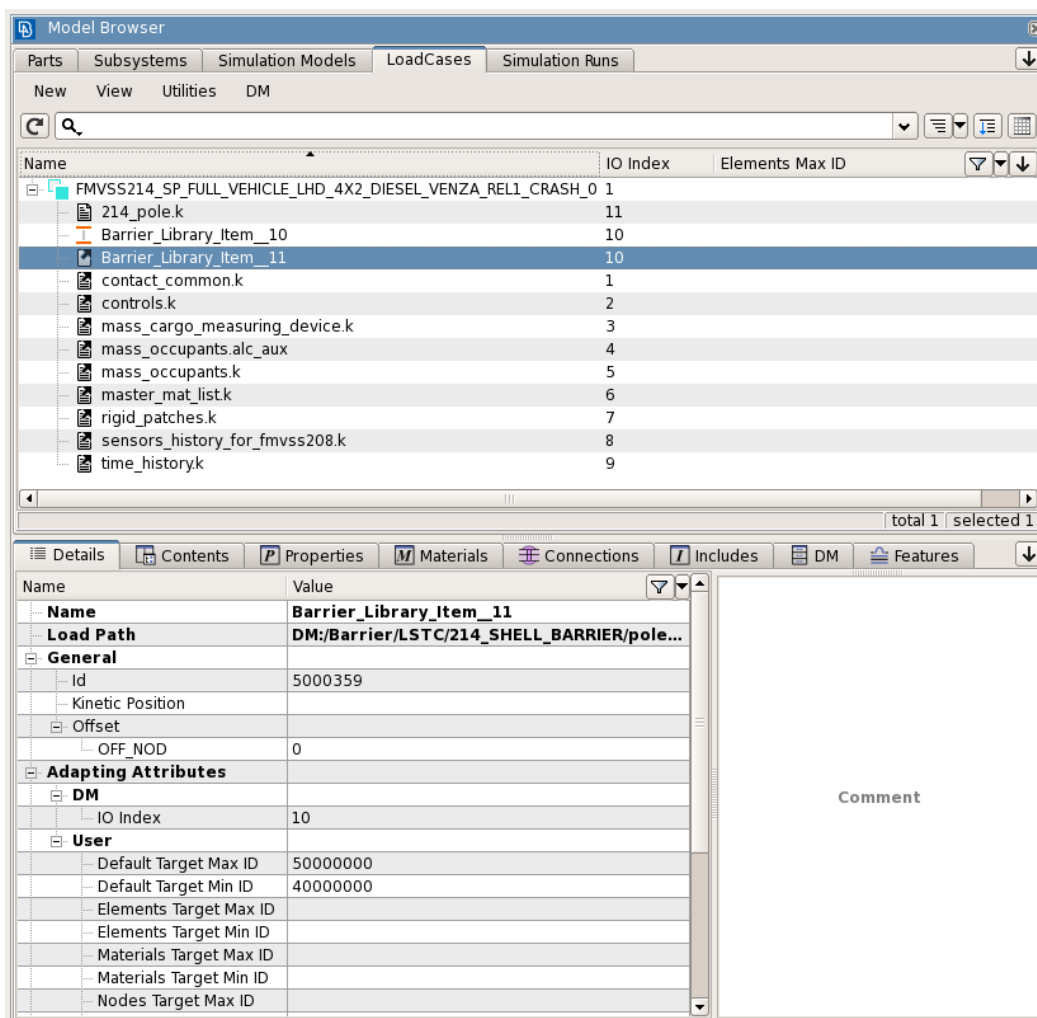

Fig.4:   Index the Loadcase Data in Model Browser

5 System actions and usability

5.1   Data Vault

ANSA offers the ability to work either on a local file based structure or on a server one. The system is applicable first of all for a single user to start a 'project' working with files stored on one's local directory. These files can be accessed only by this user and nobody can interfere in this project.
On the other hand, working with Model Browser the file storage can be on a server too. This way not only a single user but also a team can have access on it. Hence at any time, with specific privileges one can fetch the desired files (subsystems or loadcases) in ones working environment. Of course the data types exported and treated by ANSA can be used in more advanced data management systems like SPDRM.
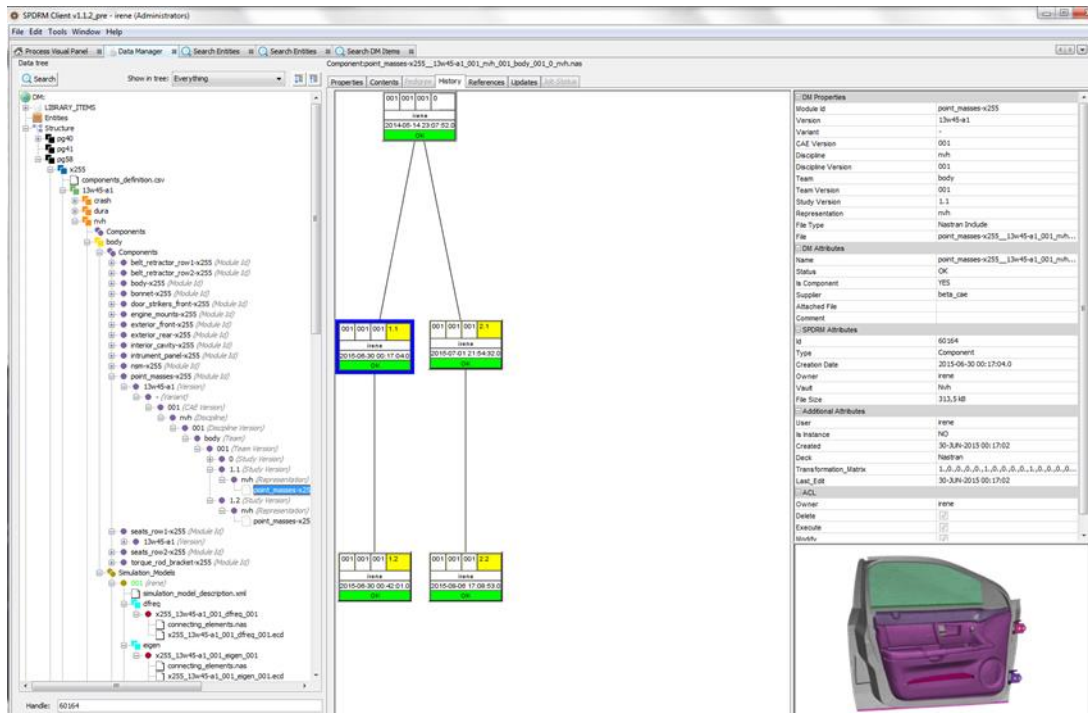

Fig.5:   Fetch a Subsystem using SPDRM

5.2   Metadata

Once a file is fetched in the Model Browser, either it is a subsystem or a loadcase item, ANSA recognizes all the source information that this file holds. All the attributes and data that characterize the adaptation of this file to a Simulation Run are extracted and stored as metadata. These metadata once they are saved follow the file's presence in a Simulation Run.
An example has to do with the connection between two subsystems. For the specific example two ANSA terms have to be introduced, Assembly and Loadcase Point. These are ANSA entities that offer the ability to mark a specific area or a Node of the model. As a result they are used in the connection definition between two subsystems. Once a simulation run is set up the Assembly and Loadcase points of a subsystem are saved as metadata following the respective file whenever it is going to be (re-)used. Consider the case of a barrier. The node of the barrier which will be matched with the respective in the vehicle, so as to be positioned, it is marked by a Loadcase Point saved in its metadata. Similarly, in the case of the seatbelt the anchor on which the belt will be attached is saved as metadata and follows the seatbelt file throughout the Simulation Run.

5.3   Self-contained files

The storage of the adaptation information of a file as metadata makes the file a self-contained unit. Metadata and the main contents of the file are 'separated'. Then main part of the file remains untouchable and its metadata that always follow it will show its way throughout a Simulation Run.

5.4   Re-usability

The ability of self-contained files makes them easily re-usable to different Simulation Models and Simulation Runs. Any time that a file is to be used in a Simulation Run there is no need to be loaded. Just its metadata are read by the Model Browser and the system can predict if this file is adaptable or not to a specific simulation run. If its connectivity entities match the project's ones, then the user can avoid rebuilding the file. Otherwise the system has to deal only with building the connectivity entities for this Simulation Run and do not deal at all with the main part of the file.

5.5   Error free work in parallel

Since the complicated Simulation Run is split into smaller self-contained files its handling becomes very flexible. A user can work only with the files that one really needs. This way one avoids fetching huge files that contain data that are not needed for a specific job and any possible, by mistake, change on them can cause problems to the complete Simulation Run. Apart from decreasing the user's interference and of course the errors, it makes also feasible more than one people to work on a project simultaneously dealing each one only with data that are relative to their current job.

5.6   Solver working way

As the process reaches the application of some solver actions on the data ANSA makes it easy following automatically the solver working way. When a file is needed to reach a specific Id range, for the purposes of a Simulation Run, the user through a simple window sets the desired target range. ANSA automatically calculates the offset values. Depending on the solver that will be used later on, known by the metadata of the file, ANSA will build in the background the desired solver keywords. In case of LS-DYNA the `*INCLUDE_TRANSFORM` with offsets will be created automatically.
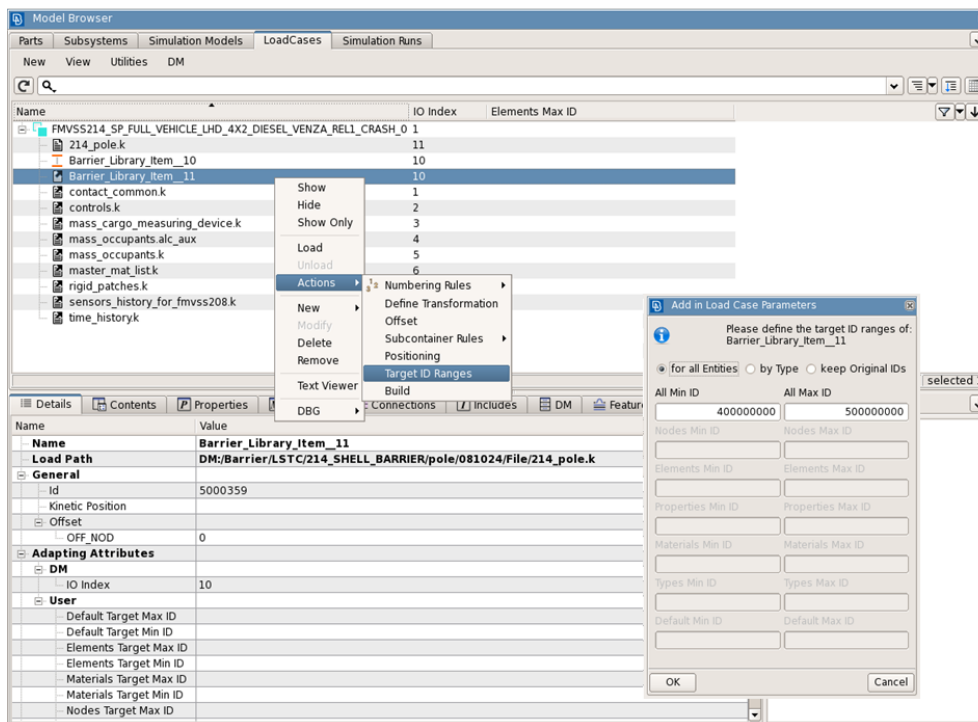

Fig.6:   Setting the Target Range of a Loadcase item through Model Browser

5.7   Cookbook

The goal is to set up the main file that will be solved by LS-DYNA. Once the Simulation Model with its subsystems and the Loadcase with the loadcase data have been set up the last step is the combination of those that will produce the LS-DYNA solution file (Simulation Run). The only action that is needed at this level is to combine them through an easy way. ANSA Model Browser offers a user friendly interface the 'Cookbook' for an easy Simulation Run set up. With the usage of activating checkboxes the user can include a simulation model and a loadcase in a simulation run. Additionally, a bulk realization of all different simulation runs can be produced from the different file combinations. Once the selection finishes the user can mark all the Simulation Runs and select to output them in one 'hit'.
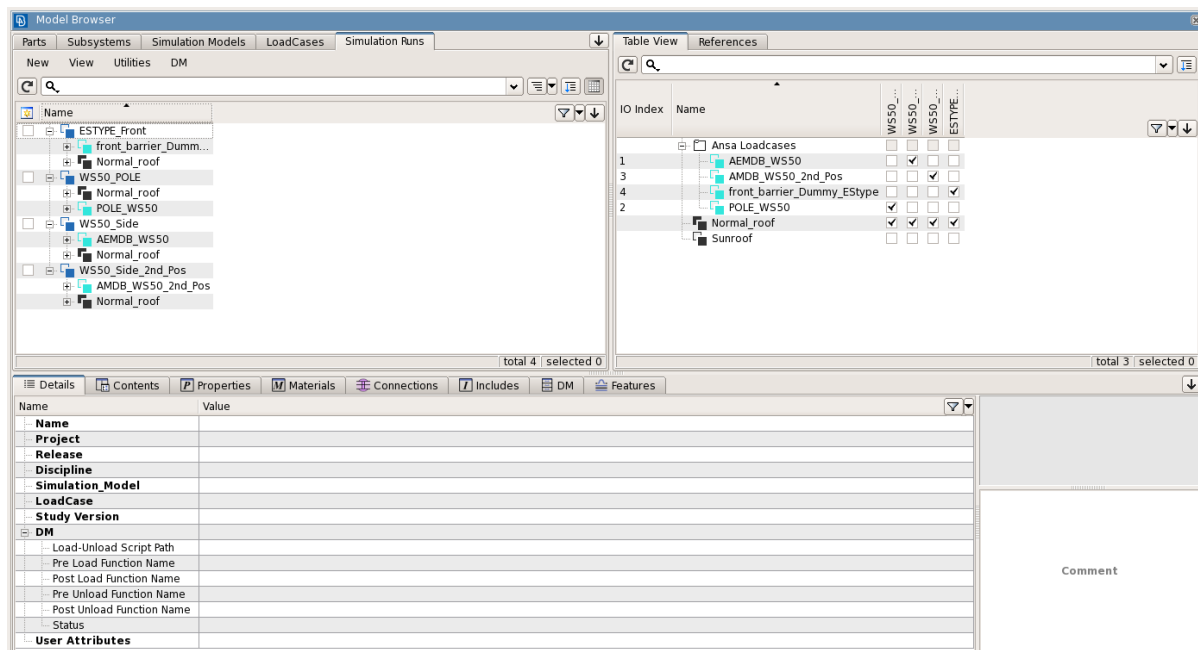

Fig.7:   Cookbook of ANSA Model Browser

6 Summary

BETA CAE Systems introduces as new data types the Subsystems, the Simulation Model, the Loadcase and the Simulation Run that make the model organization more efficient. The new tool to handle those data types is the Model Browser. The tool offers the ability to the CAE analyst to work either as a single unit on a project or as a member of a team. The data vault can be either a local directory or a server. This way, not only small projects as single files can be worked, but also big assemblies. Files are self-contained and their attributes are kept as metadata. Hence, the data exchange is easier and files can be easily re-used to different projects. Depending on the solver that is used, ANSA in the background creates the respective solver keywords. The cookbook offers an easy way to compose LS-DYNA simulation runs. Finally, using a high level of automation Model Browser can apply a bulk realization of the desired LS-DYNA run files.

7 Literature

[1]   ANSA version 16.2.x User's Guide, BETA CAE Systems SA, January 2017
[2]   Halquist, J.o., LS-DYNA Keyword Users Manula Version R7.x, Livermore Software Technology Corporation, Livermore 2014
[3]   carhs, SAFETY COMPANION 2017, 2016