HONDA APPROACH TO AUTOMATE THE NV CAE PROCESS

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ABSTRACT –
Design studies of vehicle structure for noise & vibration reduction with FE models are complex and operators are always struggling with these procedures. In addition, future CAE process will become more complex so it's so hard to catch up with manual skills anymore. We defined that standardization & automation are the direction of our enhancement.

BETA and Honda have collaborated to realize our next CAE environment. How BETA and Honda approach this challenge by ANSA, META, and SPDRM will be shown.

TECHNICAL PAPER -

1. INTRODUCTION

As known, FE analysis is the main methodology to design vehicle structure like body-in-white and currently we should decide the design without experiments of physical prototypes. To achieve the target performance of noise & vibration under this situation, CAE operators face a lot of criteria, large size FE models, a lot of data management rules and so on. This means that CAE operators are expected to have more sophisticated skills than before. Tools or scripts for aiding tasks were developed but there are still many things to learn.
On the other hand, data qualities, quantities, traceability, and reliability become more and more important for deep learning technologies. "AI" technologies have great possibility not only in autonomous driving but also in engineering field.
Considering these 2 backgrounds, we defined recent CAE development direction as "Standardization & Automation". Of course most of our CAE operators' tasks are carried out by ANSA / Meta. Therefore, we thought that application of SPDRM is the most effective way for us in terms of building auto-process and keeping logs of CAE tasks. In addition, the collaboration between Honda and BETA since 2001 is very smoothly and this is another reason why we apply SPDRM.
The summary of our approach is described in this paper. There are 3 big processes, "Import model", "Create new simulations", and "Create summarized report". Basic pre-post processes are whole controlled by SPDRM system excluding the initial model building process. Currently, the initial model building process has been defined by detailed specification, and modelling partners have made efforts to provide good quality models. We recognize that the initial model qualities and building way also need enhancement, but these are acceptable and the enhancement of the initial model building process was not covered in this project.

2. PROCESS

CAD & 3D CAE process

Figure 1 shows our engineering process by CAD & 3D CAE. We should realize the structure which satisfies the criteria related to the vehicle performance and weight. CAD – 3D CAE loops are the way we often apply to achieve a better structure. From CAE operators' side, initial models are provided and then 3D CAE analysis begins. After initial analysis, CAE operators give feedback to CAD designers. Feedback is provided through analysis report and new layout proposal. By considering each discipline's feedback, CAD designers draw new layouts and provide them to CAE operators. These loops are daily routine.

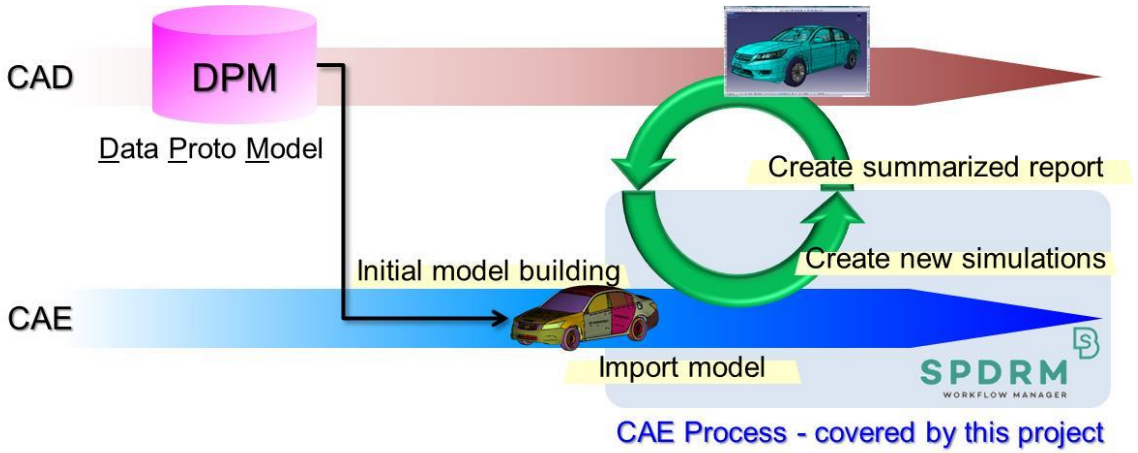

Figure 1 – CAD & 3D CAE process description

The first step of our "Import model" process is the data arrangement. Major execution in this phase is as follows.

- ✓ Import attributes
- ✓ 1 file for 1 body-in-white model → 1 file for 1 part
- ✓ FE description → LC points / A points description
- ✓ Initial analysis calculation

When CAE operators need to calculate for studies or evaluating new designers' layouts, they execute the "Create new simulation" process. In this process, we automated the tasks as much as possible and every procedure is described as nodes or task managers. These functions help us to keep high data qualities without operators' effort.

After the execution, operators have to summarize the results. At last we have well-organized output files. The auto-report creation is realized accordingly.

Import model process

Figure 2 describes the overview of the "Import model" process. First important step in this process is to convert FE representation to ANSA builders. One of our targets in this project is to be free from ID management. We conceived that it is possible when all connections between part to part and monitoring points are represented by generators like ANSA > connection, A points and LC points.

We also execute file separation in this process. Figure 3 shows the image of previous style and new style. Include management used to be applied for model management and it was 1 file for 1 component style. However this style is not the best in terms of model modification. For instance, when we replaced a part of body-in-white in the previous model management style, which is one of the major model update procedures, we always created a new file of the whole body-in-white model. This causes some inefficient matters. We have to read whole body-in-white model to ANSA every time. It is waste of time because we only need few parts

for this procedure, the replaced parts and their neighbours. In addition, data size is another issue. In old style we stored whole body-in-white model for every update, even if most of parts were not updated. In new style, only updated parts are saved, and therefore, we can avoid the waste of storage.
We also add attributes by parts shape identification in this process because our initial model building procedure doesn't include the registration tasks of attributes

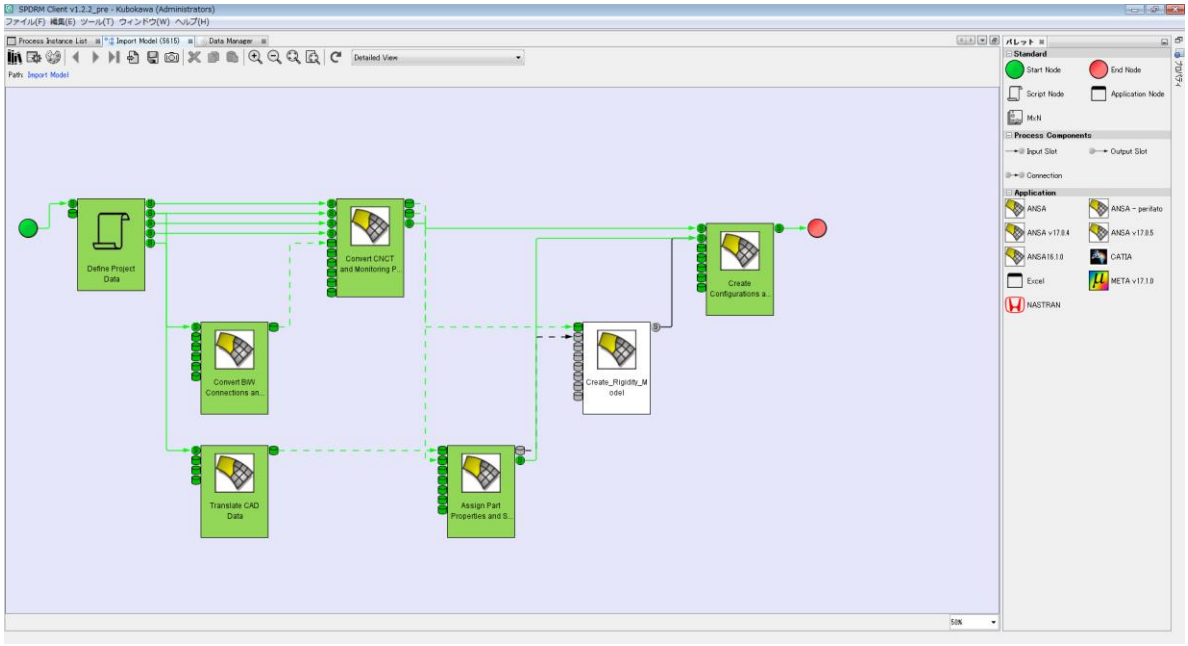

Figure 2 – "Import model" process overview

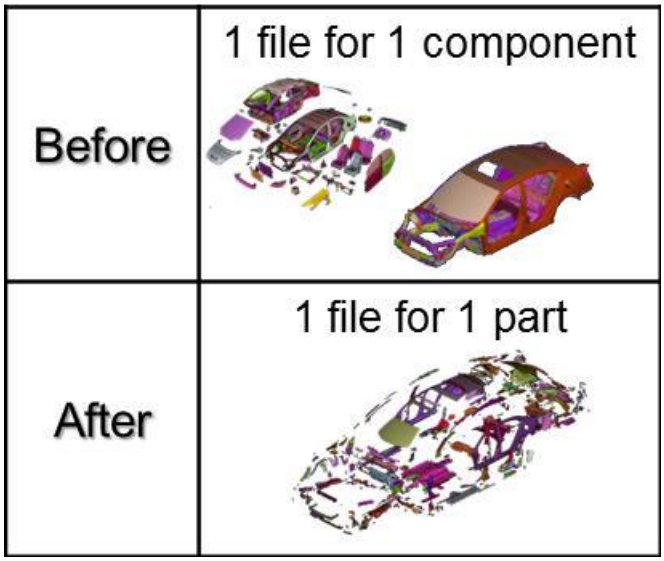

Figure 3 – Model management

<u>Create new simulations</u>
Since "Import model" is completed, we can control all of the CAE tasks under SPDRM, ANSA and META. Next step is the calculation. Principally there are 2 types of calculation. One is for verification of the designers' new layout and one is for studies by CAE operators. These studies are carried out to suggest good idea or layout to the designers. Anyway, both of tasks need modification of CAE models.
When operators just change the values like thickness, it doesn't require a lot of effort. However in case where operators modify the part shape, they have to take care of many things such as connections like spot weld, delete the old part, meshing, and so on. Before this project, these procedures were strongly person-dependent and they had to be solved for realizing efficient CAE process.

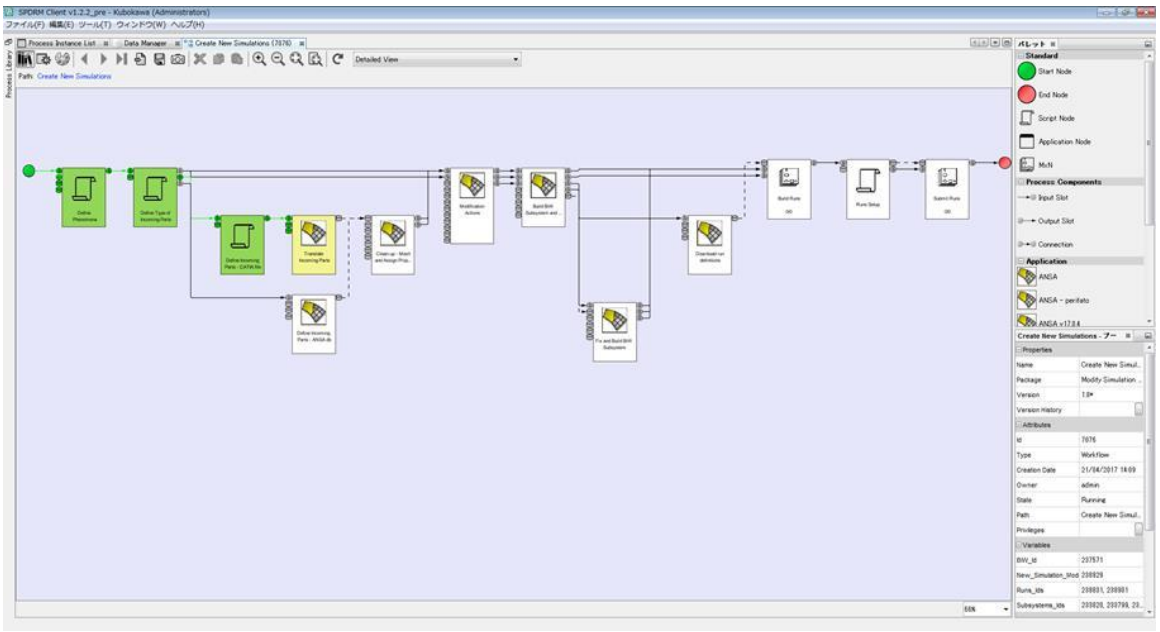

Figure 4 – “Create new simulations” process overview

The process for replacing part is a good case for explanation. Designers give new layout to CAE operators and request the analysis. First thing CAE operators do is to import the new layout from CAD. Then they clean up and mesh the geometry. On the other hand, the parent model for analysis also needs preparation. The parent model is the model before modification. Figure 5 shows the idea. From the parent model side, some parts become unnecessary after replacement so they have to be deleted. In general, the connection information should be kept in this procedure. ANSA can help us to manage the information but operators still require the skills to ensure the qualities of models.

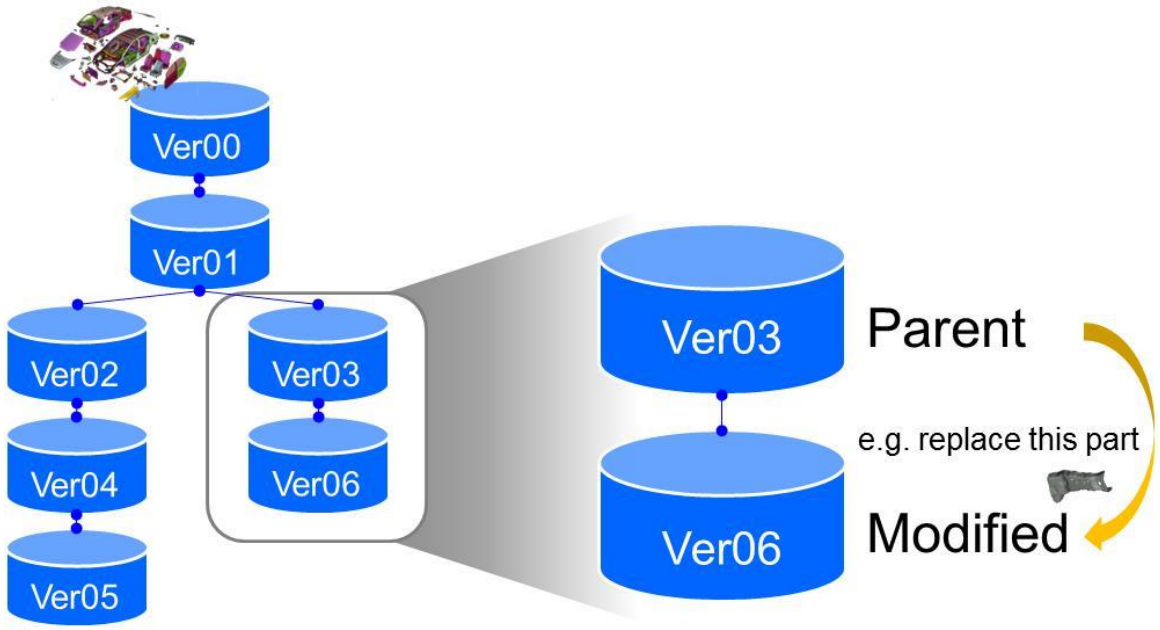

Figure 5 – Models history

We developed the systems and UI for these procedures. Figure 6 is the example. The modification procedures, which we can assume, are all included. We can introduce some functions for automation and supporting operators. For instance, ANSA only reads the parts which are related to this modification. This is because we want to avoid FPS problems and to

handle the model easily. Skeleton parts are just to view and these update are not available. These functions can navigate the operators to the right way.

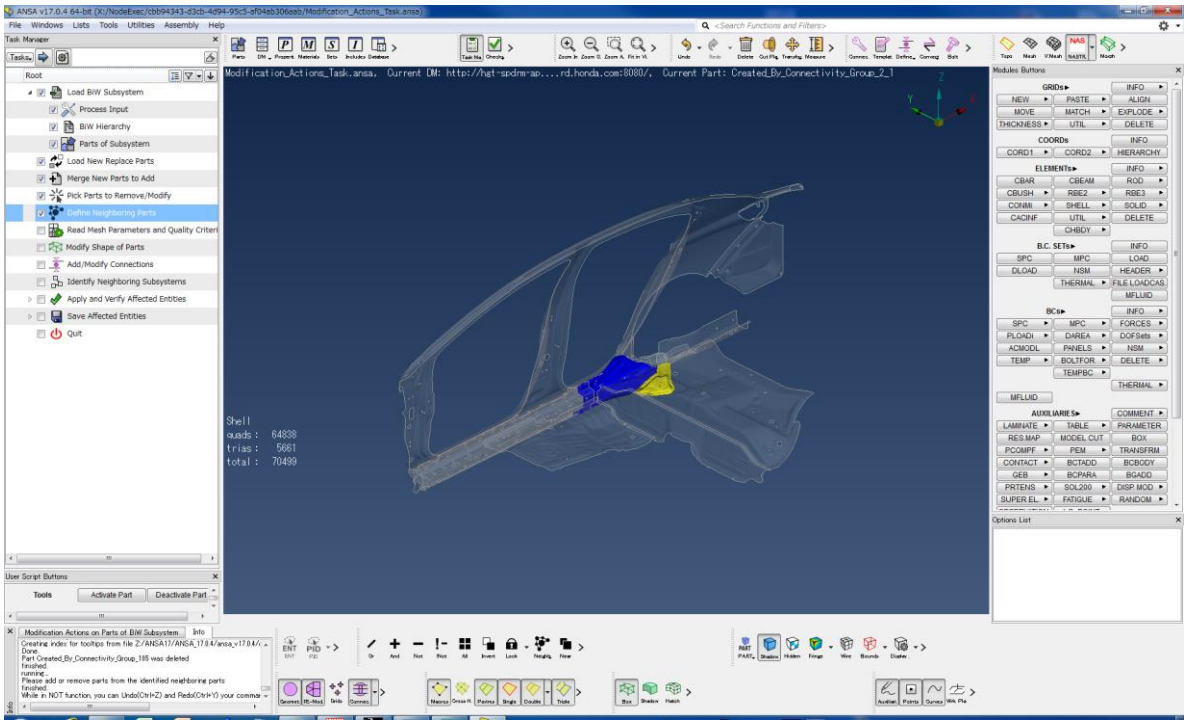

Figure 6 –UI example of “Create new simulations”

Data management is the big topic for this project, and therefore, it should be mentioned. Our idea is displayed in Figure 7. Each version has the information of criteria, CAE models, Standardized Nastran job description, result files and reports. Criteria are defined first and they are taken over. Our purpose is to execute every calculation at once and keep the traceability of each model state to realize the integrated execution. “One click execution” is not far anymore. Auto reporting is also done and the files are stored in this platform. Operators and managers are released from data hunting as they can access the required data whenever they like.

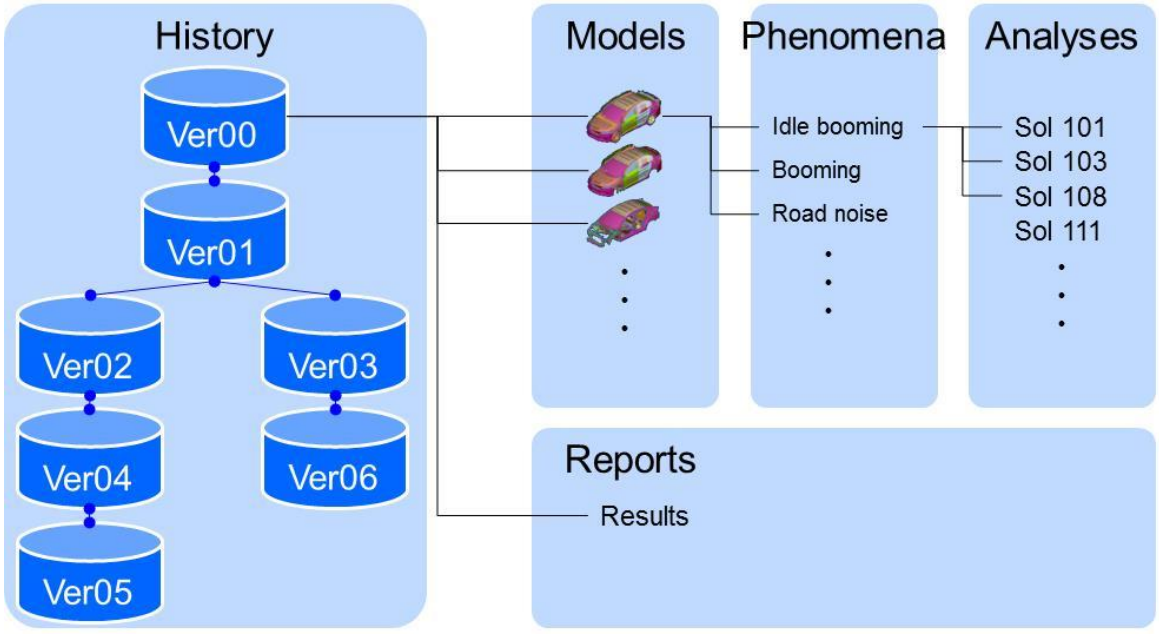

Figure 7 – Data management overview

Create report

Organized simulation results enable the full auto reporting. The reports are created by META as PowerPoint files. We defined information layers like figure 8 to access the data easily.

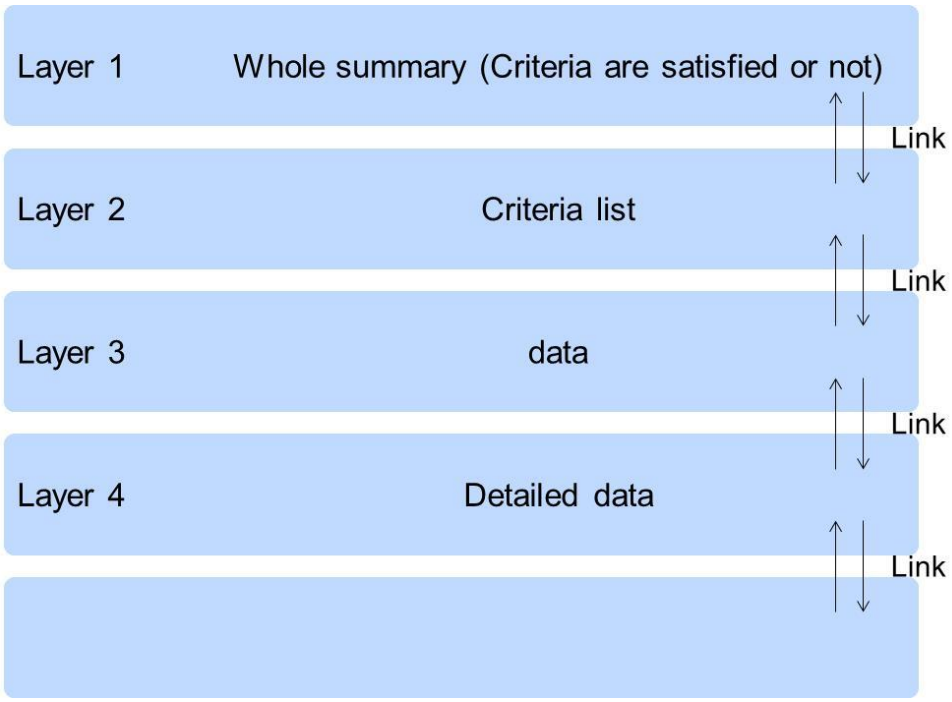

Figure 8 –Report layers

3. CONCLUSIONS

Well organized CAE platform for NVH analysis becomes reality. We recognize the effect as follows.

- ✓ Same output from every operator.
- ✓ Integration of model management system
- ✓ Good data traceability
- ✓ Free from ID management
- ✓ Integration of interface

Our next step is to simplify the processes and be faster. We also have to hear VOC (voice of customer). In this case it means the feedback from CAE operators. VOC enables the CAE platform much better.

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