FATXML - DATA CONSISTENCY IN THE CAE-PROCESS CHAIN

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FATXML, CAE process chain, data consistency

ABSTRACT –
This article provides an insight into the possibilities afforded by FATXML – a new, neutral, independent, standardized and purposely lean data format especially designed for the CAE process chain – towards enhanced integration in the development process, boosting flexibility and efficiency and improving the automated documentation of the CAE process.

TECHNICAL PAPER -

1. INTRODUCTION

Recent years have seen the development processes in the automobile industry become increasingly complex due to the introduction of overlapping PDM and PLM systems.
At the same time, the enormous increase in the number of calculations to be performed has led to a transition in the CAE processes to highly modularized input data and automated processes.
The availability of the product-defining data throughout the development process is a key element of the increasingly virtual development, serving to boost the development quality and document the product status.
As regards the CAE processes, the question arises here as to whether they can be most efficiently designed within a PLM environment or outside with a close linkage to the PLM systems.

An important criterion for the efficiency of the CAE process chain is high flexibility in order to be able to adapt to continuously changing requirements and framework conditions.
The most efficient process tool ought to be able to be integrated into the process chain for every sub-process stage. Data consistency in the CAE process must be guaranteed when a new CAE module is integrated. Losses of data and information must be prevented or minimized.
In addition, the CAE process must be open for the importing of data and models from suppliers and development service providers.

2. PROCESS CHAIN WITH FATXML

Information on model structuring, comments and documentation which have been incorporated in the models in the preprocessor are not transferred through to the postprocessors either. The model structuring has to be built up anew in the postprocessor or newly generated by means of scripts.
At present, information on the model structure is documented using comment lines in the solver input deck. This "work around solution" is inadequate, however, because comment lines are in many cases not standardized and based on company-specific or individual agreements and therefore not as a rule communicated through interfaces.
The result is data losses in the transfer from the design CAD and PDM systems into the CAE systems. This in turn results in extra work for the CAE engineers who have to search for the

missing data. Furthermore, an unambiguous documentation of the computation statuses relating to the respective design statuses is not directly given.

FATXML is a data format which makes available the product-defining data (metadata) from the design process through to the parts level throughout the entire CAE process chain (Fig. 1).

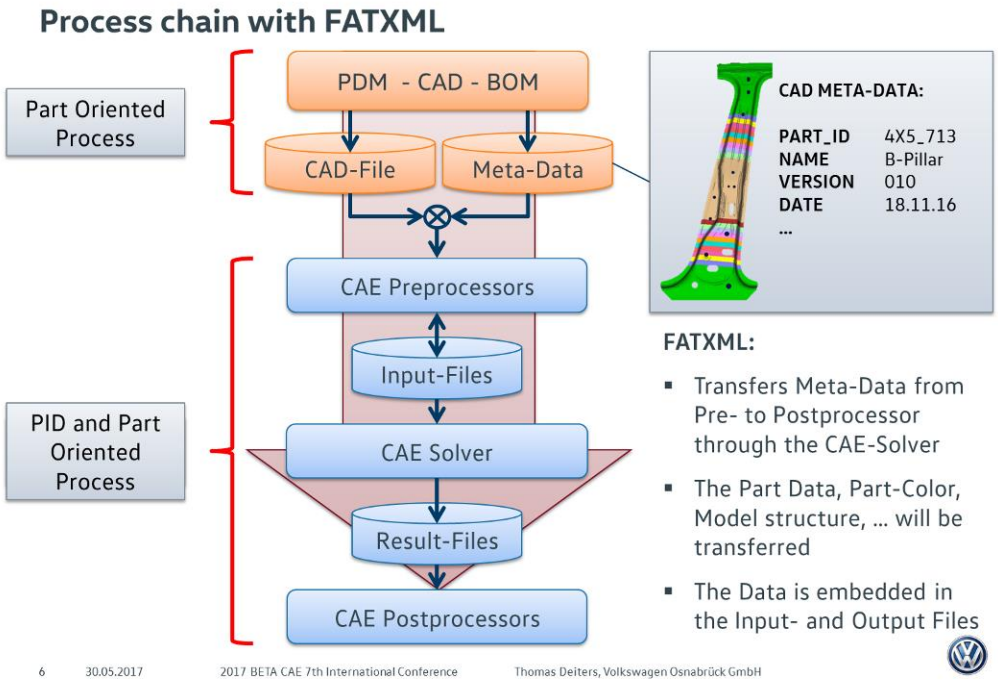

Fig. 1 Process chain with FATXML

The product information is exported from the preprocessor in the CAE solver using the existing interfaces. The solver doesn't have to interpret the data format, and instead merely writes into the results file with the computation results. For this purpose the solvers provide special input cards ("data containers") for the transfer of the metadata (Fig. 2). This provision of a special input card for the data transport is of crucial importance in terms of process efficiency since it ensures that, as opposed to comment lines, the metadata do not go missing on their trip through several interfaces. Currently the Solver-Codes PAM-CRASH, LS-DYNA, RADIOSS, OPTISTRUCT, MSC-NASTRAN and PERMAS support the FATXML-Format with special input cards and export to the results file. ABAQUS currently supports the FATXML-Format only with special defined comment cards but also with an export functionality to the results file.
The postprocessors import these data with the results file and can interpret the FATXML meta information. The result is that the product information is available throughout the entire CAE process chain. This enables a close intermeshing of the computation in the product creation process and boosts the levels of modularity and flexibility in the CAE process chain.

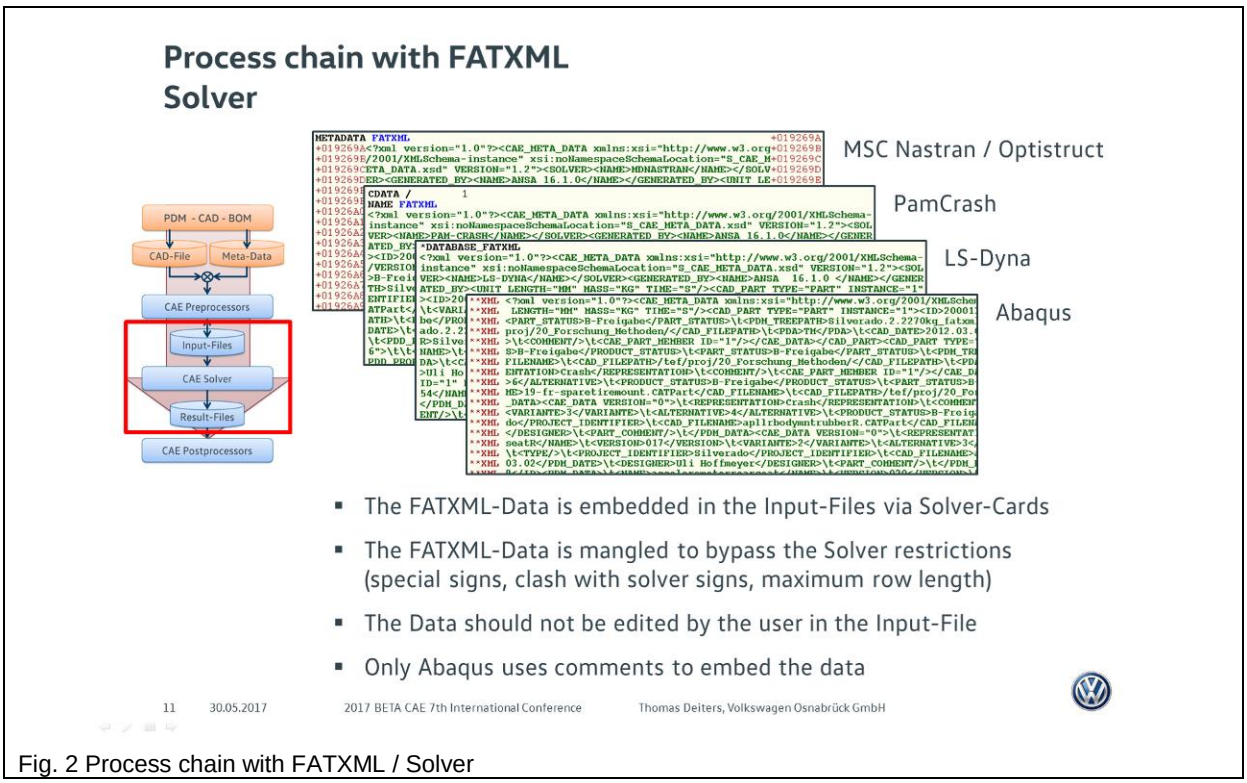

Fig. 2 Process chain with FATXML / Solver

It is often the case that several preprocessors are used for model preparation, the intention being to make use of the various strengths of the respective software tools. In this context the transfer of data from preprocessor "A" to preprocessor "C" frequently takes place via "neutral" solver input formats since, as a rule, no interfaces exist between the preprocessors (Fig. 3). However, all information and structures incorporated into preprocessor "A" are lost in the course of this procedure.

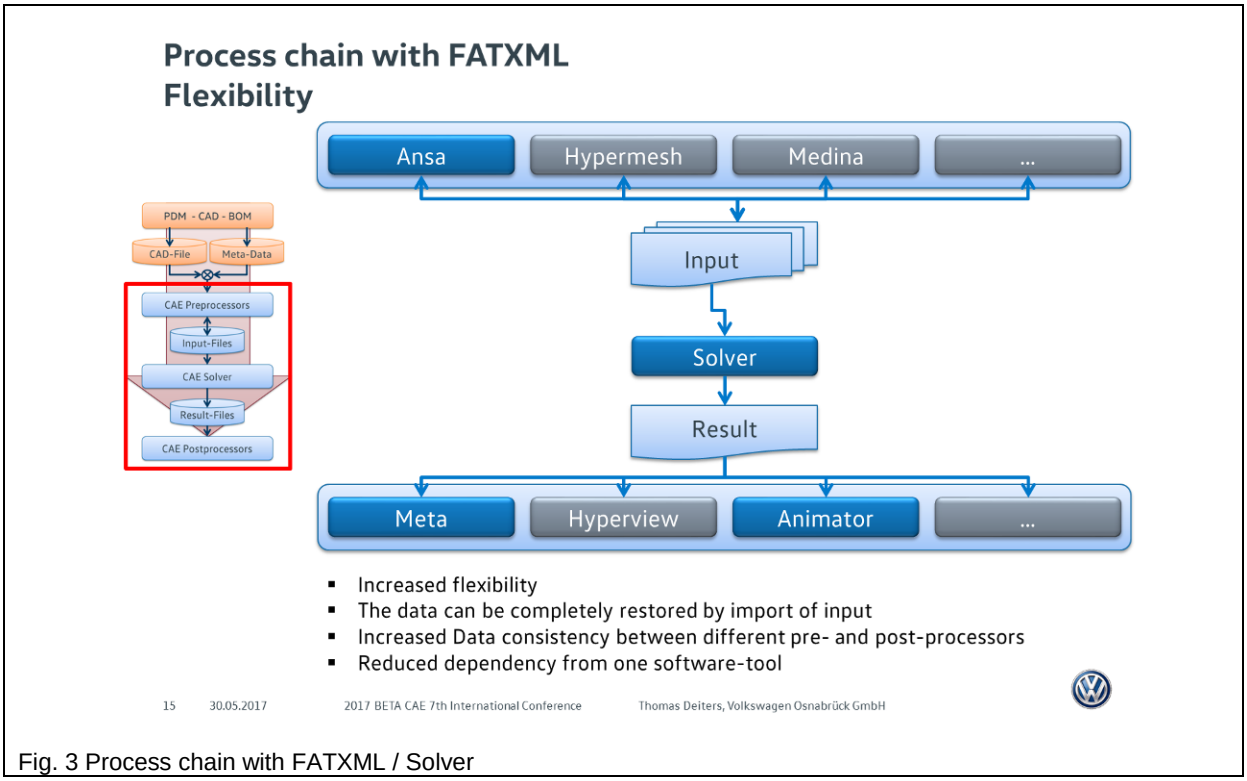

Fig. 3 Process chain with FATXML / Solver

This loss of data can be prevented by using the FATXML data format.

Following the transfer of the FATXML information to preprocessor "C", the user finds the same structures, comments and documentation, right through to the colouring of the individual parts, as he had defined in preprocessor "A".
This also applies where the selection of the postprocessor for evaluating the computed results is concerned. Here too, the user finds the same environment in various different postprocessors as he had defined for instance in preprocessor "B".

The FATXML data format was developed by a FAT-AK27 working party.
The documentation for the FATXML format, Version 1.2, dated 29.02.2016 is lodged and freely available on the website of VDA/FAT.
(https://www.vda.de/de/services/Publikationen/fatxml-format-version-v1.2.html)

The working party's participants include Audi, Behr, BMW, CRH, Johnson Controls, Kirchhoff Automotive, Opel, Porsche, ThyssenKrupp and Volkswagen, and CAE software developers Altair, Beta, GNS and T-Systems.

3. FATXML EXAMPLES

Besides the existing, PID-oriented postprocessing possibilities, the product data integrated via FATXML and the automatically generated, part-oriented model hierarchy structures open up new options such as, for example:

- Automated, enhanced documentation of the computation model throughout the entire CAE process chain
- Structuring and model definition from the preprocessing are also available in the postprocessing
- Documentation of a modularized model structure is optimally supported (taking over of components, supplier models, model database), (Fig. 4a)
- Navigation through the model with a treepath structure
- Selection of whole parts or subassemblies instead of individual PIDs (Fig. 4b)
- Transfer of the material documentation through the whole process chain (Fig. 4c)
- Availability of the product data right through to postprocessing
- Model and include documentation is possible by “misuse of parts”
- Increase of process integration in the connection process (Fig. 4d)
- No data lost (comments, information, documentation) when being transported along the process chain
- Time savings in preprocessing and postprocessing as result of the online availability of the product data (less additional lists, less searching)

The postprocessors can work on the basis of the FATXML standard and use it for extended evaluation and analysis possibilities in the interests of quality improvement:

- Comparison functionalities between the basic CAD statuses from the PDM system and the currently computed CAE variants
- Selection of parts with model differences in terms of the basic data relating to the computed CAE variants

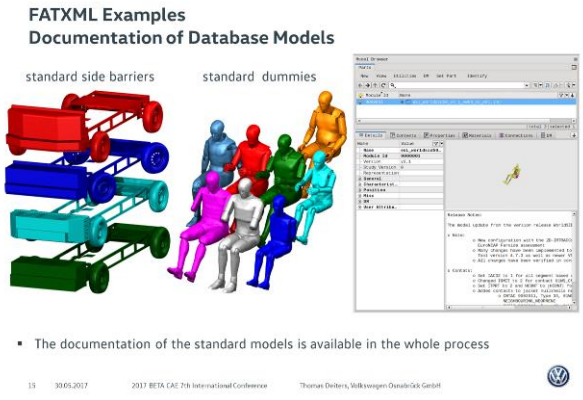

Fig. 3a FATXML Examples / Documentation

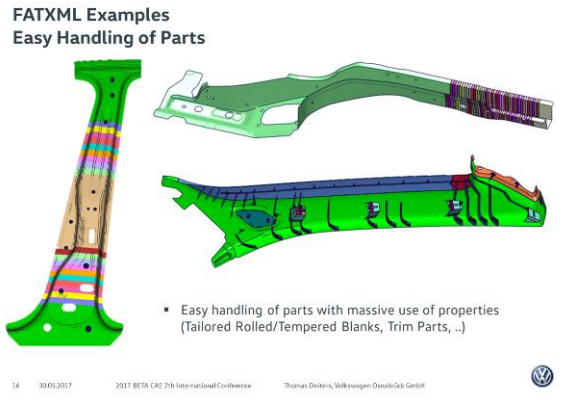

Fig. 3b FATXML Examples / Part Handling

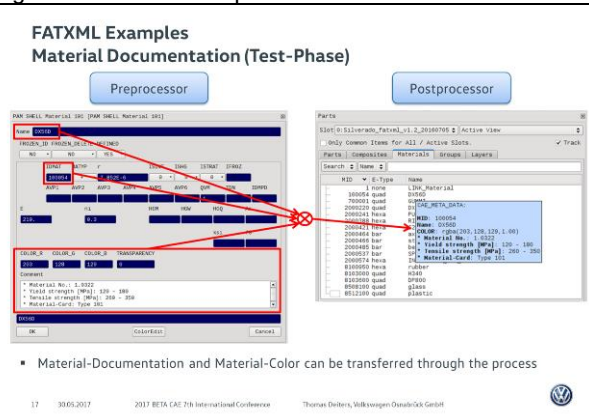

Fig. 3c FATXML Examples / Material Documentation

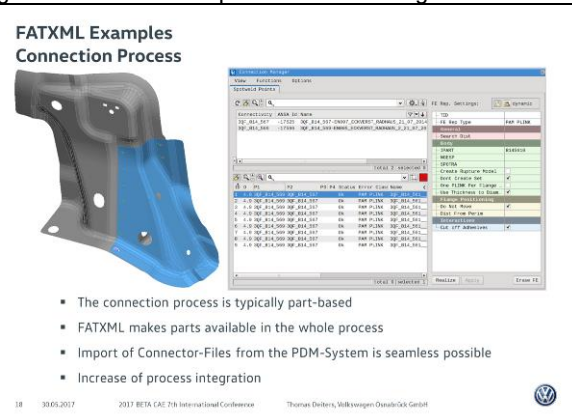

Fig. 3d FATXML Examples / Connection Process

4. MODULAR MODEL ASSEMBLING WITH FATXML

The growing number of load configurations requires a modularization of the data structures in the interests of ensuring efficient data storage and variant control. For this purpose, standard project components for the whole-car computation (e.g. steering column, assemblies or axles) are stored just once in a central database and all computations, depending on vehicle configuration, made available.
In addition, load-specific standard components, for example barriers or dummies for crash calculations, are stored in central databases.
Project-specific subcomponents, e.g. a door, can be made accessible for all project personnel in a project database. This means that the modifications for various different variants can be used efficiently several times over.

Each individual subcomponent can be unambiguously documented with FATXML. Depending on load and variant configuration, the respective components are brought together by means of a simulation management tool to form a computation-ready dataset for the whole-vehicle computation (Fig. 5).

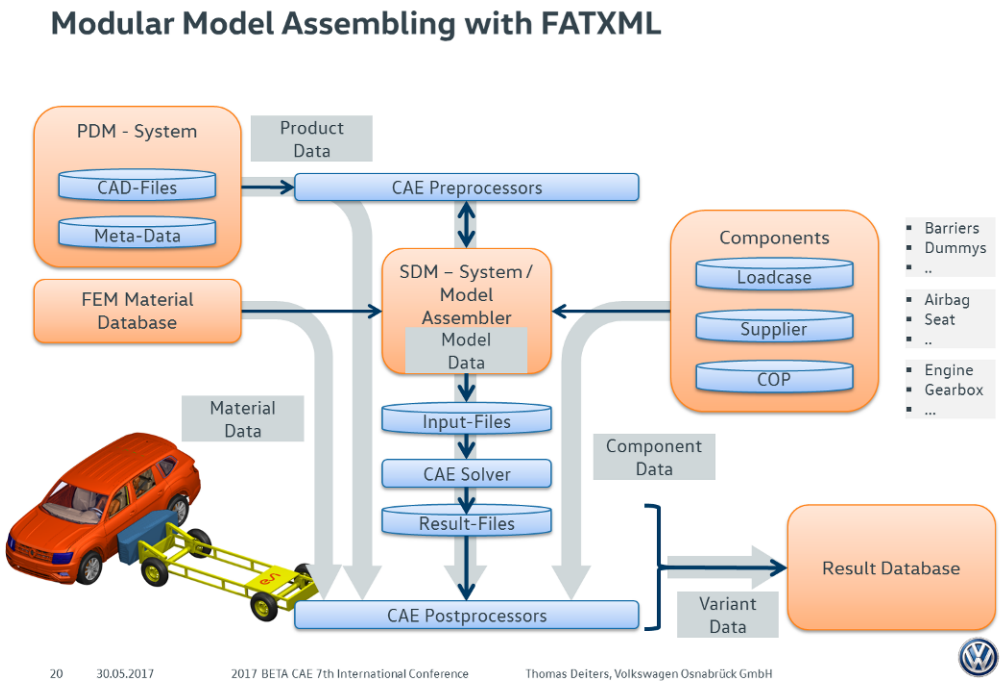

Fig. 5 Modular Model Assembling with FATXML

The decentral, implicit component documentation also means that the overall input deck and the results file for the completed computation are unambiguously documented, where necessary right through to the part level.

5. CONCLUSIONS

Because of the enhanced data consistency it enables, the FATXML format offers considerable advantages for enhancing integration into the overall development process as well as for boosting the flexibility and efficiency of the CAE process.

The component and part documentation integrated directly into the CAE process enables an automated, unambiguous variant documentation without the necessity for further IT infrastructure or interactive work steps.

The neutral and standardized format is freely available and publicly documented.
Its lean, CAE process-oriented structure makes this format easy to integrate into existing CAE processes.

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