A PROCESS FOR CREATING, MANAGING AND DEPLOYING MATERIALS IN ANSA

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ABSTRACT –
Systems simulations involve material models for many materials. Since different kinds of simulations may be performed ranging from NVH to crash, such material files exist for a variety of solvers. It is a difficult task to ensure the self-consistency of material nomenclature for all these cases, that the materials information is current and that the right material files are used for each material. We present a system where materials information is uniformly deployed to CAD and CAE from libraries set up in Matereality. Consistent naming conventions and unit systems are used. Material files are linked to source material data for reference and traceability.

TECHNICAL PAPER -

1. INTRODUCTION

The application of computer simulation in new product development requires a variety of data inputs such as CAD geometries, load cases and material information. Elaborate systems exist within the PLM space for the management and deployment of CAD. Similarly, the bill of materials (BOM) is also well established for the call out of appropriate materials for a particular component. These standardizations are not as well established in the simulation space. Recently, much effort has been devoted to the management of simulation data. A small but important part of this space is that related to materials. Simulations utilize material cards, formatted files containing material parameters, physical property representations of material behaviour. These files are often cryptic in nature, containing not just material properties but derived values, equation coefficients and software settings. It is therefore not at all simple to know what material data has been used to derive these files without external record keeping.

For use in simulations, material files are conventionally stored in a shared directory location accessible by the whole CAE team. Such a simple structure is easy to build but not easy to maintain. Difficulties arise when a material file needs to be updated or replaced. Traceability to source material data is not evident. There is a risk that the CAE user may pick a material file that is not intended for the component. In cases where multiple unit systems are in use within the same team, simulations could be performed using the wrong units.

While these challenges represent a trip hazard rather than major stumbling block, they can impede the pace of simulation, creating anxiety and risk. In our work, we demonstrate a process workflow to bring the same kind of order used in PLM to the area of CAE materials where the files are well documented and attached to source data, categorically linked to materials and can be deployed to ANSA with confidence. Unified material nomenclature ensures that the material names in the BOM catalog correspond to those seen in ANSA making it easy for the CAE user to select the correct material file to perform their simulations.

2. PROCESS WORKFLOW

In the proposed workflow, enterprises maintain a repository of material files in a single managed repository. New material files can be obtained in a number of ways: from material

suppliers, other stakeholders, test labs. Upon qualification, these are also added to the repository. Additionally, enterprises receive raw material data which can be converted by internal experts or consultants into the required material files.
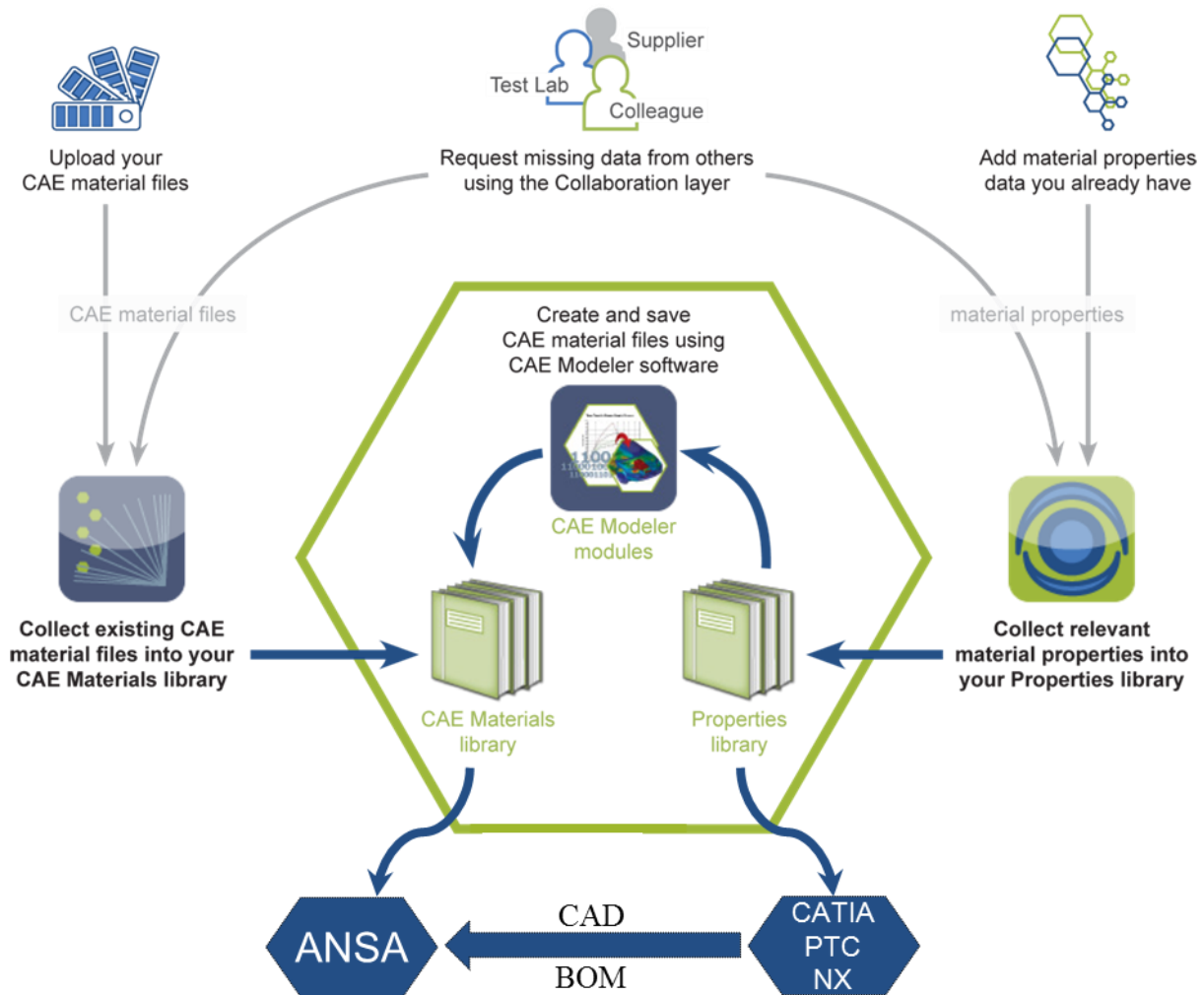

Figure 1 – Process workflow for managing and deploying materials in ANSA

The Matereality software provides enterprises with a single data infrastructure to store all aspects of material information. Figure 1 illustrates the components of the infrastructure that are pertinent to CAE material file management. In this workflow the contents of existing material file repositories are migrated to a CAE Materials library located within the infrastructure. Figure 2 illustrates the migration process. Incoming material files are categorized by a number of metadata tags including solver name, units, material model and material file type. These distinctions are important to ensure that the right data are deployed for a particular project.
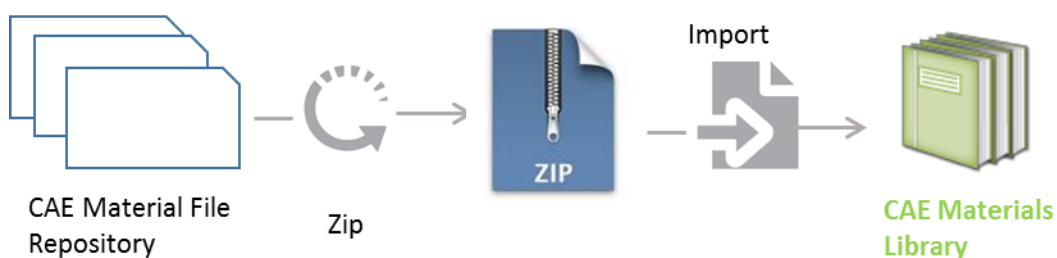
2.1 Import of legacy material files

Figure 2 –Workflow for bulk import of material files to the CAE Materials library

The contents of entire file structures can be zipped and uploaded in a single operation as shown in Figure 3. The software unzips and deposits each material file into its CAE Materials Library. If the incoming file folders are categorized by solver or unit system, then it is advisable to upload the files by solver. This process allows for easier categorization of incoming material files.
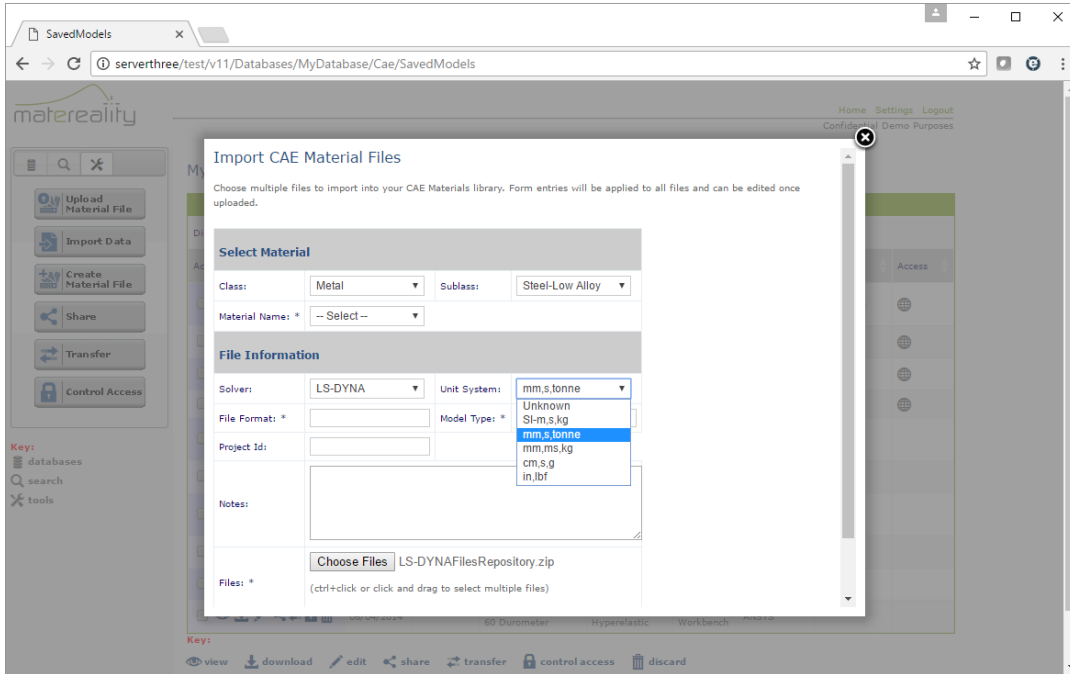

Figure 3 – Bulk import of LS-DYNA material files to the CAE Materials Library

A necessary subsequent step is the assignment of material files to named materials in the system. Material names are usually under the jurisdiction of materials engineers who are tasked with ensuring a consistent material nomenclature throughout the enterprise. This important task prevents the risk of the wrong material being utilized at the various stages of the product life cycle, whether in simulation or in real life.
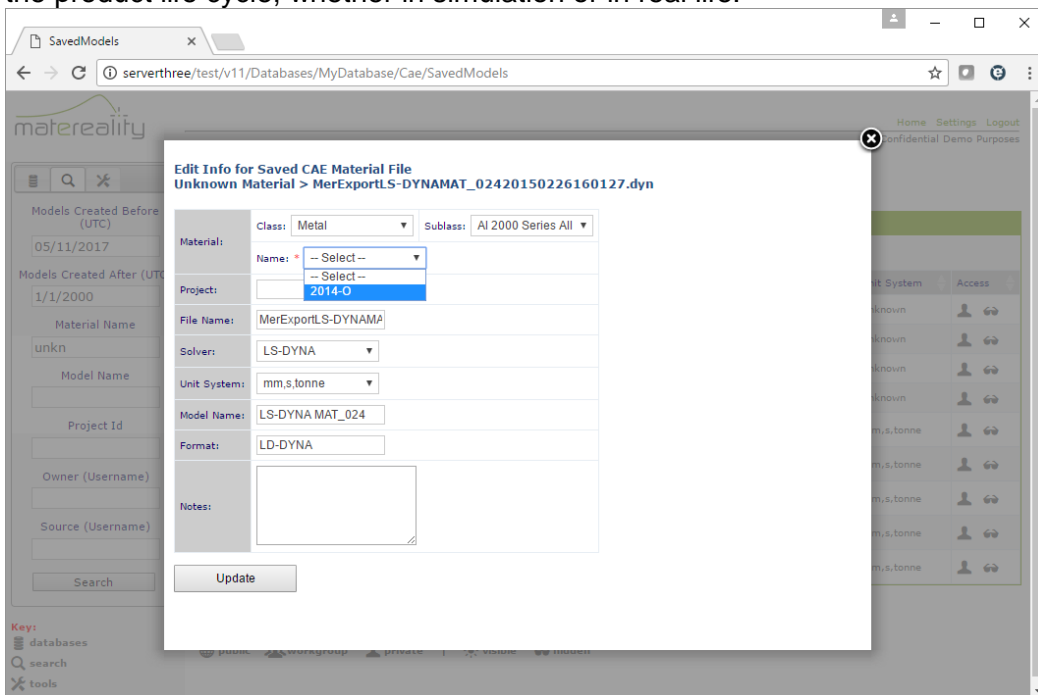

Figure 4 – Assigning CAE material file to a material name

Material files once imported into the CAE Materials library are catalogued and annotated and can now be managed. Files can be shared internally by the simulation users, shared with others on an as-needed basis or bulk exported to CAE pre-processors such as ANSA. Files can be sorted by solver, unit system or project. New material files received from collaborators or material suppliers can be added and catalogued to the library. Old material files can be discarded. All actions are logged by the Activity Tracker app providing the record keeping much desired by enterprises. In this way, the content of the CAE materials of the enterprise can be actively managed and kept up to date.
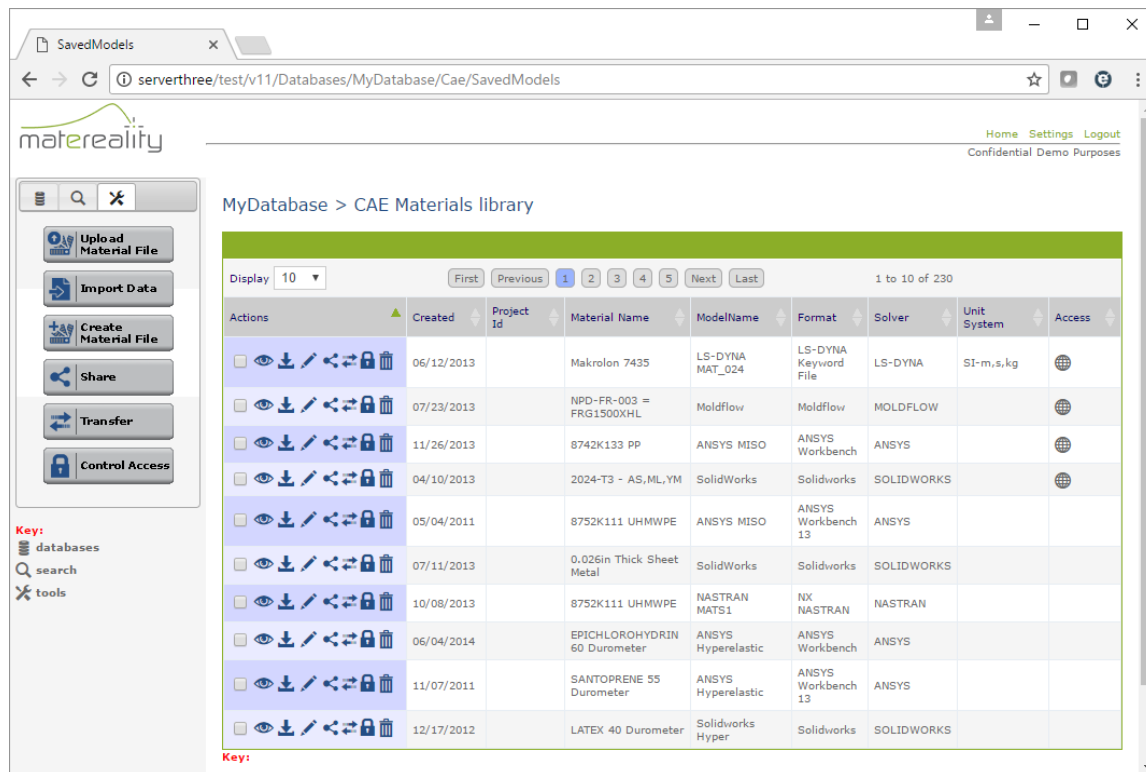

Figure 5 – Using the CAE Materials library to manage the material files

2.2 Creating new CAE material files

The Property Library contains material data for the materials of the enterprise. The material properties can be in any form including single-point data, curves, equation coefficients and so on. Such data is typically received from internal or external test laboratories, but can also be sourced from material suppliers and stakeholders. Since such data is often received as Excel files, a workflow exists for the import of this data into the Property library using an Excel macro. Single point data can simply be cut and paste into the library using the Simple Loader app.
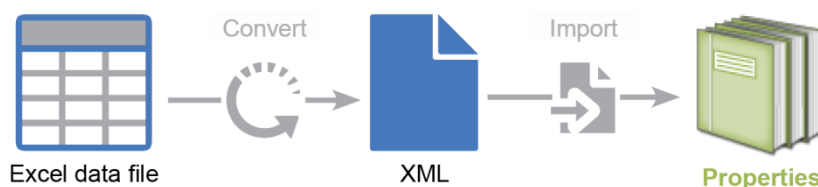

Figure 6 – Using an Excel importer to add raw material data to the Property Library.

Many simulations do not directly consume raw material data. Rather, a conversion process is needed to develop material parameters in the right format and units needed by the solver. The CAE Modeler software provides the capability to perform these conversions for commonly used material models in most solvers. The capabilities of this material parameter conversion software has been described previously [1,2] and will not be covered here.

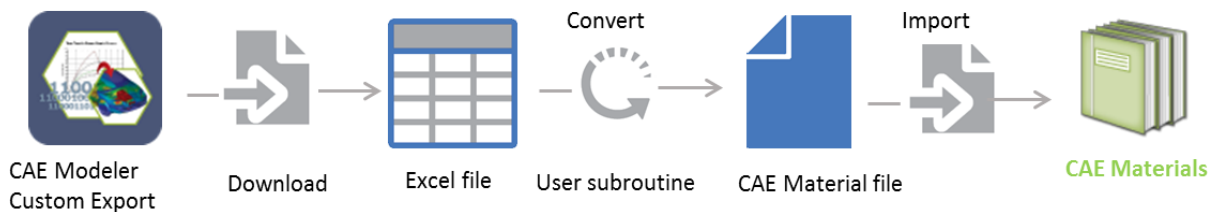External user-defined data conversions are also facilitated by the following workflow.

Figure 7 – Using user-defined data conversions to create and add CAE Material files.

2.3 Creating master material lists for BOM assignments

The Materials Library of the software contains the master list of materials that are used by the enterprise. The imported CAE Material files are assigned to these materials. The data required for assigning materials to CAD geometries is typically simple, including density, modulus and Poisson's ratio. The Linear CAE materials app is used to export master material lists to designer software such as NX, CATIA and Creo.
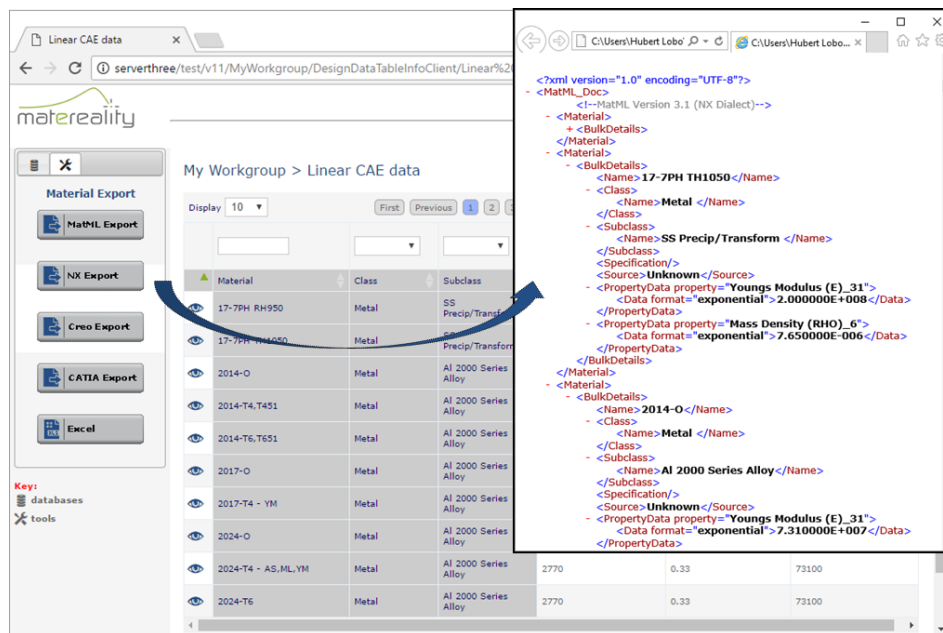

Figure 8 – Exporting material data for CAD material assignments

Master material lists are a vital step in the process workflow to ensure that materials are correctly assigned to CAD geometries removing uncertainty about which material to assign when using ANSA.

2.4 Material specification-based nomenclatures

Some enterprises utilize material specifications as a basis for BOM material callouts. In this case, the materials engineers refer to certain desired characteristics of a material rather than an actual material itself. The required properties are referred to in terms of ranges or targets rather than actual measured values. This allows the enterprise to have flexibility in material selection rather than specifying a material from a particular supplier. The use of specifications presents an additional complication which must be managed because it is unclear what material card to apply to what is essentially a hypothetical material. The role of the CAE expert is crucial in such cases in assigning a 'typical' material for each specification. Further, the exports now need to be modified such that the material names for CAD material assignments are now replaced by specification names. This also carries over into the simulation space where material file designated by the CAE expert is now assigned a specification name to avoid any ambiguity when the CAD file appears in ANSA.

2.5 Creating exports for ANSA

The CAE Materials Grid app of the software provides a master view of all material files that are available for export to ANSA. Depending on the project, it may be useful to send only

sub-set of the collection to ANSA. For example, it may be to constrain the export to only certain materials, or models
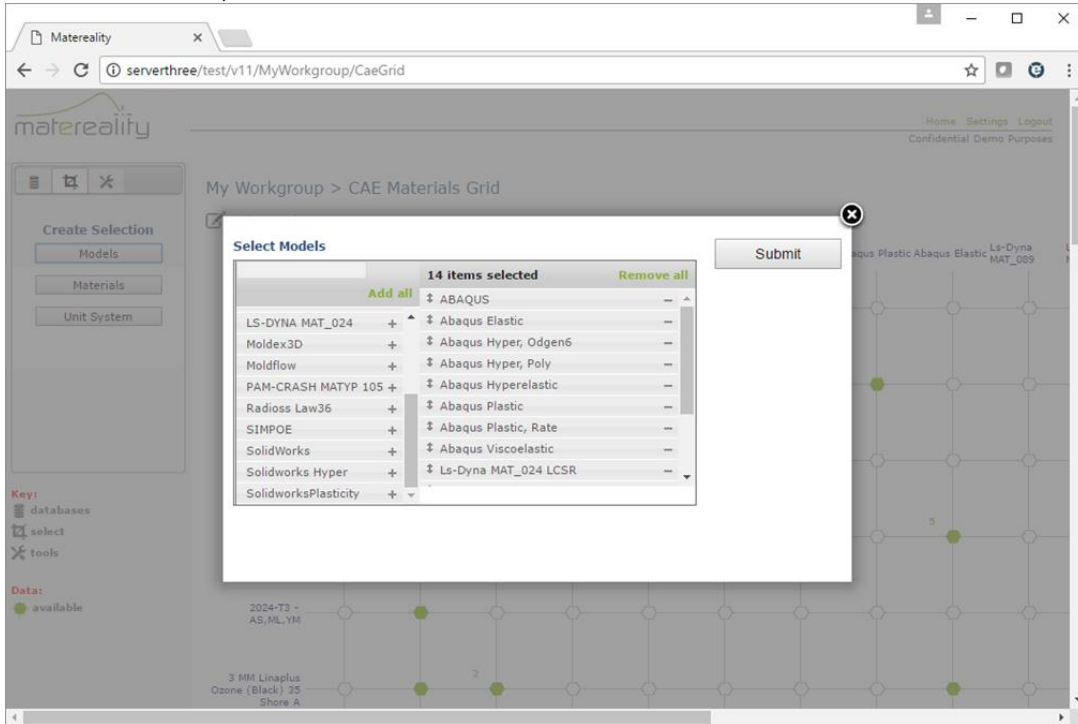

Figure 9 – Exporting material data for CAD material assignments

The selected files can be downloaded to a folder system that is readable by ANSA, where the material files are each stored in a separate folder. The contents of each folder are readable by ANSA. An XML metadata file provides additional information about the files including target solver, unit systems, material names and file formats..
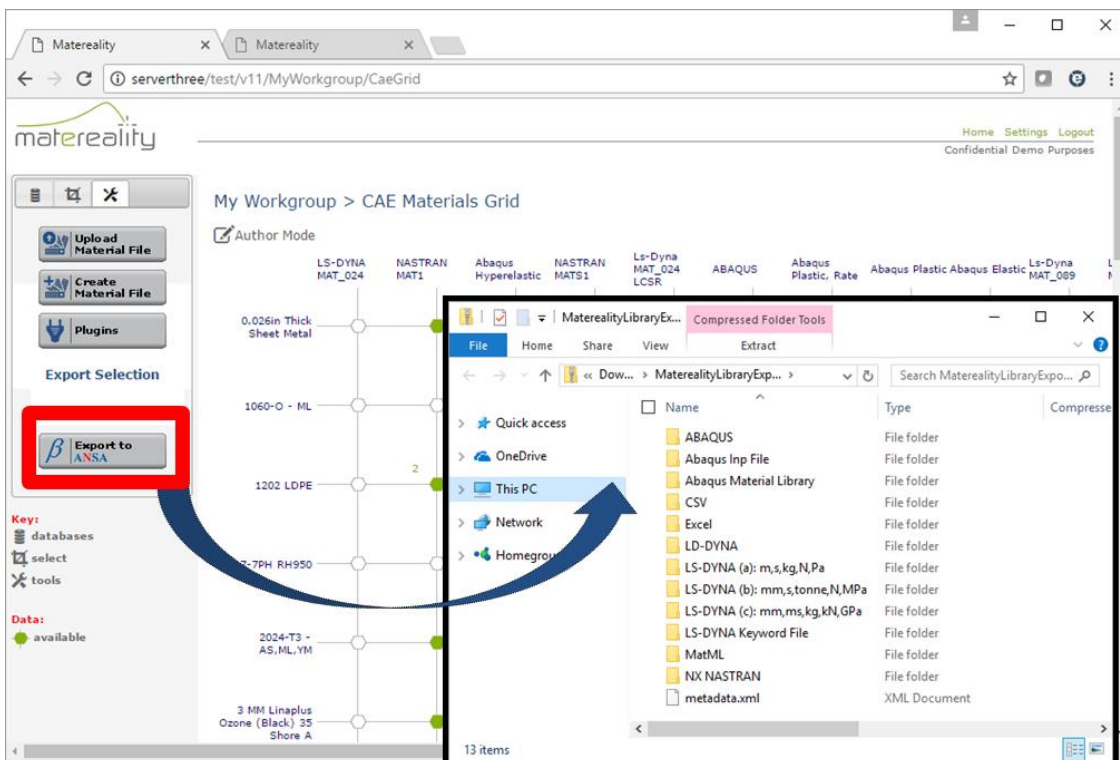

Figure 10 – Exporting a material file collection to ANSA

2.6 Using imported material files in ANSA

During the import process, a Matereality plug-in is used to read the incoming zip file into ANSA. The material files appear in the material database window of ANSA and are catalogued by material name, solver and unit system. ANSA can use this information to correctly display the material files to the user so that he/she can correctly assign material files to parts based on the CAE material assignment call outs
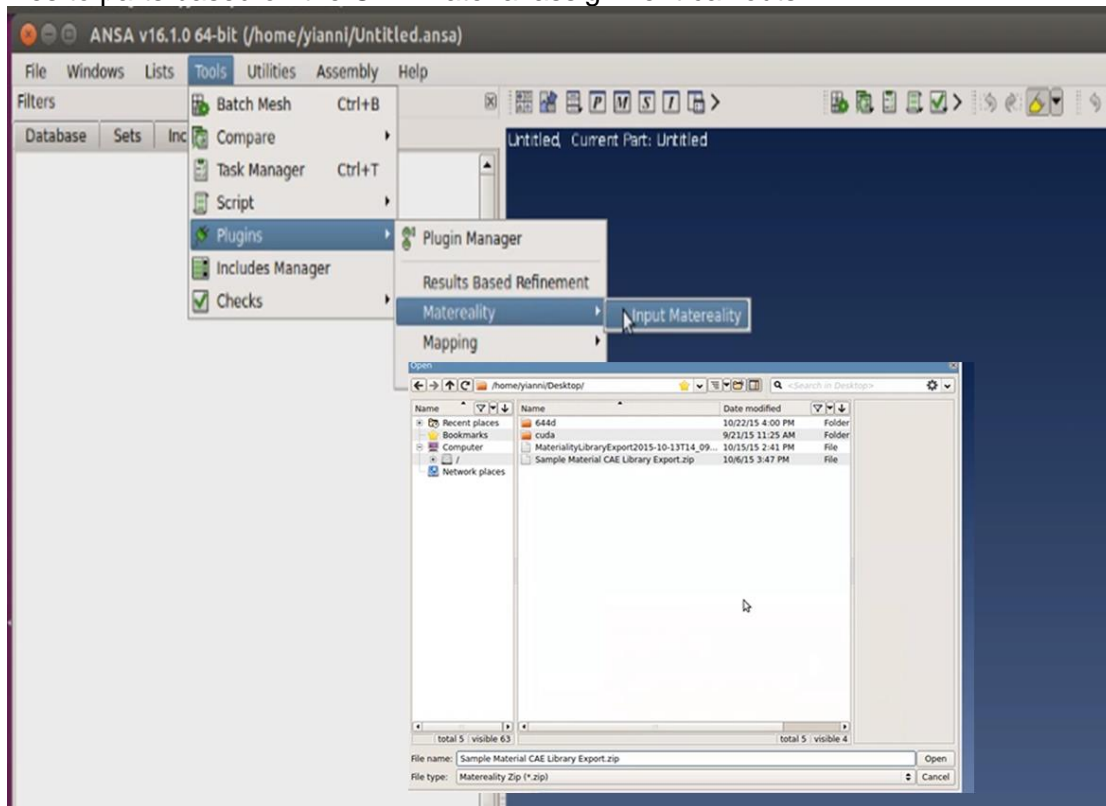

Figure 11 – Adding the material file collection to ANSA

X. CONCLUSIONS

A streamlined process exists for handling materials across both CAD and CAE platforms by using a master materials source located in Matereality, The process is facilitated by common material nomenclature maintained by the materials engineering groups of the enterprise. The software manages tasks including traceability to source data, keeping the material file collection valid and current, facilitating material parameter conversion using internal software as well as user-preferred external macros and scripts.

REFERENCES

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