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Comos – PDMS and E3D data transfer

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Tiivistelmä

Opinnäytetyö tehtiin Andritz Oy:lle, joka on maailman laajuisen yrityksen Andritz AG:n toinen Suomalainen tytäryhtiö, jolla on toimitiloja Suomessa monilla eri paikkakunnilla. Yhtiö toimittaa järjestelmiä, laitteita ja palveluita paperi- sekä selluteollisuuteen.

Suunnittelutyössä tärkeää on, että tiedonsiirto ohjelmistojen välillä toimii moitteettomasti. Tiedonsiirron kehittäminen on edellytys kilpailukykyiselle toiminnalle ja lisäksi siitä on käytännön hyötyä reaaliaikaisen informaation päivityksen muodossa, mikä puolestaan vähentää mahdollisia käsityön aiheuttamia virheitä sekä tiedonkäsittelyyn kuluvaa aikaa jättäen enemmän käytettäväksi suunnittelua varten.

Työn tuloksina saatiin selvitys Comos-, PDMS- ja E3D ohjelmistojen välisen tiedonsiirtolinkin rakenteesta ja kertyneistä tiedoista yhtenäinen dokumentti myöhempää tarkastelua varten. Lisäksi työssä koottiin geneeristä informaatiota Comoksen ja Aveva E3D toiminnoista ja rakenteesta. Ohessa luotiin myös yksinkertainen käyttöohjeistus. Siinä määritellään, kuinka tiedonsiirtolinkki luodaan erilaisille kohteille, miten linkki toimii ja mitä tietoa siirretään tällä hetkellä.

Avainsanat

[Comos, Aveva, PDMS, E3D, tiedonsiirto, kehitys, suunnittelu, dokumentointi]

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Abstract

This thesis was made for Andritz Oy, which is a Finnish subsidiary company for the worldwide company Andritz AG. There are multiple locations in Finland, where engineering, manufacturing and marketing are handled. The company provides systems, equipment and services for the pulp and paper industry.

In engineering and design, it is important that data transfer between software works seamlessly. Developing data transfer tools is mandatory in order to stay competitive on the field you are working with. Data transfer development has huge practical worth as it reduces total cost in projects, decreases the workload of individual people while also leaving smaller chances for human error.

This thesis's main goal was to clarify the link between Comos – PDMS and E3D software, while also covering the generic information about Comos and Aveva E3D. Additionally, simple instructions for end-users were created to show how to link different object types with the data transfer tool, what data is actually transferred across the platforms and how it is made possible.

Keywords/tags (subjects)

[Comos, Aveva, PDMS, E3D, data transfer, development, design, documentation]

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Abbreviations / explanations

AEI – Automation, Electrification and Instrumentation

Aveva PDMS – Plant Design Management System

Aveva Everything3D – New improved design system, next step from PDMS

Citrix – Virtual computer solution to access Comos and E3D from the network

Comos – Engineering software with integrated database for process industry

DSN – Data Source Name

FUP – Function plan diagram, shows principles applied to the software program

Hook-up – Installation drawing, specifies what components are needed for installation and the scope of supply and scope of erection.

ODBC – Open Database Connectivity

PADD – Production of Annotated and dimensioned drawings

PID – Piping and instrumentation diagram

PML – Avevas domain specific language, programmable macro language

UDA – User Defined Attribute

1 Introduction

1.1 Background

The data transfer tool has been developed within the past three years. It has many benefits in making engineering faster and more automated. The efficient flow of information is an important aspect in providing the best possible quality with reasonable time investments. Linking the object on all platforms reduces the workload of individuals and the possibility of human error as the data becomes usable in all locations with one entry of data, without having to manually input data to various locations. Before the existence of a proper data transfer tool, all information had to be manually transferred in engineering systems such as Comos, PDMS and E3D.

1.2 Goals

This thesis is more importantly an examination rather than developing anything new. The target of this thesis is to clarify the properties of two systems used by Andritz, Comos and E3D, which is a newer system from Aveva possibly replacing the older design solution PDMS completely in the future. Comos is focused on 2D engineering, producing required process documentation and fill in technical data for equipment. Aveva E3D is primarily used for creation of the 3D model and isometric drawings.

Research was conducted from the data transfer point of view, while also covering the general information about the software. The current situation is that a data transfer tool is available and in use for most ongoing projects, but information about how the tool works and how end-users should operate is not explained well for new people well. There were not enough records at the moment gathered into one document.

1.3 Principles and sources

Gathering information for the subject was difficult due to lack of written material available. Andritz provided some documentation regarding the data transfer tool. Most of the knowledge is from the engineering development team, COMOS administrator and PDMS users through meetings and discussions. User manuals for Comos and E3D were helpful and provided lots of general knowledge. Testing and experimenting with the tool were done and results used for this report.

2 What is Andritz?

Andritz AG is an international company providing equipment, plant design, systems and many other things for various industries worldwide. The headquarters of Andritz AG is located in Graz, Austria. The company currently employs approximately 29 700 employees, covering over 280 locations in over 40 countries.

Figure 1 Andritz Varkaus

Andritz Oy is a Finnish subsidiary, which is one of the top suppliers for pulp and paper industry providing solutions for wood processing, fiber processing, chemical recovery, biomass usage and energy generation. Currently there are more than 1300 employees working. The headquarters of Finnish operations is in Helsinki, with other

centers of operation located in Lahti, Lappeenranta, Kotka, Savonlinna, Tampere and Varkaus. (Andritz website, 2019)

2.1 History

Andritz AG has a long history in manufacturing. It was originally founded by Josef Körösi in 1852, in the municipality of Andritz, Austria. The company first started as a small iron foundry. After foundation, the company started to quickly increase its production to include larger goods, for example cranes, pumps, water turbines and later expanded even more into steam boiler and mining business. After 1950s, the company took steps towards its modern form and started production of complete paper machines. (Andritz website, 2019)

In Finland, the power and recovery boiler business had started growing at the same time by A. Ahlström Oyj, which was a big employer in the lumber industry. A. Ahlström Oyj had the biggest paper machine PK1 in Europe at that time, located in Varkaus, Finland.

Andritz AG expanded to Finland first in 1994 with the acquisition of Kone Woods and further during the break of the 21st century in 2001 with the acquisition of the Ahlström machinery group. Kone Woods provided Andritz technology for wood peeling and chipping and Ahlström gave expertise about producing chemical pulp and recycled pulp. (Haukkasalo, 03.04.2020)

3 About Comos

Siemens solution, Comos is a plant engineering software. Mainly used in process industry as a global database across all the different phases of design and creating all the required documents to build a successful new plant. Positives about global database is that once created, data and all the templates and base objects can be used in various projects from anywhere in the world. Information is stored in the object-oriented database. Thus, it saves time from recreating general documentation because of cross-project copying possibilities.

3.1 Project types

There are different types of projects in the project database and only one project can be open at a time. Comos has four types of projects, which are explained in the next sentences:

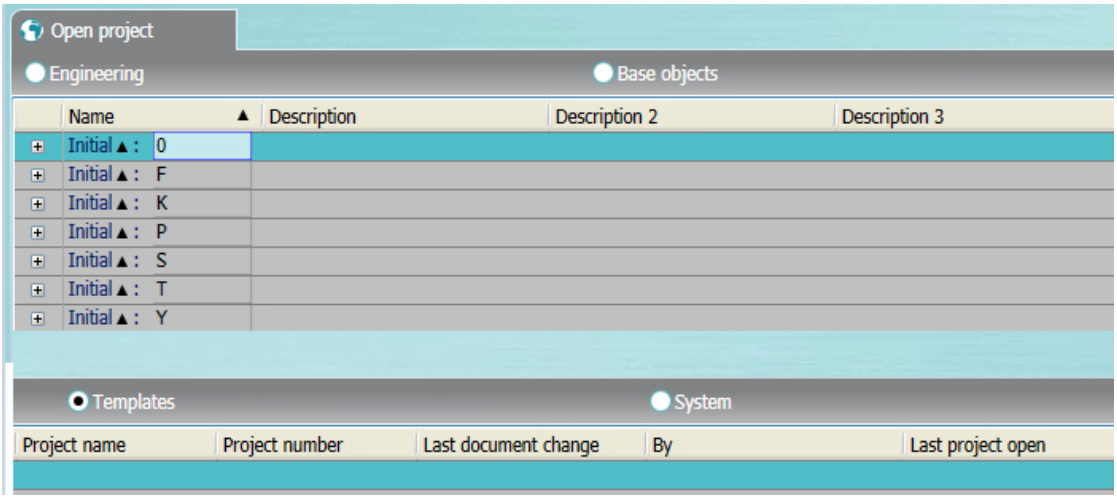

Figure 2 Comos project types and search hierarchy

3.1.1 Base project

These are used as libraries for base objects for the actual engineering projects. When new typicals are needed, they will be created to the base project so they can be used in any other project too. A base project must be used carefully, it is easy to cause errors in the synchronization. If customer standards insist changes, they are done into the copied base objects or templates in the actual engineering project so that the changes are only applied locally for that case.

3.1.2 Engineering project

Engineering projects are a very important part in the plant design. They contain nearly of all the engineering data required for the life cycle of a new plant starting from task proposal to the commissioning. One can find all the documents and details about each part used in the whole process from the database hierarchy or SQL queries made by users to process massive amounts of data in a short period of time or export them into separate files for reviewing or delivering to suppliers, manufacturers and to customers.

3.1.3 System project

In General, there is only one system project for the Comos environment to control its functions. Normal users have no access to it, only system administrator's work with them when needed. System project is locked from users by a program code.

3.1.4 Template project

Test environment for the actual projects or new features. These also contain templates for engineering projects used as a reference or the training of new employees. Template is a complete design to some process area, for example, they are using all the same elements as the actual design. The template is copied to an engineering project and data for elements are filled in. A wide variety of available templates helps completing projects more efficiently.

3.2 Structure

Comos is operated with the Citrix network and help of an Enterprise server that is working together with the SQL servers. Enterprise server is important for data transferring purposes, because the server makes it possible to operate between external applications and systems.

With Access database work can be done locally, but in order to work with Comos in a global environment these three steps of authentication are required:

- Client login to database server
    - ODBC data connection setup
    - System DSN / User DSN set for client
- File server login
    - Required rights to use file server
- User login to Citrix and Comos login
    - Access and administration become active

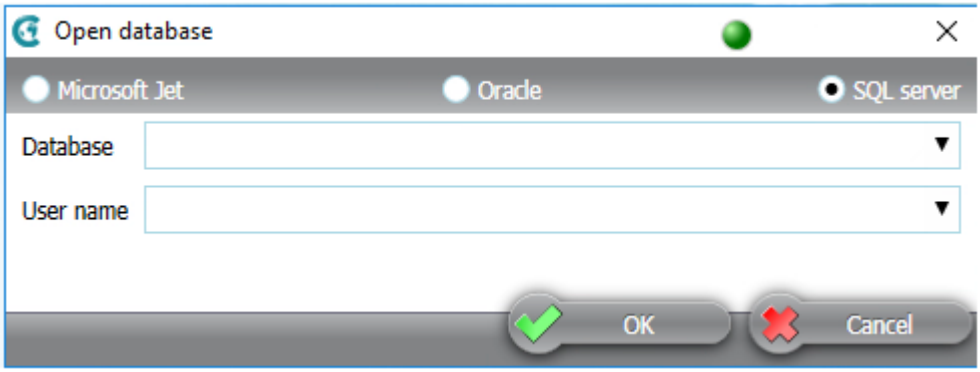

Figure 3 User login in Comos

Client login to database server and file server login are done automatically by the system. For the end-user, the only step needed is login to Citrix and then open the Comos **app** or the **desktop** version and connect to a SQL server. In some cases, like importing new CAD files to Comos, the work must be done from the desktop, app version cannot create copy of the files on your own computers hard drive.

Comos reads user DSN entries and after that the system DSN entries. If there is an entry in the user DSN it will be the one appearing to others in the database. On the other hand, some attributes may have predefined system entry values originated from base objects. These values can be recognized from the *-sign in front of the value and should be checked by the user that they are correct before applying any sorts of linking, most notably seen on queries and there looking at the used hook-ups. In projects, some instrument loops will get typical suggestions from the base project (0-project) and need to be corrected if the suggestion is incorrect for that application.

Hook-ups are installation drawings, that are used for purchasing installation materials and the instruments themselves. A hook-up includes picture of the equipment and a list of materials used in the picture. Scope of supply and scope of erection are also specified for the material list.

3.3 Comos objects

3.3.1 Creating objects

When new additions to a project are needed, first search for a base object to that certain object or loop in question. In the hierarchy when you want to add something new for example to under a loop the right-click options look like below (Figure 4). There are a lot of templates and base objects available that can also be modified. Items that are available change according to the “owner”, in this case the loop itself. Available items for loops, equipment or drawings are preset in the system. After an item from the menu has been selected, it will appear under the loop and it can be configured further. Naming and filling necessary attribute data should be done as soon as possible. The objects in Comos are managed with the help of unique identifiers (UID), which is a database key to identify an objects data set. This code is used when importing to or exporting data from Comos. UID is also used for the data link tool to work.

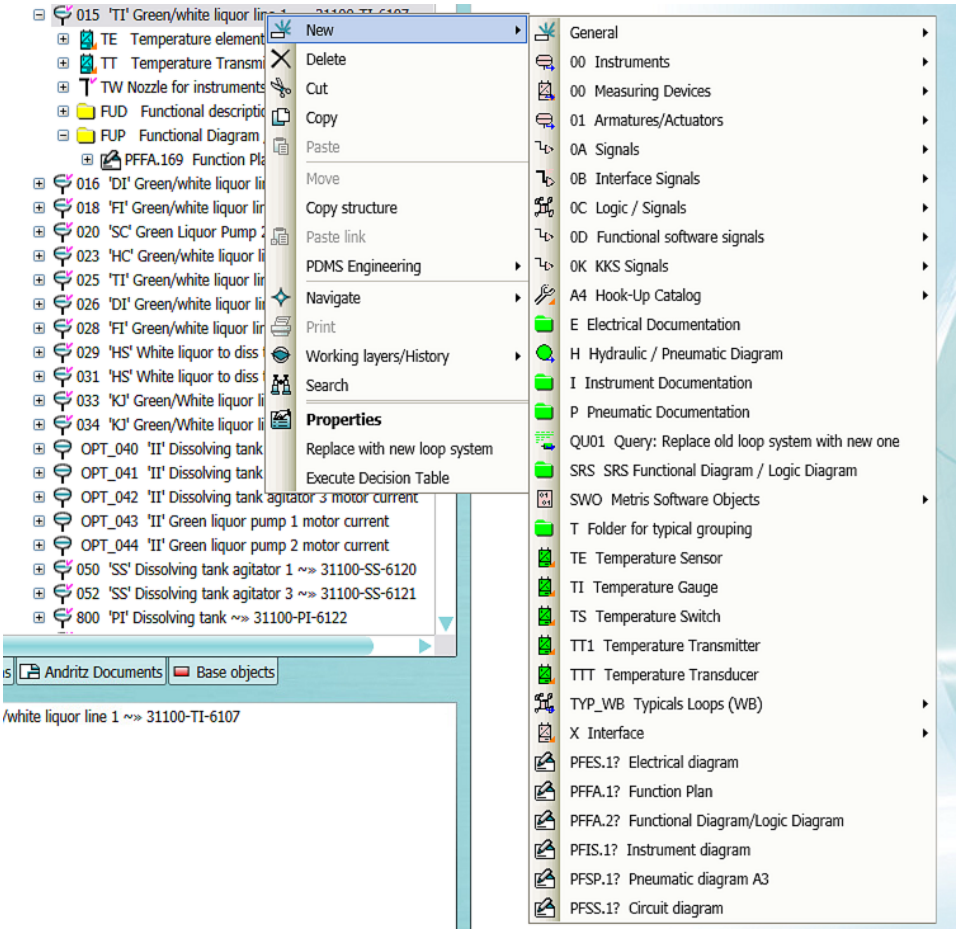

Figure 4 Adding new components to a loop

3.3.2 Template

A template is a pre-defined object, query or structure that serves as starting point for some part of the project. Templates have pre-defined settings and options selected to match what is generally used with the knowledge gathered from past projects.

There are two kind of templates, one group is global templates and then there is also another group local templates. Local templates are project specific and they can be freely modified according to customer standards. Global templates are located in the base project and template project (Chapter 3.1.1 & 3.1.4). Global templates can be used in all engineering projects that are linked to the base project. Normal users are not allowed to modify these templates without permission.

3.3.3 Attributes in Comos

Every object in Comos is defined with attributes, attributes have their own tab inside of each object in the configuring interface. This tab contains everything needed for design, purchasing, commissioning and data linking. The information in the attribute tab varies depending on what is the purpose of the object, inherently, the data shown comes from base object and can be further modified by user if needed.

Attribute tab is for example the following:

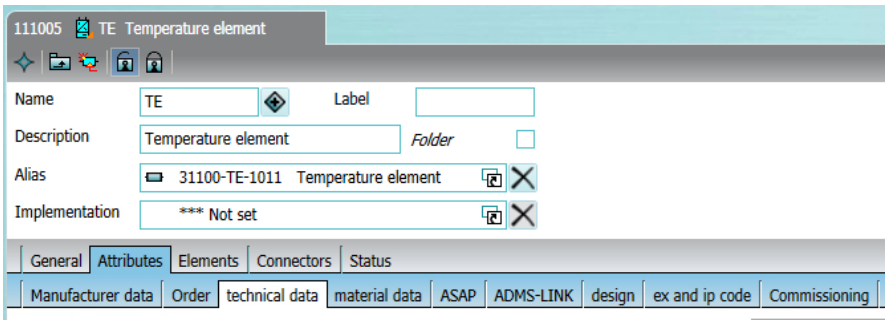

Figure 5 Attributes structure

- Description
- Process data
- Manufacturer data
- Technical information
- etc.

Each attribute under the sub-category has its own tags used in the data transfer between Comos and PDMS/E3D.

3.3.4 Queries

Handling and inserting data into thousands of objects would be very inefficient if done manually. In Comos it is possible to create SQL-queries to sort, filter and edit object data to every object under selected filtering/sorting at the same time. Queries can be exported into different formats, as Excel-, Access-, txt- and XML-files are supported. Some document types can also be exported into DWG/DXF, MS Word and pdf files. Users can effectively use excel functions for modifying data, with the limitation to remember inserting only raw values to the cells used for Comos in the end. Data transferring functions do not work with Excel syntax. Importing data from specified excel files is also possible directly back to a query. Data will update in real-time to all the places where the data is connected in Comos and further to PDMS/E3D once per day through XML-connector data transfer from the enterprise server.

3.4 Diagrams

A Comos database includes diagrams for most of the 2D-engineering in projects.

3.4.1 Interactive reports

Interactive reports are the generic documentation used for engineering and documenting the units. After an object in the database is linked or used somewhere, in this case, a PID drawing, an option to navigate between object and the drawing becomes possible.

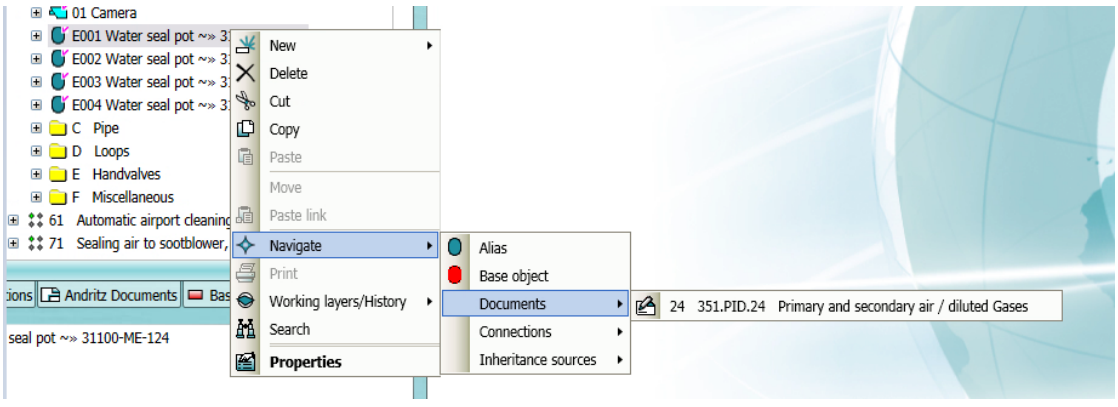

Figure 6 Comos Navigate tool

Interactive reports consist of graphical elements and symbols for engineering objects. Drawings such as these are considered interactive:

- PID diagrams

- Circuit diagrams
- Hook-ups
- Function plans (FUPs)

3.4.2 Evaluating reports

Evaluating reports are usually Excel, pdf or Word documents containing data sheets or bills of materials. The report data is generated from the data input in interactive items. Bills of materials are taken from the hook-up drawings used for each instrument. Hook-ups have important information about installation and materials, with queries it is possible to automatically calculate into a single list all the used materials and then compile them into a file for purchasing or document delivery.

4 About PDMS/E3D

Engineers have used 3D CAD software for decades. Former CADCentre (name changed to Aveva in 2001) PDMS had its first initial release in 1974 and got its latest release in June 2015. The PDMS abbreviation comes from Plant Design Management System. PDMS interface has upgraded a lot since the early stages but it is still old fashioned compared to the new systems. Aveva first announced “the future of plant design” Everything3D in late 2012. The first public version was released in January 2013. After that PDMS and E3D environments have been in use for plant design side by side. (Stavanja, 2013)

4.1 Structure

In the same way as Comos, Aveva PDMS and Everything3D are also very efficient process plant design systems focused primarily in the CAD-documentation. Aveva software consists of multiple modules and their databases for different tasks. All operations are made from the interface by selecting a choice or items from the menu. Currently Aveva is going through modernization of the system from the PDMS to Everything3D, which has updated user interface and is supposed to give big efficiency upgrades compared to the old version. These solutions use the same primary databases so old projects are still compatible with the new system. Old user templates were brought along with the integration of new system. Users can even work with the same project with different versions.

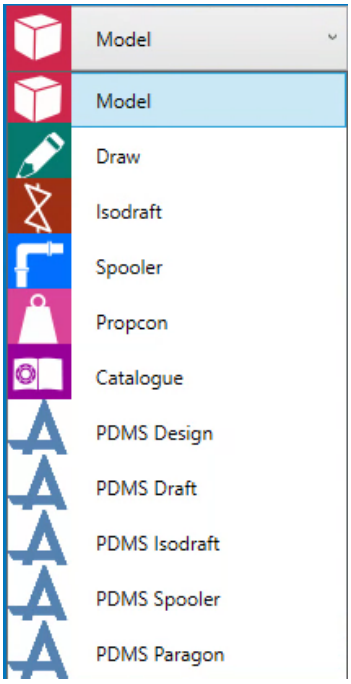

Figure 7 Aveva modules

- Design/Model – Main 3D design module, uses design database.
- Spooler – Used to set the pipework design into sections, data helps creating isometric drawings.
- Isodraft – Used to produce automatically annotated and dimensioned piping isometric drawings which also include material lists for that pipe section.
- Draft/Draw – Creating annotated and dimensioned drawings from the design model. Information is taken from the drawing database and dimensioning from the model database. Drawings made with the draw module can be referred as drafts.
- Paragon – Used to modify and create catalogues.
- Propcon – Administrator module for managing properties database.
- Catalogue – Libraries used to insert components without having to create new models for every object after the catalogue is created. Each component is given specifications, which can also be modified later.

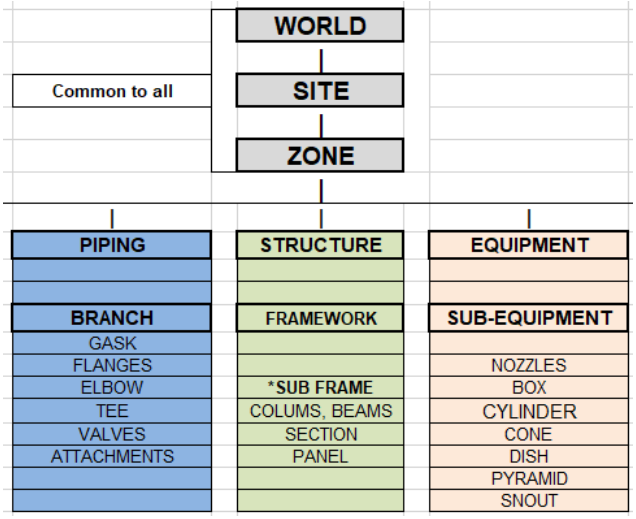

Figure 8 PDMS/E3D hierarchy levels (Model database)

PDMS/E3D hierarchy is divided into three main levels. The highest hierarchy level is called “World” and is created first for a new project, everything else will be found below this level. Very important level is “Site”. Each Site presents certain process areas or geographical locations. The lowest levels of the hierarchy under “Zone” contain objects that can be found in the design model. The sub-disciplines below zone depend on the purpose of the location. They can be specified for piping, structures and equipment. The basic principle of the hierarchy is that every element is owned by another element. Above (figure 8),

the hierarchy of a model database as an example is shown. Elements on the bottom of the hierarchy are owned by the elements above until the World level.

The overall purpose of different databases is to create a complete 3D model of a plant. 2D schematics and engineering diagrams are used to support the 3D model. All databases have a hierarchical structure. All information in project, administrative and technical data are stored in them. Information is managed with the main modules by creating, editing and extracting information from the databases.

4.1.1 Projects in general

Engineering a project is a complete collection of information, which relates to a single design. Aveva projects are started similarly as Comos projects. They are given a unique name and then allocated by administrator when the project is initially started.

4.1.2 Database types

PDMS/E3D has many separate databases, with each containing specific parts of information required for design and system upkeep. As shown in figure 8, Model database has very centric role. It consists of all available things shown in the design model.

There are also many other types of storage locations:

- Design
- Draw
- PADD
- ISOD
- 2D design databases
    - Schematic
    - Engineering
- Reference
- Catalogue
- Dictionary
- Properties
- Project common
- Administration
- System
- COMMS
- MISC
- Transaction

4.2 User requirements

To ensure quality of the finished product, project personnel must have received proper introduction and training to the system. General PDMS/E3D training is not main responsibility for the company, subcontractors must take care of that themselves. However, the company will provide assistance in using the design tools and the working methods. PDMS/E3D material need to be looked separately for each project, in order to take into account the customer standards and change accordingly.

All PDMS/E3D users must have expertise in the following areas, admins have additional requirements.

Admins:

- Installation of PDMS environment (workstation and server)
- Installing license server and maintenance
- Creating project Backup
- Basics of VPN
- Understanding of cyber security and protecting valuable information
- Creation, startup and securing functionality of global daemons
- Creating Users and Master databases
- User account management
- Understanding database writing rights
- License management (recognition and needs)
- Ordering new license

Users:

- Proper use of tools needed in projects
- Understanding, what is a global project
- Following the predefined rules for projects (naming standards, hierarchies and document settings)
- Correct ways of design
- Making PDMS reports
- Import/export functions

4.3 Attributes in PDMS/E3D

Attributes are different from the Comos attributes because of the model design elements are shown in 3-dimensions that require additional variables for the data transfer to work. Attributes are parameters that can be changed. Each element has the basic attribute set, that need to be filled including:

- Name: Name shown in the hierarchy, **case sensitive**! If not given manually, it will be automatically generated
- Type: Defines which additional attributes will be available to that object, for example EQUI for equipment
- Owner: Shows, in what hierarchy level the element exists, name of the owning element is presented
- Position: Coordinates, where the origin of the object is in the XYZ-plane, point of origin is different for each primitive. Primitives are the basic shapes used for equipment models

Attributes are not tied to hierarchy levels. Most of the attributes are used on multiple levels and on many elements. There are also specific attributes that are not needed on many element types. For example, piping specifications or technical data are only needed on piping elements and position in the model is a common attribute for all objects. Attributes can be viewed in the attribute window for each element separately.

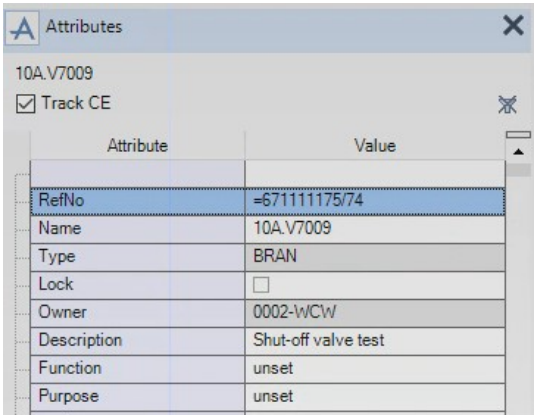

Figure 9 E3D attribute window

Users are also able to create extra attributes called UDAs (User Defined Attributes). In PDMS/E3D UDAs are separated from normal static attributes by placing colon-sign at the beginning of attribute name. UDAs are fully customizable via the used special programming language in PDMS/E3D, programmable macro language (PML). Something like colour could be created as user attribute.

4.4 Tools

The PDMS/E3D system has different tool kits for each main category of design. The toolbar changes according to the chosen set to match the needs of designers for particular tasks.

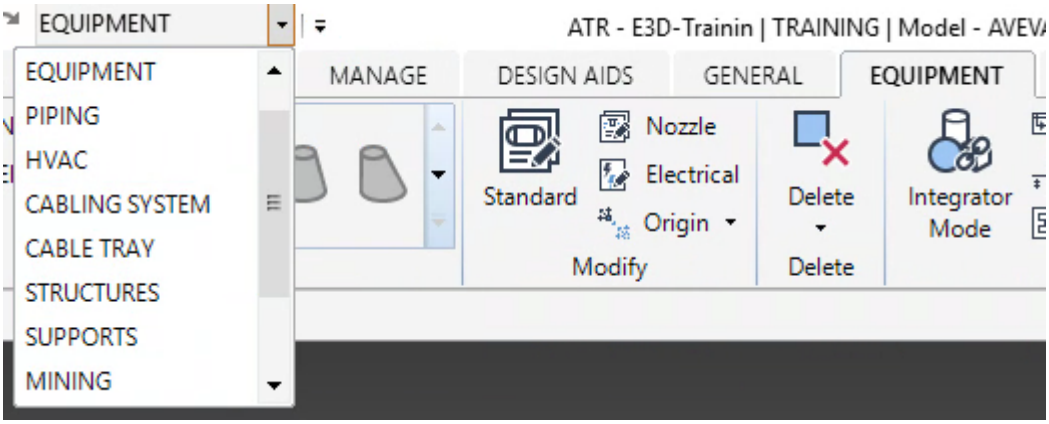

Figure 10 E3D toolkits

There are also tailored objects for Andritz use, just like in Comos, which are used in the model design to avoid extra work caused by recreating objects. Data libraries have been created for common use, fiber line, power boilers, recovery boilers, white liquor plants and wood handling units. These contain templates for the standard parts used in projects, usually only size of the parts change in the model to match the wanted production volumes to precisely represent the actual plant in question.

4.4.1 Glamox OptiWin lighting design

Glamox is a Norwegian company who developed a light calculation program, first for DOS system the program was called “Optima” and later in 1991 for Windows it got renamed as “OptiWin”. In further development the company introduced PDMS plug-ins. The program is more commonly used for calculating lighting for big ships and oil rigs, but there is interest and benefits in using it for plant design as well.

Problem with the software comes with challenges while exporting 3D modeling file from PDMS to Glamox. 3D-model cannot be too large in size and cannot contain too many details, which means the engineers would have to create new files. Also, if there are new changes to the layout in the model, the export must be recreated, which again require lots of effort.

Solution to the problem described above is the Glamox Plug-in, which generates simplified 3D files to be exported into OptiWin. There are two versions of the plug-in, first one is the LITE version that helps you generate the document for exporting and then do the lighting calculation in Glamox. Another option is the PRO plug-in which allows the calculations to be done in PDMS/E3D interface itself.

4.5 Drafting

Drawings or drafts in PDMS/E3D are done with a separate module called DRAW, specifically for generating drawings directly from the data in 3D model. Usually drawings are created from template, in that case some steps of drawing creation are not needed. For example, configuring new sheet or creating a view is not needed. Template appearances are controlled and defined by administrator users. If a drawing produced with the module is updated with new dimensions, they will be automatically updated to the draft also. Data for creating drawings come from drawing database and dimensioning information is taken directly from the model in model database.

Isometric drawings for piping are done with ISODRAFT module. Drawings include material list for that piping section. Style and content of the drawings are to be specified according to company standards and requirements.

5 COMOS <–> PDMS/E3D data transfer

The link between Comos and PDMS/E3D works both ways. Data scope is defined and maintained in specification, which are located in the global settings file for the data export. Whole projects from Comos are transferred to PDMS/E3D as a big XML-file with XML-connectors. Then the information is separated to databases with Avevas own data handling tools. Tool performs data transfer each night between Comos and PDMS/E3D engineering databases for imports and exports via scripts automatically.

Transfer process is started with a scheduled task by windows scheduler. Tasks are preconfigured scripts in Comos. Generally, they are operations related to exporting or importing data and files. A task runs a query for objects and data associated with them, then another task is performed to make an XML export. Export will be taken into Aveva Engineering Databases.

5.1 Data storing

5.1.1 Data storage structure for Comos

The data is managed in the network. Comos users are clients and everyone accesses a common server/database. In Comos, everything that is referred as an object originate to the actual database. The server, where they locate to, is known as the database server. Things that are considered as documents or files in Comos are stored as physical files into document folders. These folders are located in the database server or separately on their own corresponding servers, file server or document server.

5.1.2 Data storage structure for PDMS/E3D

Information is stored on many different databases related to the modules; stored data can then be sent forward through output channels. Outputs are done with macro commands. Every database has hierarchical structure that is slightly different for each other, because of the content they hold. Elements are owned by other elements, excluding World-level element. What each hierarchy element can own is defined in database schema, which could be described as data from other data, also known as metadata.

5.2 Import/export

The Comos enterprise server is used for importing and exporting data from external sources. Attributes exported to PDMS/E3D are specifications for each instrument and other objects like pipes or equipment.

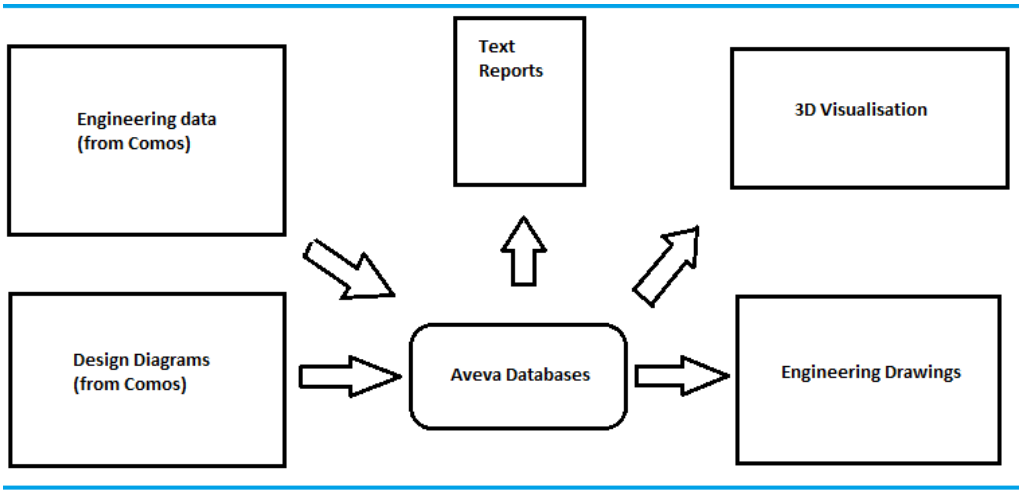

Figure 11 Data flow chart from Comos to PDMS/E3D

Currently the PDMS/E3D to COMOS import query brings back the actual position of the element in the 3D model. In figure 12, shows what attributes can be imported automatically. If an image file exists from PDMS object, it will also be imported back to Comos. The image can be found from the same attributes tab as the in-plant positioning data.

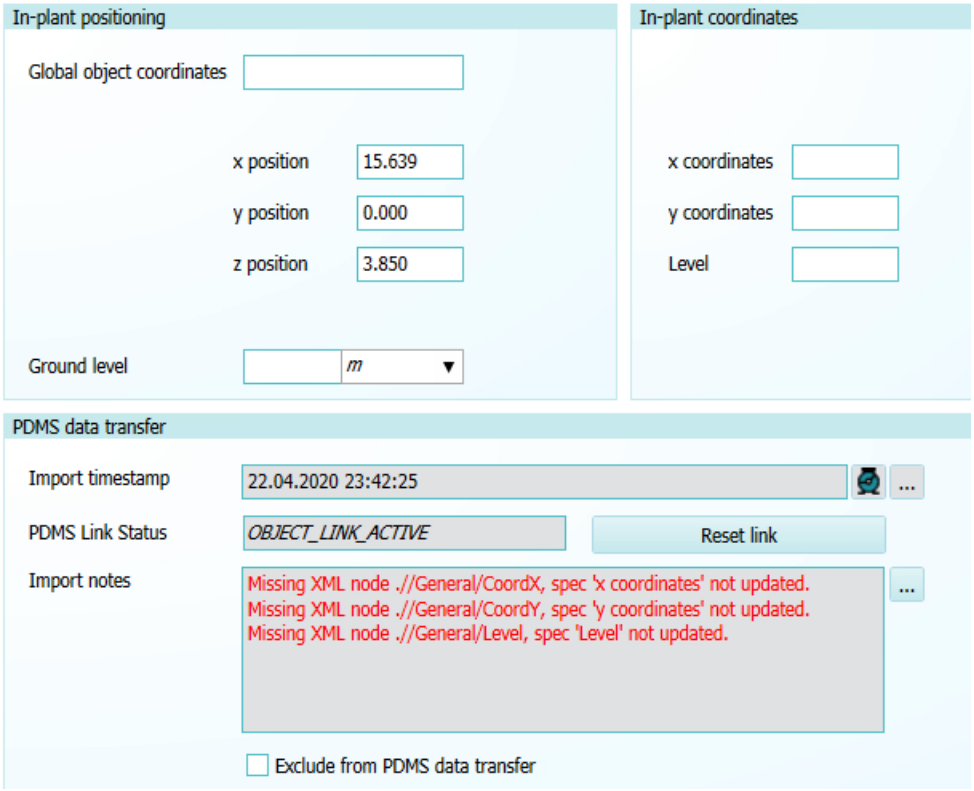

Figure 12 Data transfer from PDMS/E3D to Comos

The third program, Autodesk Navisworks, is a 3D model viewer, which works together with PDMS/E3D engineering database and design database. A user can search and view any part of the plant by tags used in Comos. A Navis-model is generated from information available in Aveva databases. This means that in the end if anything is updated to Comos, those values will be updated in transfer cycle to the Navis model too.

Two different versions of Navis is generated for Andritz. A commercial version (Figure 13) and an another version for internal use (Figure 14), the internal version has more engineering related attributes generated from PDMS/E3D data originated from Comos.

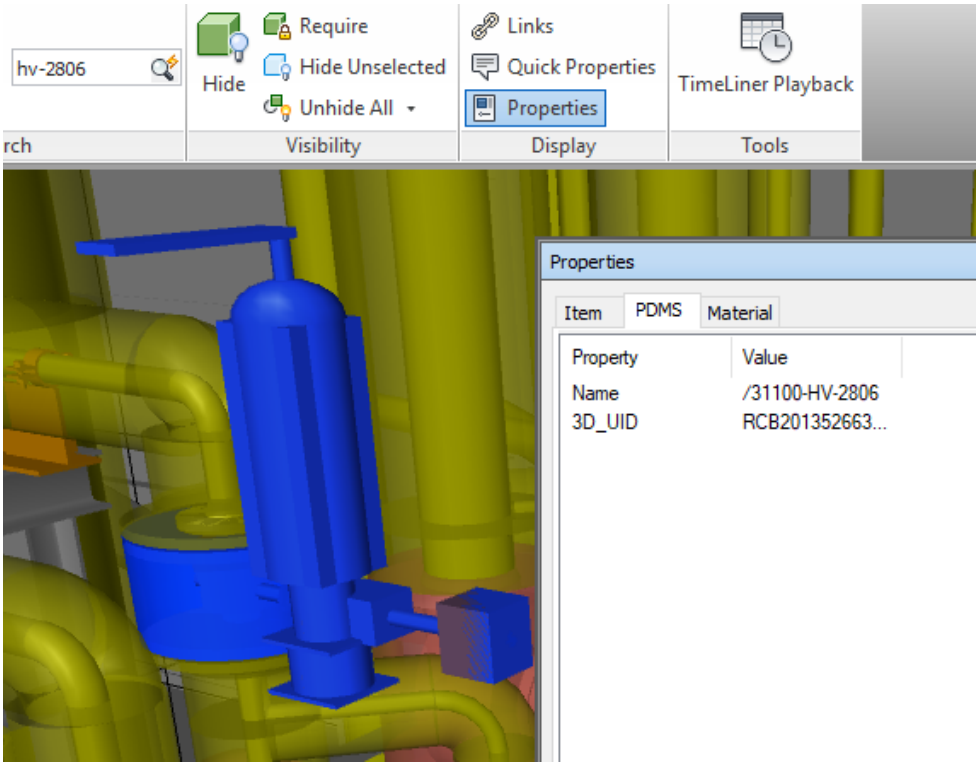

Figure 13 PDMS/E3D to Navis commercial data transfer

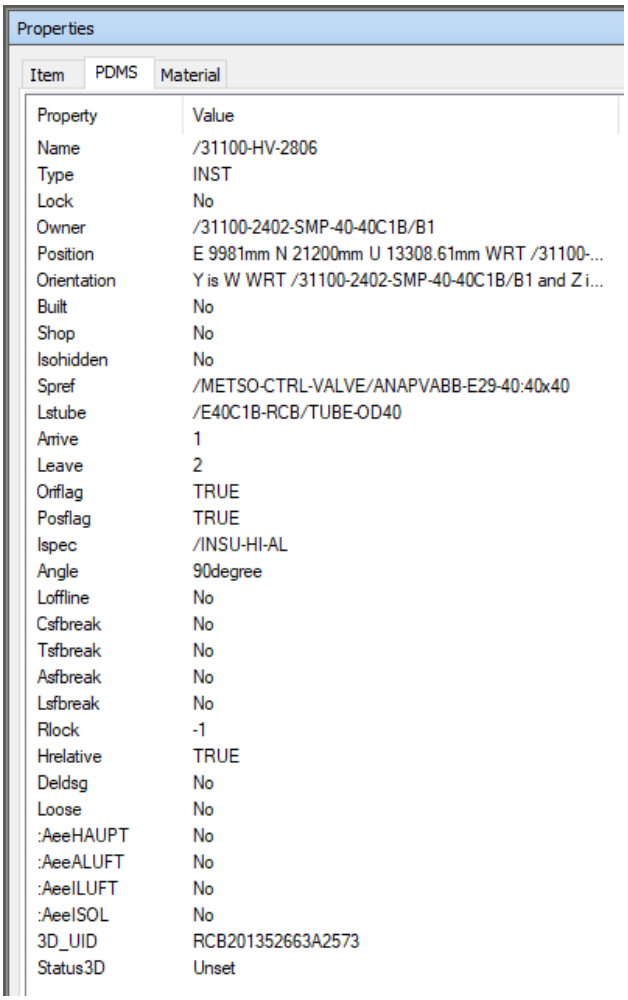

Figure 14 PDMS/E3D to Navis internal data transfer

5.3 Comos linking tools

To see what has been linked, queries in Comos are showing the status of the linked objects and their attributes. These queries can be found or created to the Internal folder in the project hierarchy → AEI Lists → Right-mouse → New and then select the list wanted to be created.

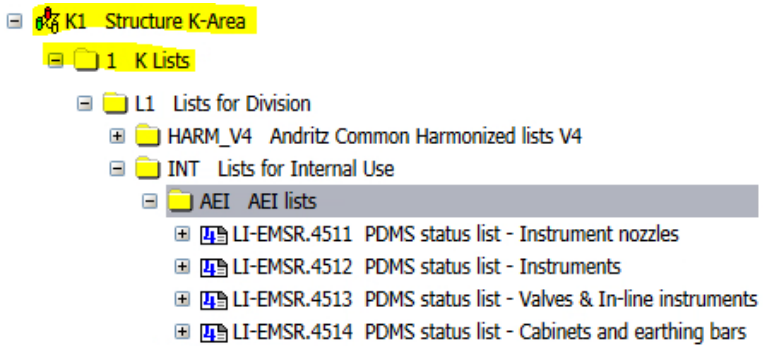

Figure 15 Comos link status queries

These queries show general data regarding the objects, such as:

- Loop information
- Device information
- PDMS/E3D position imported back to Comos
- Link status
- Scope of supply
- Connected to – info
- ADMS integration info (Doclinks)

6 Instructions for data transfer link

These instructions are meant to clarify how to enable data transfer for objects between Comos and Aveva PDMS/E3D.

The data linking tool itself actually works between the Aveva Engineering database and Design database, not between Comos and Aveva. Tool searches for data in the engineering database brought there by xml-connector and then a user can create the link between engineering and design database objects.

Topics:

- Creating object in PDMS/E3D
- Linking existing object
- Searching for imported data
- Updating linked values

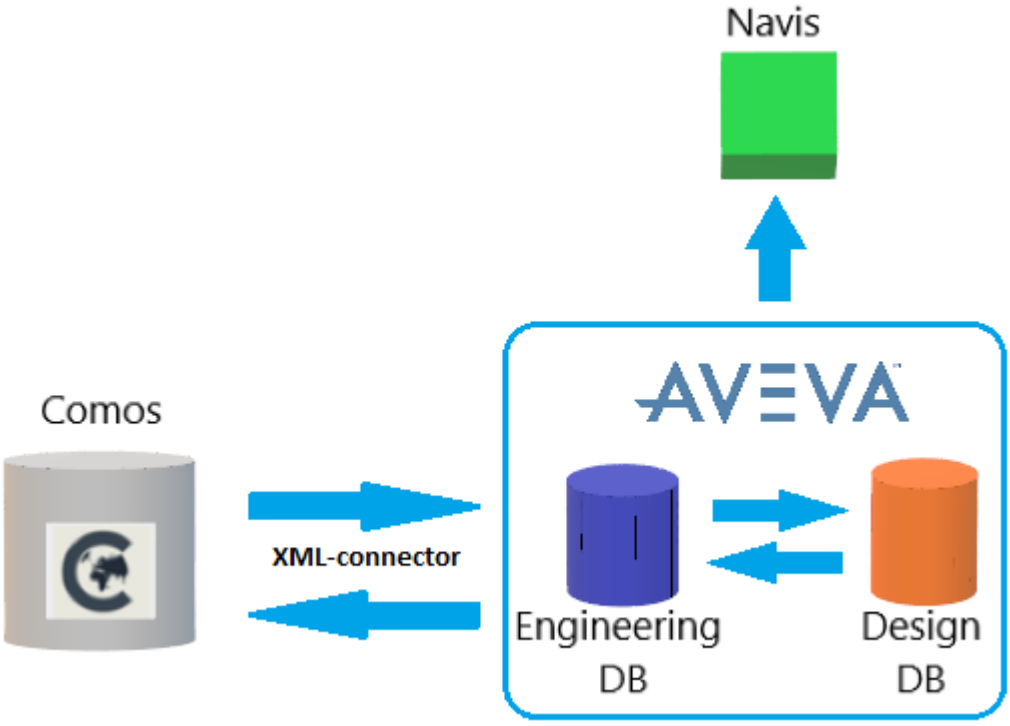

Figure 16 Basic concept of the data transfer

6.1 Searching for imported data

When you open a project in E3D from Aveva launcher, on the top-right corner of the toolbar there is (A) Tools menu. Linking, creating and updating attributes for objects is done with “Compare/update”.

Figure 17 Where to find data linking tool in E3D

Clicking the “Compare/update” button opens a new window to proceed further. By default, the window is locked on the side. The window can be dragged and increased or decreased in size as any other window.

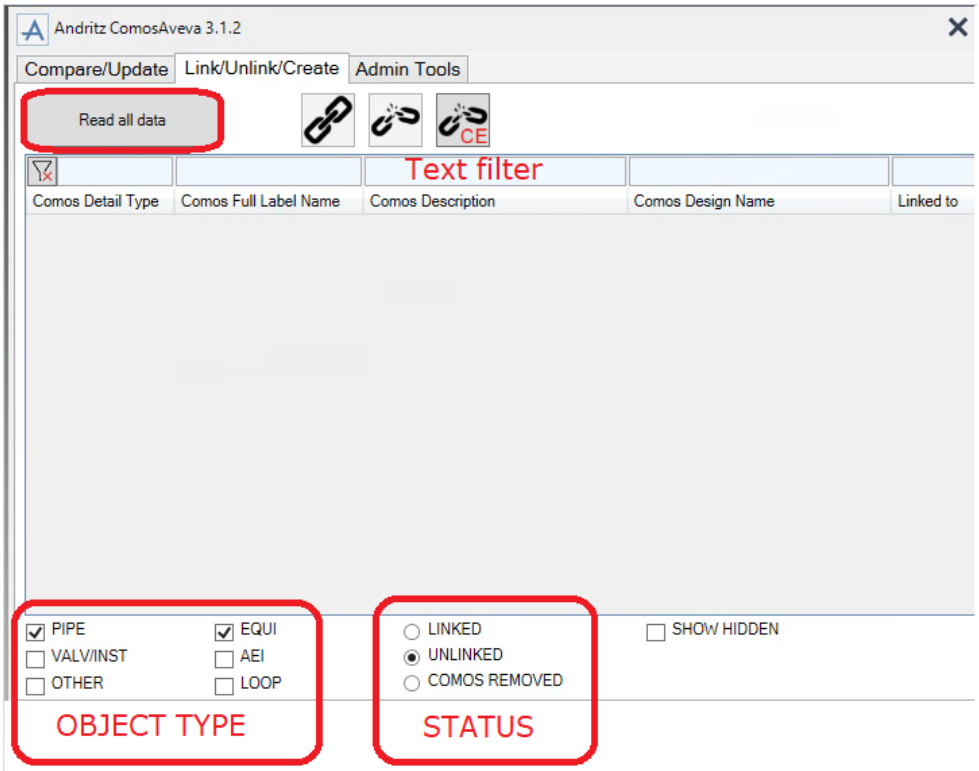

Figure 18 Data linking tool

Open the “Link/Unlink/Create” page in the data transfer tool. By clicking the “Read all data”-button it reads all imported data from the Aveva Engineering database where it is stored and then shown as a list below. This list should be filtered with type selection and text filters for easier use. Columns are searched by the name of the object in Comos. Device description or position number (Comos design name) are good filters.

6.2 Linking existing object

When an object has already been created to E3D or PDMS, linking is done by selecting the correct element from model explorer and then selecting “Link Selection to CE” in the tool. Make sure to check that the component type matches the Comos detail type, which in this case is instrument to avoid making incorrect links. It is possible to link an instrument to the wrong type as it is not yet monitored.

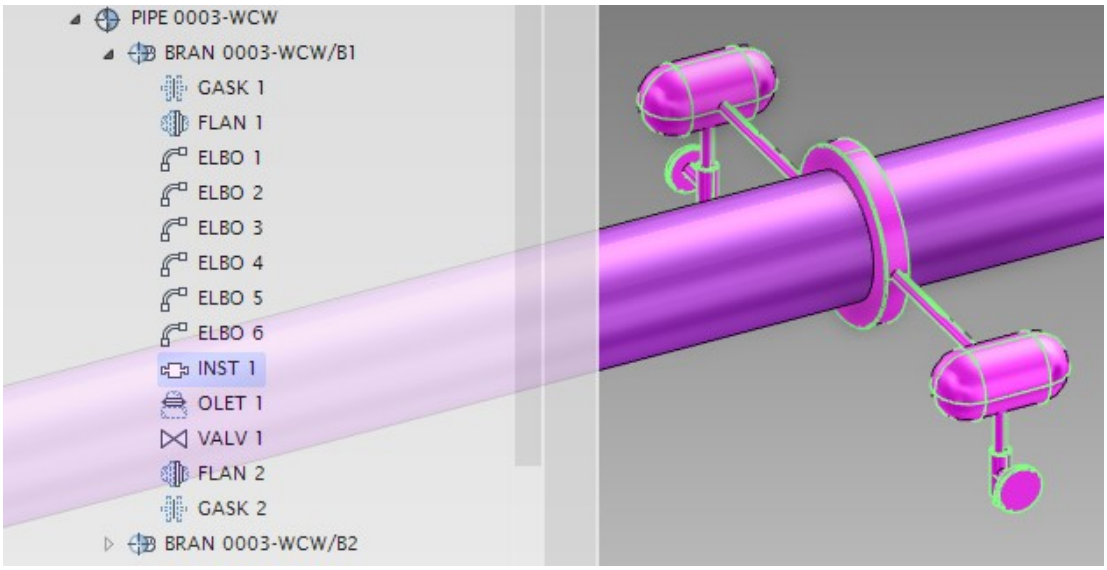

Figure 19 Selected Element

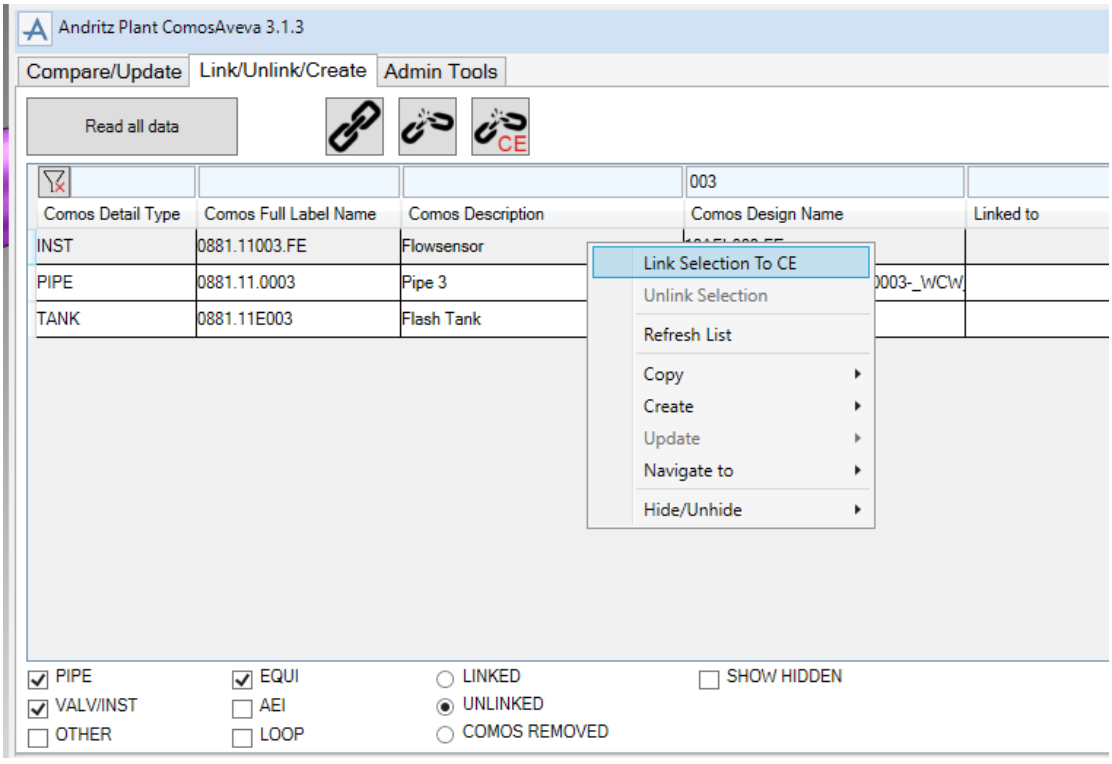

Figure 20 Link to current Element

With use of the Link Status – tool, name and attributes of separate instrument under Zone can be updated to match the Engineering database. The green colour indicates successful linking.

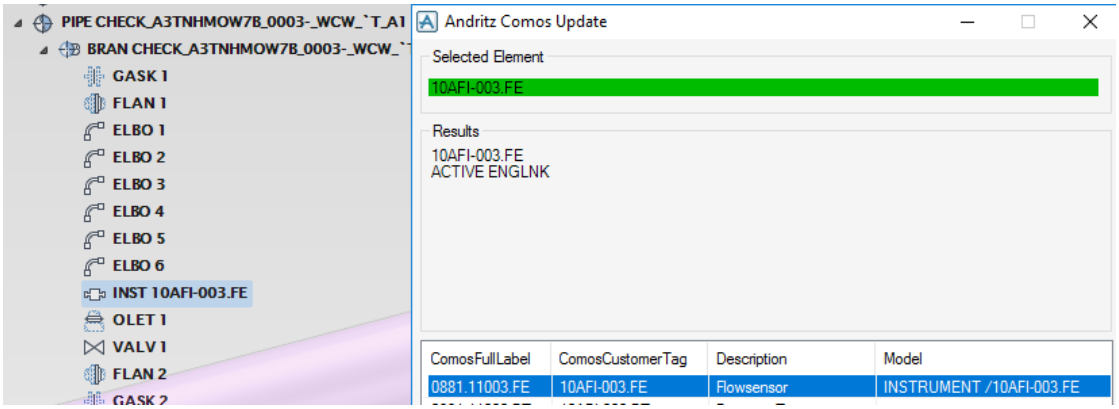

Figure 21 E3D succesfully linked instrument

6.2.1 Equipment and piping update

Equipment and piping data (Level 1 objects) can be updated directly from the link tool after they have been linked. Select the Site or Zone to compare values in Design and Engineering databases. Multiple rows can be updated at the same time by selecting them all with the CTRL+A command or CTRL+Shift-left mouse clicking them and then doing the “Import selection”.

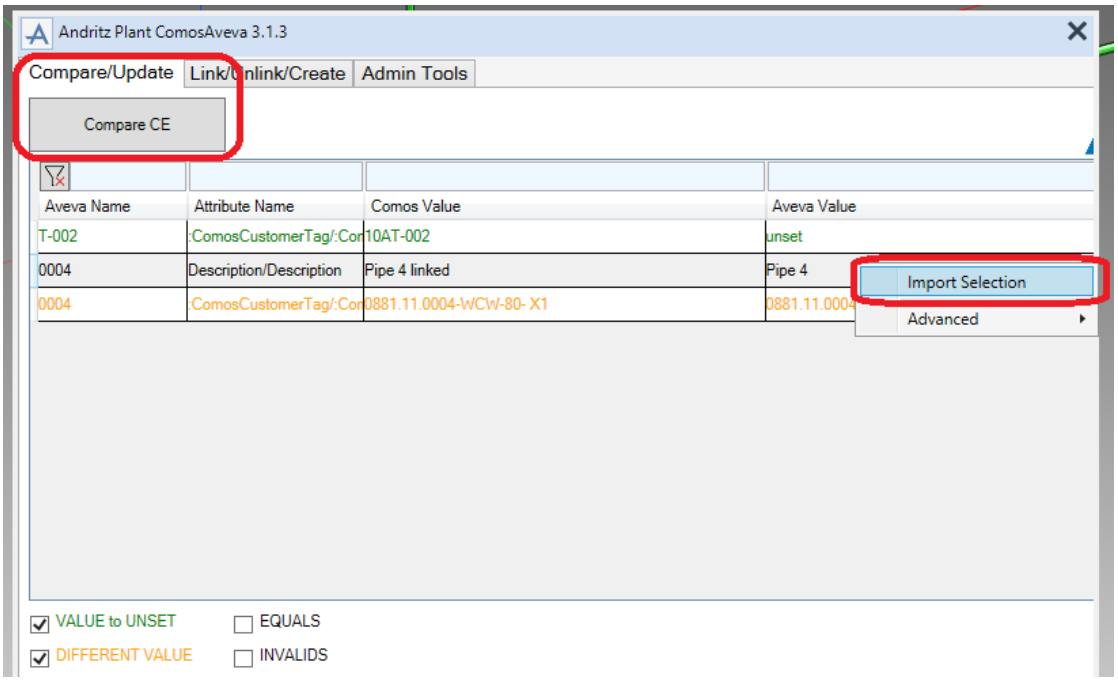

Figure 22 Import selected function

6.3 Creating and linking new object

Creating a new object is done in the same menu as linking existing elements. First make sure to navigate to correct the Zone/Element in the model hierarchy.

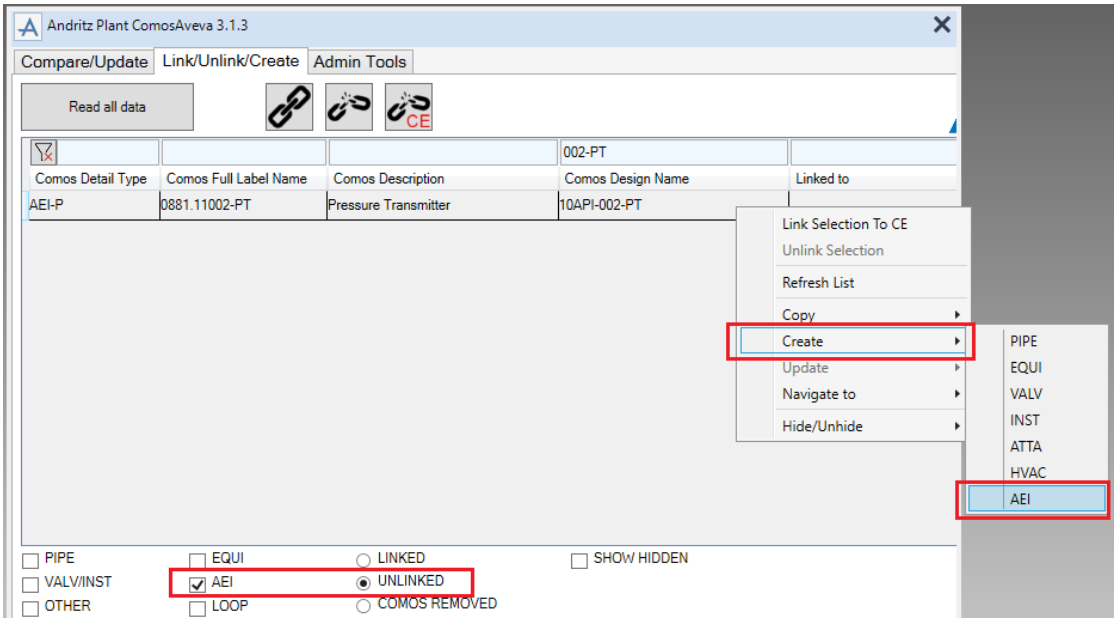

Figure 23 Creating new instrument

The object will now be created under the selected element and automatically linked to the object in engineering database. In the link tool by right mouse clicking the row in the Comos list it has an option to create an object with the type. (When object is already created you cannot create duplicates)

When a new object is created, the E3D/PDMS must be restarted to activate the link. A user can create multiple new objects in one session before restarting E3D/PDMS to make links active.

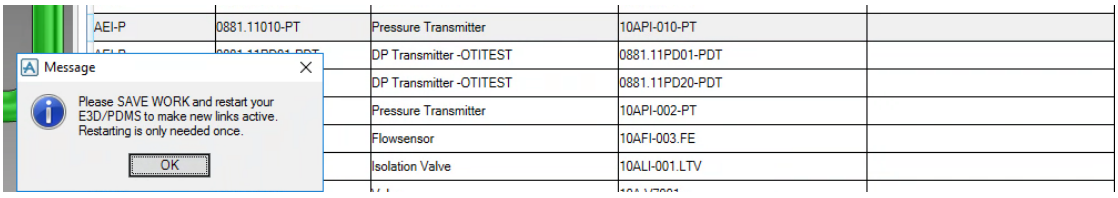

Figure 24 Remember to SAVE WORK

6.4 Updating object naming

After link has been created with the linking tool, the name in the model explorer does not automatically update accordingly for sub-discipline elements (Level 2 objects). Open the “Link Status”-tool from the (A) Tools menu.

By selecting the pipeline, you will see linked components available for updating. By selecting the correct part and clicking the “update”, the previously called valve “VALV 1” takes the name from the database and updates it to “VALV 10A.V7007”.

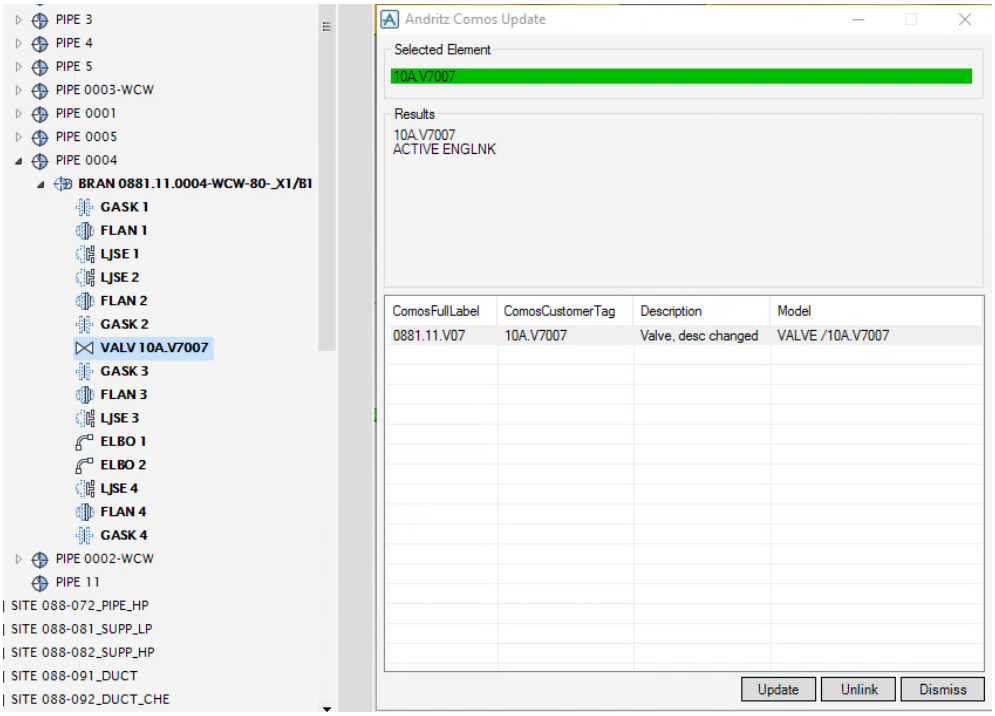

Figure 25 Link status/update value

To check that the component is linked into the right object, one can open the PID drawing to see if the naming matches.

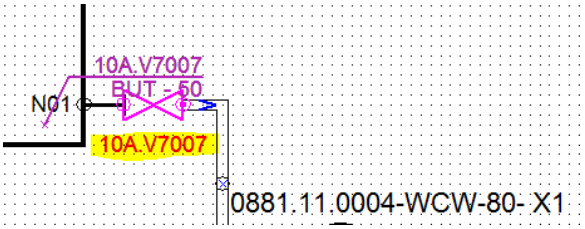

Figure 26 Same valve in Comos PID

6.5 Nozzles

Nozzles are important elements; they are the process connection between a pipeline and measuring instrument or the connection between equipment such as a tank/pump and pipeline. Nozzles are created as OLET elements in PDMS/E3D. In Comos nozzles are named with xW, W stands for well and x for the represented measurement type (L, P, T). NOZZLEx or Nxx is used for general nozzles connecting equipment, where x/xx is number indicator. Implementing nozzles will most likely be subject to change in the future.

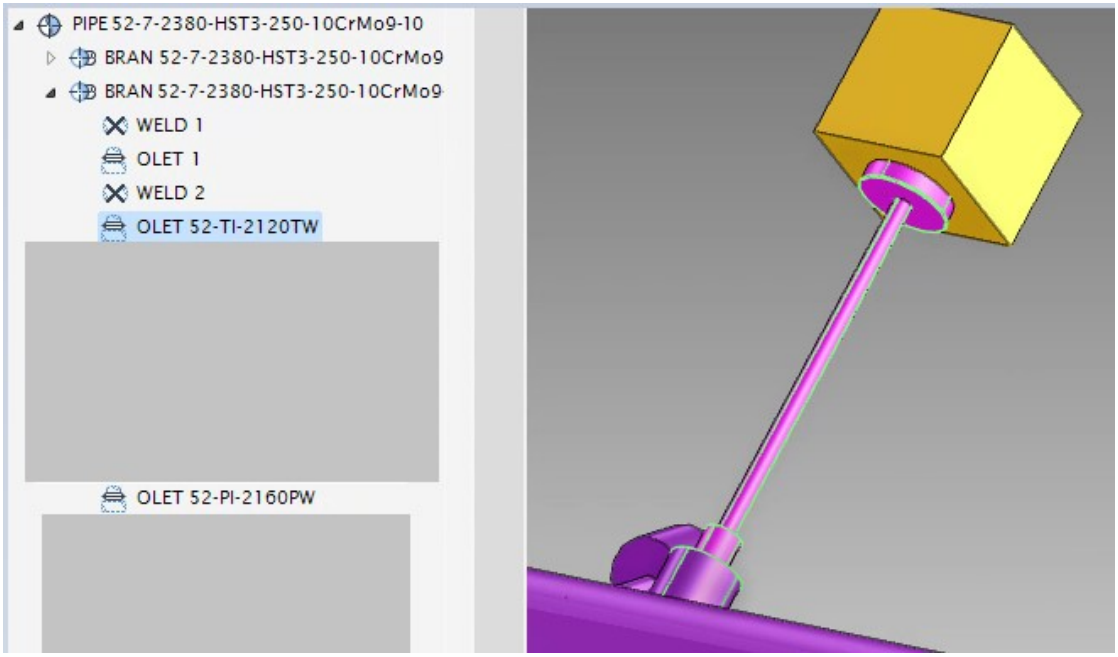

Figure 27 Instrument nozzle OLET 52-TI-2120TW and placeholder box for sensor

Nozzles do not have unique tags in Comos, they are given a name automatically by the hierarchy as shown (Figure 27). In E3D hierarchy they are usually owned by pipeline or pipe branch.

If a nozzle is modeled in the 3D model and it is linked to Comos, an automatic positioning tool will locate a 100mm x 100mm sized box element representing the actual measurement device to the pipeline of connecting nozzle (final placement is still done manually) when an **AEI-type** element is created with the linking tool. When nozzle is not found or link not established, the box will by default be created in to the origo of the model (0, 0, 0).

7 Results and conclusions

7.1 Conclusions

During the writing of this thesis, a study was conducted to learn and document the basic idea of the Comos environment and what is happening in the background. The same was done for Aveva PDMS/E3D software to give some level of understanding to users, who have none or little prior experience with the system.

The main goal was to keep documentation from the data transfer point of view, as it has not been documented very clearly. This thesis includes step by step instructions on how to create a data transfer link between a Comos object and the object in the PDMS/E3D plant design model. General information about the two discussed above was also written to make this more explanatory for the audience.

7.2 Future development suggestions

A data transfer tool is implemented and in use for most of the projects. Currently the transferred data is fairly limited, due to the fact that the tool has been in use for less than a few years. There is a lot of room for expanding the feature in upcoming years. Coherent naming and application for both sides would create solid baseline for engineering objects to begin with. Some objects like instrument nozzles have no naming set in Comos and yet they are brought to PDMS/E3D as important parts.

On demand, new attributes can be added to the Comos XML-export fairly effortlessly and then put into use from the Engineering database in the PDMS/E3D environment. These attributes would be for example helpful parameters needed by model designers. Current attributes within the data transfer scope are shown in Appendices 1-5.

The overall efficiency of the tool could be improved. Currently, creating new columns for text filtering is not possible, it would make more specific filtering for certain object types available. Updating data from a database with the tool can be automated further, for example in a situation where piping, nozzles and their instrument linkings have been completed for one pipe branch and all the linked values could be updated with one button. Currently only equipment and piping

(Level 1 objects) can be updated directly with the Compare/Update tool. Other elements (Level 2 objects) have to be updated with the Link status tool separately.

To further reduce the chance of false linkings, the tool could be restricted to only linking objects, that share the same type and then giving a warning pop-up if this rule is violated.

A new catalogue for model templates was brought up in discussion due to the fact, that right now instruments and other design objects in Comos have different structures than what PDMS/E3D shows, this makes linking them together a rather difficult case. Being able to add a complete package from a template to a model at designated coordinates on the pipeline and create necessary objects automatically would make the design much more efficient. Instead of bringing each instrument and their attachments one by one, a complete pressure measurement selected from the catalogue would be created instantly.

For the simplicity of both hierarchies, it has been taken into consideration that Comos and PDMS/E3D hierarchies would be standardized to match each other. This would mean that the current way of arranging sites and zones in Aveva would be pushed aside and changed to the Comos hierarchy model. Arranging all equipment, instruments, structures and piping by process areas under the sites and zones. If the two hierarchies could be harmonized, PDMS/E3D site and zone levels included, elements could be created directly to the correct place without users having to manually navigate to the wanted hierarchy levels. This change would benefit designers and also make developing automated functions easier.

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Appendices

Appendix 1 Comos to PDMS/E3D attributes (Level 1 objects)

Attribute Name	Level 1 object types					
in PDMS/E3D	**Pipe**	**Pump**	**Fan**	**Tank**	**Conveyor**	**GenEQ**
@ObjectLevel	**1**	**1**	**1**	**1**	**1**	**1**
@ObjectType	**PIPE**	**EQUI**	**EQUI**	**EQUI**	**EQUI**	**EQUI**
@Name						
@ExcludeFrom3D						
ComosUID	x	x	x	x	x	x
Description	x	x	x	x	x	x
ComosBaseOb	x	x	x	x	x	x
ComosFullLabel	x	x	x	x	x	x
ComosCustomerTag	x	x	x	x	x	x
ProcessArea	x	x	x	x	x	x
UploadDate	x	x	x	x	x	x
Date	x	x	x	x	x	x
FlowSheetNumber	x	x	x	x	x	x
ComosDescription	x	x	x	x	x	x
Owner						
ComosActive	x	x	x	x	x	x
OrderIndex	x	x	x	x	x	x
DesignName	x	x	x	x	x	x
SystemCode	x	x	x	x	x	x
FunctionalGroup	x	x	x	x	x	x
TagStatus1	x	x	x	x	x	x
TagStatus2	x	x	x	x	x	x
TagStatus3	x	x	x	x	x	x
DetailType	x	x	x	x	x	x
Manufacturer		x	x	x	x	x
ManufacturerType		x	x	x	x	x
Supplier		x	x	x	x	x
Medium	x	x	x	x	x	x
ScopeOfSupply	x	x	x	x	x	x
PipeSpecification	x					
PEDClass	x					
PEDMod	x					
DesignStd	x					
Media						
DN	x					
OperatingPressure	x					
PS	x					
CalcPressure	x					
OperatingTemperature	x					
TS	x					
CalcTemperature	x					
FromDescription	x					
FromComosUID	x					
FromType	x					
ToDescription	x					
ToComosUID	x					
ToType	x					
GroupNumber	x					

Appendix 2 Comos to PDMS/E3D attributes (Level 1 objects)

Attribute Name	Level 1 object types					
in PDMS/E3D	**Pipe**	**Pump**	**Fan**	**Tank**	**Conveyor**	**GenEQ**
@ObjectLevel	**1**	**1**	**1**	**1**	**1**	**1**
@ObjectType	**PIPE**	**EQUI**	**EQUI**	**EQUI**	**EQUI**	**EQUI**
TracingSpecification	x					
InsulationSpecification	x					
IsometricDrawingNumber	x					
MechanicalErection	x					
Team	x					
InspectionRtUt	x					
InspectionMtPt	x					
InspectionVt	x					
WaterRunGroup	x					
HydroTestPressureGroup	x					
MediumCode	x	x	x	x	x	x
MediumCodeCustomer	x	x	x	x	x	x
ExternalDiameter	x					
WallThickness	x					
Material	x					
Width						x
Depth						x
Height						x
EmptyWeight		x	x	x	x	x
MaxWeight		x	x	x	x	x
OperatingWeight		x	x	x	x	x
SeismicClass	x					
VacuumPressure	x			x		
InsuTargetTemp	x					
TestPressure	x					
PumpType		x				
PumpCapacity		x				
PumpHead		x				
FanCapacity			x			
FanPressureDifference			x			
GrossVolume				x		
ConveyorType					x	
ValveDN						
ValveType						
ProcessConnection						
JunctionBoxUIDs						
JunctionBoxTags						
ControlSystem						

Appendix 3 Comos to PDMS/E3D attributes (Level 2 objects)

Attribute Name	Level 2 object types						
in PDMS	Valve	inline instr	AEI	Loop	I nozzle	P nozzle	Motor
@ObjectLevel	2	2	2	2	2	2	2
@ObjectType	VALV	INST	AEI	LOOP	NOZZLE	NOZZLE	MOTOR
ComosUID	x	x	x	x	x	x	x
Description	x	x	x	x	x	x	x
ComosBaseOb	x	x	x	x	x	x	x
ComosFullLabel	x	x	x	x	x	x	x
ComosCustomerTag	x	x	x	x	x	x	x
ProcessArea	x	x	x	x	x	x	x
UploadDate	x	x	x	x	x	x	x
Date	x	x	x	x	x	x	x
FlowSheetNumber	x	x	x	x	x	x	x
ComosDescription	x	x	x	x	x	x	x
Owner	x	x	x	x	x	x	x
ComosActive	x	x	x	x	x	x	x
OrderIndex	x	x	x	x	x	x	x
DesignName	x	x	x	x	x	x	x
SystemCode	x	x	x	x	x	x	x
FunctionalGroup	x	x	x	x	x	x	x
TagStatus1	x	x	x	x	x	x	x
TagStatus2	x	x	x	x	x	x	x
TagStatus3	x	x	x	x	x	x	x
DetailType	x	x	x	x	x	x	x
Manufacturer	x	x	x		x	x	x
ManufacturerType	x	x	x		x	x	x
Supplier	x	x	x		x	x	x
Medium	x	x	x		x	x	
ScopeOfSupply	x	x	x	x	x	x	x
PipeSpecification							
PEDClass							
PEDMod							
DesignStd							
Media							
DN							
OperatingPressure							
PS							
CalcPressure							
OperatingTemperature							
TS							
CalcTemperature							
FromDescription			x		x	x	
FromComosUID			x		x	x	
FromType			x		x	x	
ToDescription							
ToComosUID							
ToType							
GroupNumber							

Appendix 4 Comos to PDMS/E3D attributes (Level 2 objects)

Attribute Name	Level 2 object types						
in PDMS/E3D	Valve	inline instr	AEI	Loop	I nozzle	P nozzle	Motor
@ObjectLevel	2	2	2	2	2	2	2
@ObjectType	VALV	INST	AEI	LOOP	NOZZLE	NOZZLE	MOTOR
@Name							
@ExcludeFrom3D							
ComosUID	x	x	x	x	x	x	x
Description	x	x	x	x	x	x	x
ComosBaseOb	x	x	x	x	x	x	x
ComosFullLabel	x	x	x	x	x	x	x
ComosCustomerTag	x	x	x	x	x	x	x
ProcessArea	x	x	x	x	x	x	x
UploadDate	x	x	x	x	x	x	x
Date	x	x	x	x	x	x	x
FlowSheetNumber	x	x	x	x	x	x	x
ComosDescription	x	x	x	x	x	x	x
Owner	x	x	x	x	x	x	x
ComosActive	x	x	x	x	x	x	x
OrderIndex	x	x	x	x	x	x	x
DesignName	x	x	x	x	x	x	x
SystemCode	x	x	x	x	x	x	x
FunctionalGroup	x	x	x	x	x	x	x
TagStatus1	x	x	x	x	x	x	x
TagStatus2	x	x	x	x	x	x	x
TagStatus3	x	x	x	x	x	x	x
DetailType	x	x	x	x	x	x	x
Manufacturer	x	x	x		x	x	x
ManufacturerType	x	x	x		x	x	x
Supplier	x	x	x		x	x	x
Medium	x	x	x		x	x	
ScopeOfSupply	x	x	x	x	x	x	x
PipeSpecification							
PEDClass							
PEDMod							
DesignStd							
Media							
DN							
OperatingPressure							
PS							
CalcPressure							
OperatingTemperature							
TS							
CalcTemperature							
FromDescription			x		x	x	
FromComosUID			x		x	x	
FromType			x		x	x	
ToDescription							
ToComosUID							
ToType							
GroupNumber							

Appendix 5 PDMS/E3D to Comos attributes

Attribute Name in PDMS/E3D	Data source in Comos	PIPE	ANY OTHER
@Name	Object property (SystemUID)	x	x
PositionX	Spec GPOS.COORD_X	x	x
PositionY	Spec GPOS.COORD_Y	x	x
PositionZ	Spec GPOS.COORD_Z	x	x
CoordX	Spec GPOS.COORD_X1	x	x
CoordY	Spec GPOS.COORD_Y1	x	x
Level	Spec GPOS.COORD_Z1	x	x
PositionTailX	Spec GPOS.COORD_X_T	x	
PositionTailY	Spec GPOS.COORD_Y_T	x	
PositionTailZ	Spec GPOS.COORD_Z_T	x	
CoordTailX	Spec GPOS.COORD_X1_T	x	
CoordTailY	Spec GPOS.COORD_Y1_T	x	
LevelTail	Spec GPOS.COORD_Z1_T	x	
Status3D	Spec BE.L072	x	x
Galv	Spec AN.L143	x	x
Length	Spec TD.M169	x	x
BendCount	Spec TD.R070	x	x
GroundLevel	Spec GPOS.COORD_LVL	x	x

Appendix 6 PDMS/E3D link status query

SYSTEM UID	P&ID NO	LOOP POSITION NO	LOOP DESCRIPTION	DEVICE POSITION NO	DEVICE DESCRIPTION	PDMS					
						X POSITION	Y POSITION	Z POSITION	X COORDINATE	Y COORDINATE	LEVEL
A3TNH60C7B				10A.V7001x	Valve	1.907	0.000	-1.950	A	1	-1.950
A3TNHLRA7B				10A.V7003	Shutt-off valve	4.223	0.000	3.850	B	1	+3.850
A3TNHNYR7B				10A.V7005	Valve	7.332	0.000	-1.157	B	1	-1.157
A3TNHPXC7B				10A.V7007	Valve, desc changed	15.639	0.000	3.850			
A3WDPVU65R				10A.V7009	Shut-off valve Test 2	2.948	0.000	2.139	B	1	+2.139
A3WE4F1JEY				10A.V7008	Valve	7.332	0.000	-0.907	B	1	-0.907
A3TNHNH87B		10AFI-003	Flow Indication	10AFI-003.FE	Flowsensor	5.520	0.000	-1.350	B	1	-1.350
A3TNHKLC7B		10ALI-001	Level Indication	10ALI-001.V01	Valve	2.430	0.000	1.950	A	1	+1.950

EXLUDE FROM PDMS DATA TRANSFER	PDMS LINK STATUS	3D STATUS	LINKED TO CABINET IN COMOS	DEVICE TYPE	CONNECTED TO		SCOPE OF SUPPLY	SUPPLIER	ADMS			REV.
					POSITION NO	DESCRIPTION			DOCUMENT LINKS	INSTRUCTION (STATUS)	DIME. DRAW. (STATUS)	
	OK			Manual valve			Existing		7			
	OK			Manual valve	0881.11.0002-WCW-200- X1	Pipe	ANDRITZ		6			
	OK			Manual valve			ANDRITZ		6			
	OK			Manual valve			ANDRITZ		6			
	OK			Manual valve			ANDRITZ		6			
	OK			Manual valve			ANDRITZ		6			
	OK			In-line instrument	0881.11.0003-WCW-100- X11A	Pipe	ANDRITZ		5			
	OK			Automatic valve	0881.11.0002-WCW-200- X1	Pipe	ANDRITZ		5			