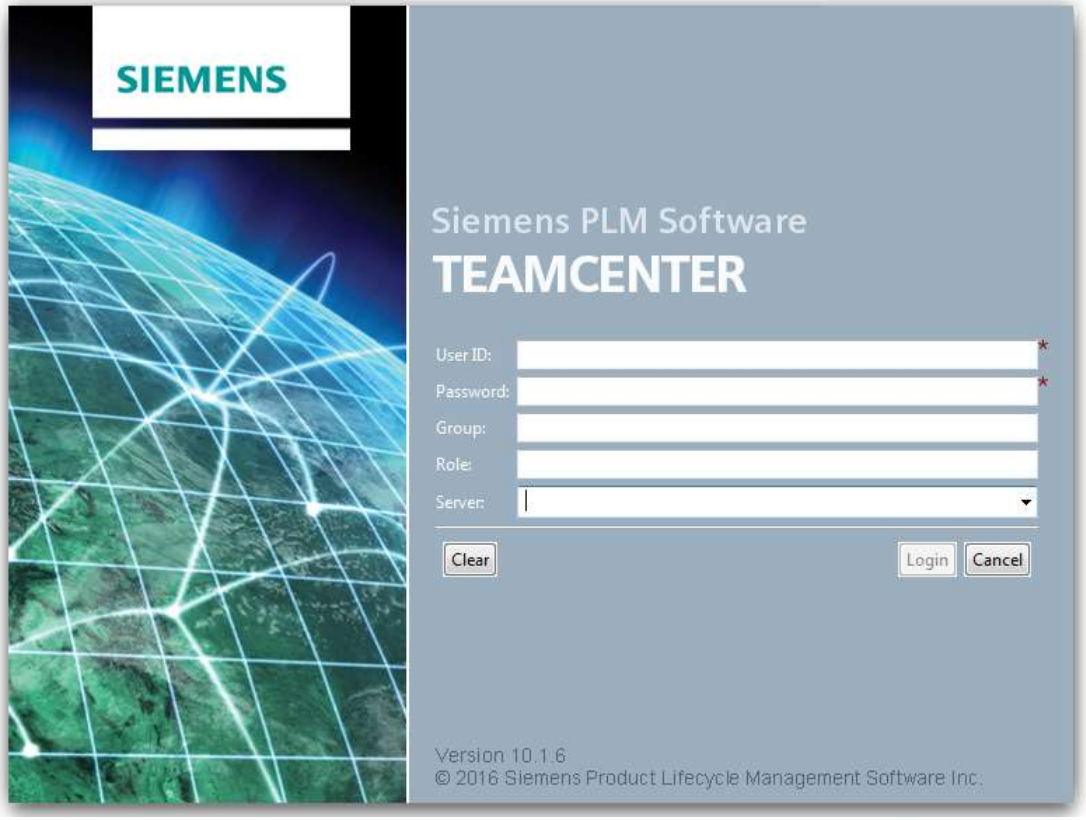
PLM/PDM SYSTEMS
3D platforms

Ernoe Baka GT3

GT3

BME GEP- ÉS TERMÉKTERVEZÉS TANSZÉK

BME DEPARTMENT OF MACHINE AND PRODUCT DESIGN

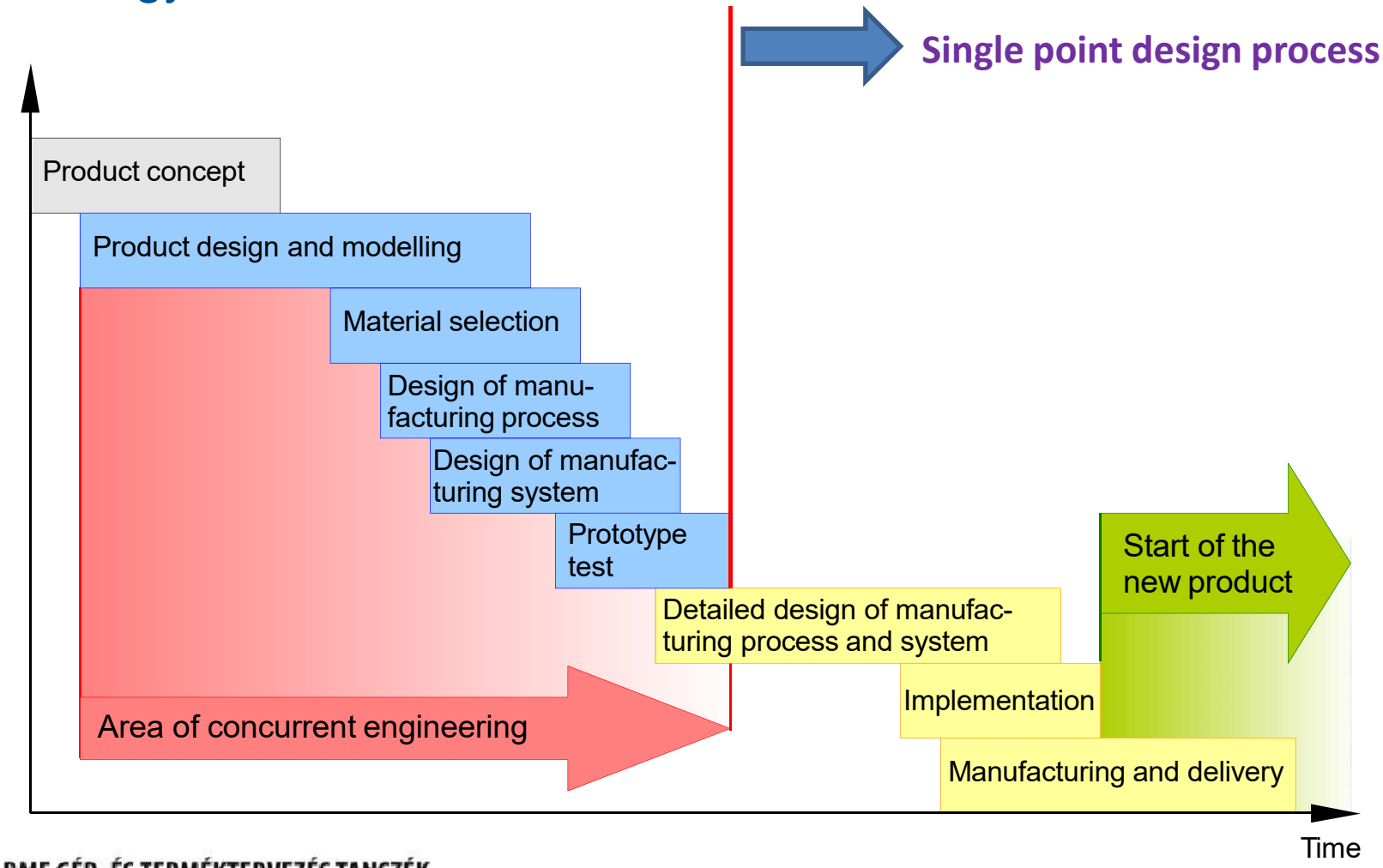


We design everything in 3D, question is: WHAT software

The 2 biggest ones are:
SIEMENS PLM
DASSAULT ENOVIA

THE PROCESS OF PRODUCT DEVELOPMENT

The integrated CAD systems provide basic support for concurrent (simultaneous) engineering. This systems (Dassault Systemes CATIA, Siemens NX, PTC Creo) have ***high level implementation*** of Top-Down design strategy.



THE PROCESS OF PRODUCT DEVELOPMENT (Top-Down)

The design

creation of the main conceptional model (skeleton)

creation of the assembly sub-levels with sub-conceptional models

development of the specific components based on the skeletons

Features of design

requires only the essential information about the concept at the beginning of the procedure

the modifications initiated at the conceptual level in parts in assembly

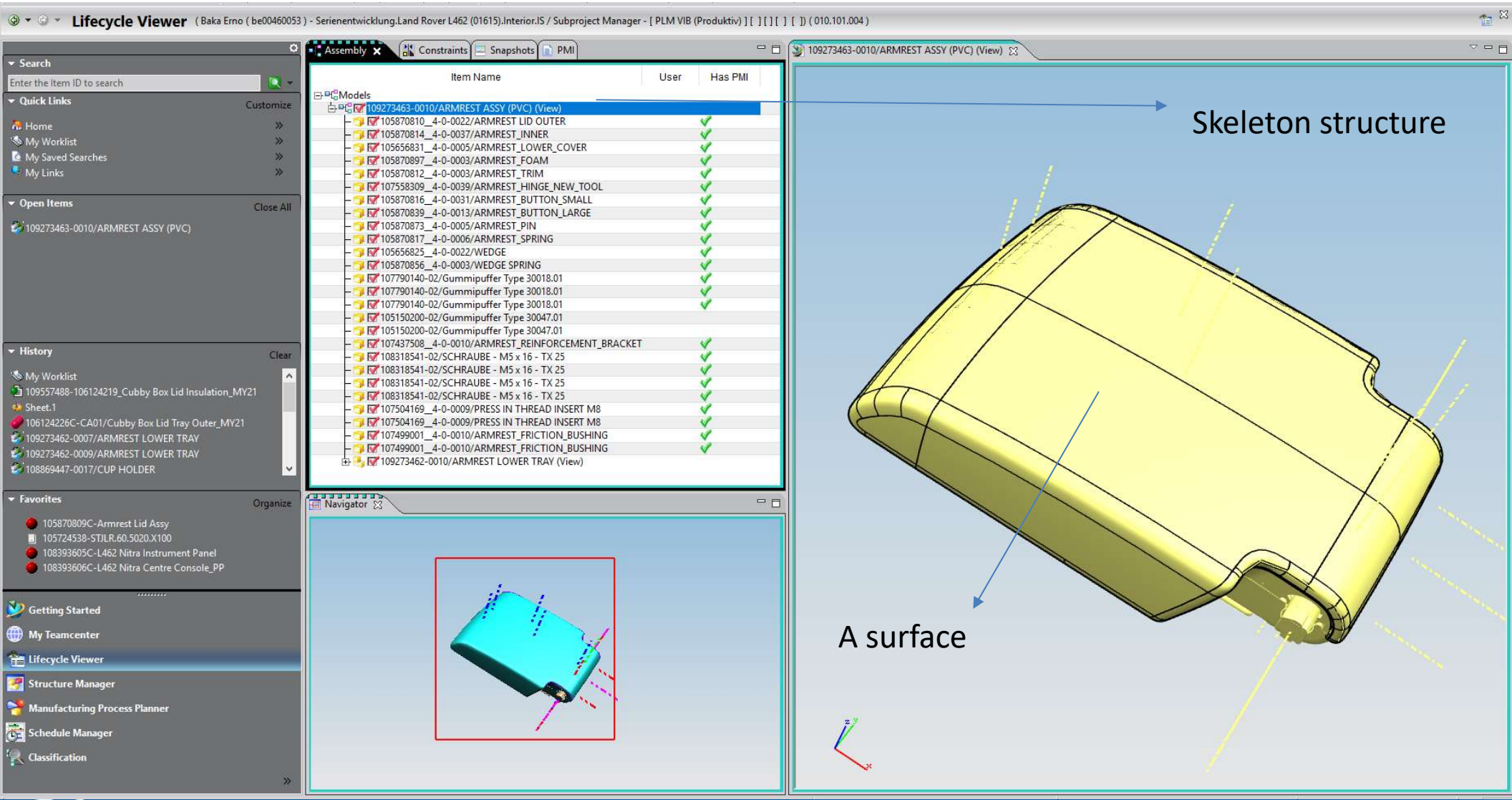
Proper for a “new” design from scratch

parallel execution with automated communication

THE PROCESS OF PRODUCT DEVELOPMENT (top-down)

We start from A surface and we create the assembly as the main structure. Then we realize the design in parts from Top-down…then we developing the parts in assemblies in the BoM (bill of materials)

When we got the A surface from OEM carmaker we just start the TOP DOWN design with creating the individual parts



THE PROCESS OF PRODUCT DEVELOPMENT (Bottom-Up)

The Design

creation of the basic components

connection the components with specific conditions

verification of the final assembly

Features of design

requires full information about the basic components at the beginning of the procedure

the modifications initiated at the component level

require strict verification at the end of the process

serial execution hard to arrange the steps in parallel order
high communication requirement

Proper for aftermarket and after-sales support (spare parts management)

PDM/PLM SYSTEMS

Nowadays the engineering activity not only focuses on the design of the products, creating the related computer models with the necessary manufacturing documentation, but this activity is much broader and it includes more extensive tasks. These tasks have to be resolved in global design groups, i.e. together with engineers in different locations.

The design procedures can fully be covered by computational support. But apart from the obvious advantages, this support also has disadvantages. The exponentially growing electronic data causes many problems in the design procedure and requires more and more attention of handling the growing inputs and factors.

It consumes huge time!

the engineering time is 30%, the rest 70% is a kind of documentation of the process

PDM/PLM SYSTEMS

An engineer has to face the following challenges during the design procedure:

- review and handling of an enormous amount of electronic data
- tracking the changes of the product data
- supporting extended teamwork in time and location
- handling of the design related other procedures

…and of course conduct the detailed design in a certain timeframe for a reasonable cost

PDM/PLM SYSTEMS

The PDM (Product Database Management) systems handle only the product data. The PLM (Product Lifecycle Management) systems handle the product and all related data during its lifecycle. A typical PLM system has modular structure.

PRODUCT MODEL AND INFORMATION MANAGEMENT

Before introducing the design supporting background systems it is useful to give an overview of the engineering environment of these systems, highlighting the area of concurrent engineering.

Concurrent Engineering (Simultaneous Engineering) is the method of the design, manufacturing, logistic and service procedures. This method arranges all the possible procedures parallel both in time and logical work flow. The advantages of this method are the following:

- with 30% - 70% shorter development time
- with 65% - 90% fewer changes in design
- with 20% - 90% shorter time to market time
- with 200% - 600% higher product quality
- with 20% - 110% higher engineering productivity

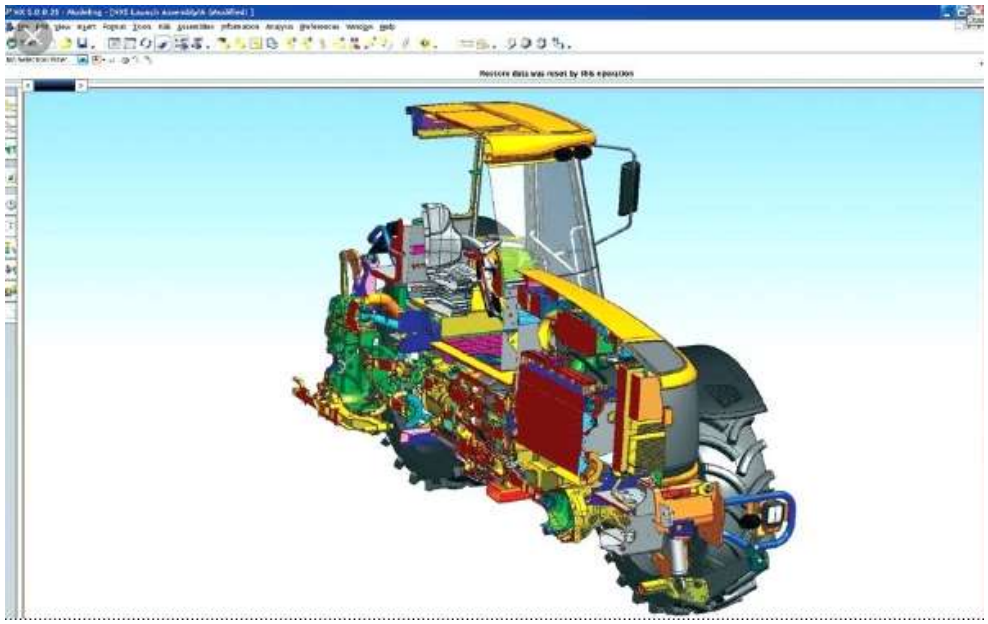
PRODUCT MODEL AND INFORMATION MANAGEMENT

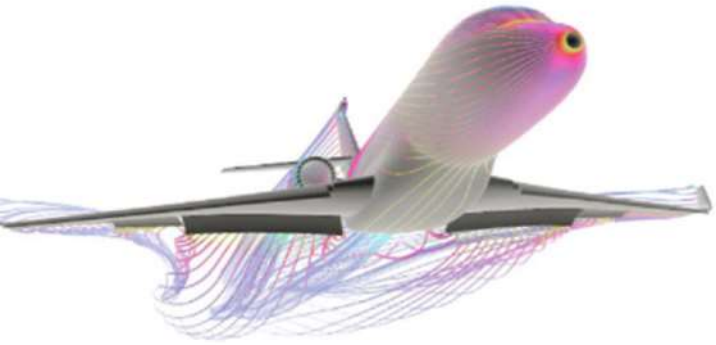
The Product Model is the lifecycle model of the product with all the required information for design and manufacturing. Years before this model was a 3-dimensional CAD model, but nowadays it is a highly detailed computer model so called ***Digital Mock-Up*** (DMU). The main purpose of using a DMU is the replacement of the physical tests with virtual ones. These virtual tests could be following ones: (DoE design of experiments)

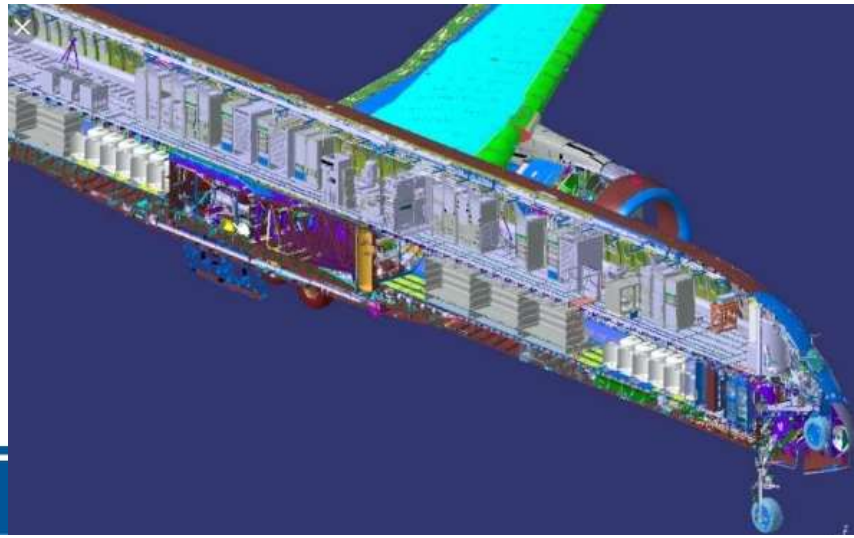
- kinematic and dynamic simulations
- different FEA test (static, fluid dynamic, etc.)
- ergonomic studies
- industrial design related studies (surface continuity, reflection tests)
- fundamental interference test among the built-in components
- assembly and service simulations

PRODUCT MODEL AND INFORMATION MANAGEMENT

This kind of Digital Mock-Up can be found in different areas of the industry (defence, aerospace, automotive industry)







PRODUCT MODEL AND INFORMATION MANAGEMENT

The huge amount of product information can only be stored in databases and these systems provide the structural storage of the product information

The fundamental elements of these systems are the following

Data

The data is the set of those unstructured facts which can be stored, searched, actualized and restored. These data are typical raw information like measurement data. There are some special types of data:

software: this data can manipulate another data

metadata: stores the description of another data

Information

Information is the set of facts with meaning and evaluated data. The most important function of a database system is extract/retrieve these information from the data.

PRODUCT MODEL AND INFORMATION MANAGEMENT

Database (DB)

Database is the collection of the long turn stored structural information. DB is an integrated data structure storing the objects together with the related information (metadata). The data models of the databases are the following:

- **Flat model**: data stored in tables
- **Hierarchical model**: data stored in tree structure, good performance in case of parent/child relationship (BOM, catalogues, etc.)
- **Network model**: data stored in records, the records organized in groups, cross references among data are enabled

PRODUCT MODEL AND INFORMATION MANAGEMENT

Other data models of the databases:

- **Relational model**: stores the relationships among data, the data and the relationships stored in different tables, very flexible data model

- **Object-oriented model**: the database built from intelligent object supporting the following operations:
  - encapsulation: data and the related operations are stored in objects
  - inheritance: high level objects (children) inherit properties from low level objects (parents)
  - polymorphism: the same command is interpreted in different ways in case of different objects

DataBase Management System (DBMS)

DBMS is a software system providing access for the databases and containing various service functions. The fundamental functions of a DBMS are the following:

- **indexing**: a method for increasing the speed of data search
- **supporting transactions**: controlled manipulating of several data in the same time
- **replication**: continuous synchronizing of more database instances, automatic switching in case of the error of the primary database
- **security functions**: support of the encryption, user access rights and logging the activities
- **locking**: DBMS locks the related data until a transaction is successfully closed

PRODUCT MODEL AND INFORMATION MANAGEMENT

The additional functions of a DBMS are the following:

- **query ability**: supporting the complex, sometimes nested queries
- **backup and replication**: supporting the unified database structures even in case of far geographical locations
- **rule enforcement**: decreasing the errors caused by manual input
- **advanced security**: controlling the data access, remove functions both on user and user group levels
- **change and access logging**: tracking the data manipulation
- **automated optimization**: statistically based automated setup procedure to increase the performance of the DBMS

Our goal here can be: we can find anything which we do not know where it is……(sophisticated Search modules)

PRODUCT DATABASE MANAGEMENT (PDM)

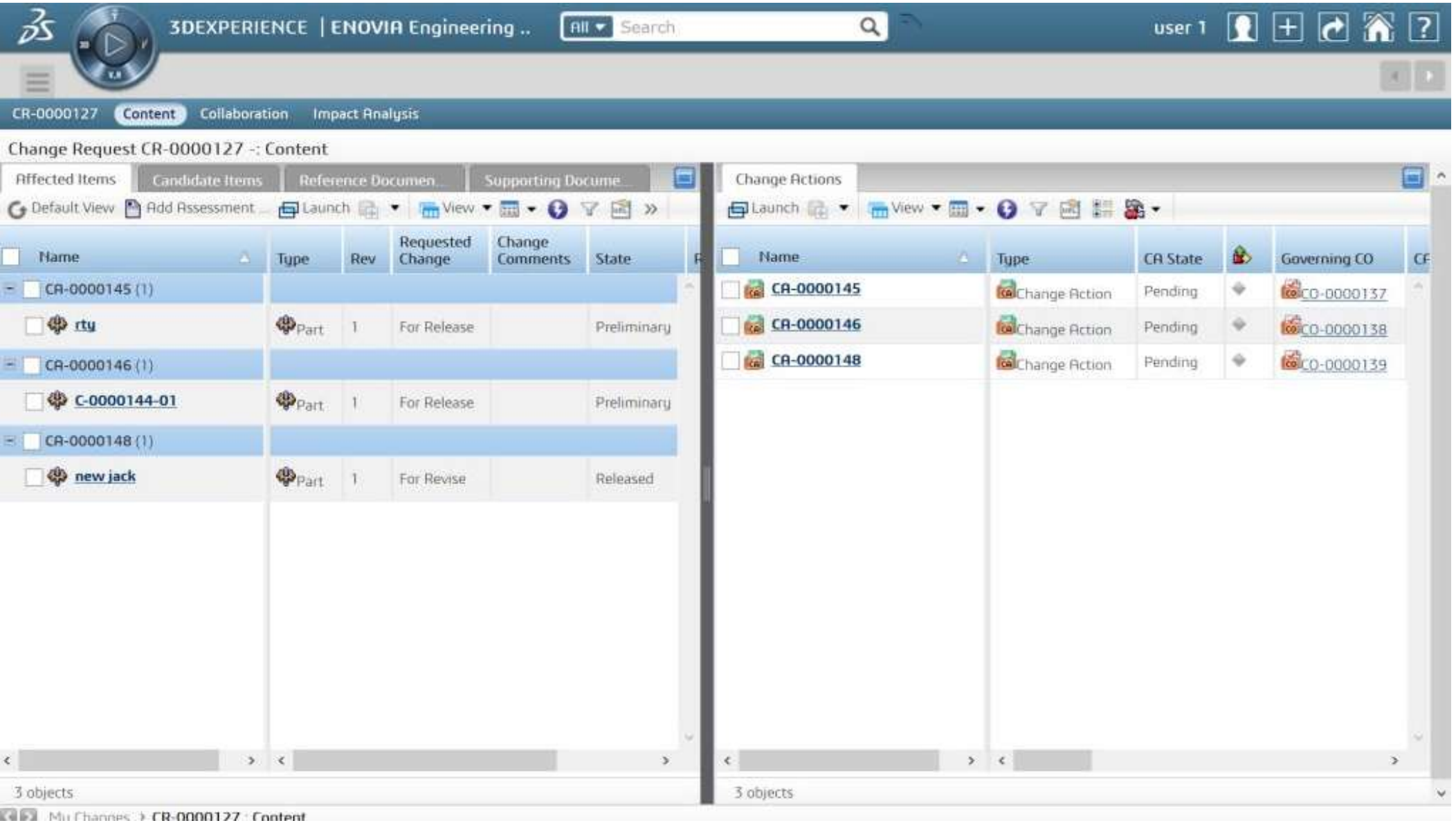
PDM systems provide the structural storage for all the product related data. The main functions of the PDM systems are the following:

- **heterogeneous data handling**: storage of heterogeneous product data (CAD files, Office documents, e-mails, etc.)
- **quick information search**: in case of any product data
- **visualization**: displaying the up to date CAD data (previews, exploded views, etc.)
- **product structure handling**: displaying and exporting the product structures in customizable formats (Bill of Material (BOM) lists)

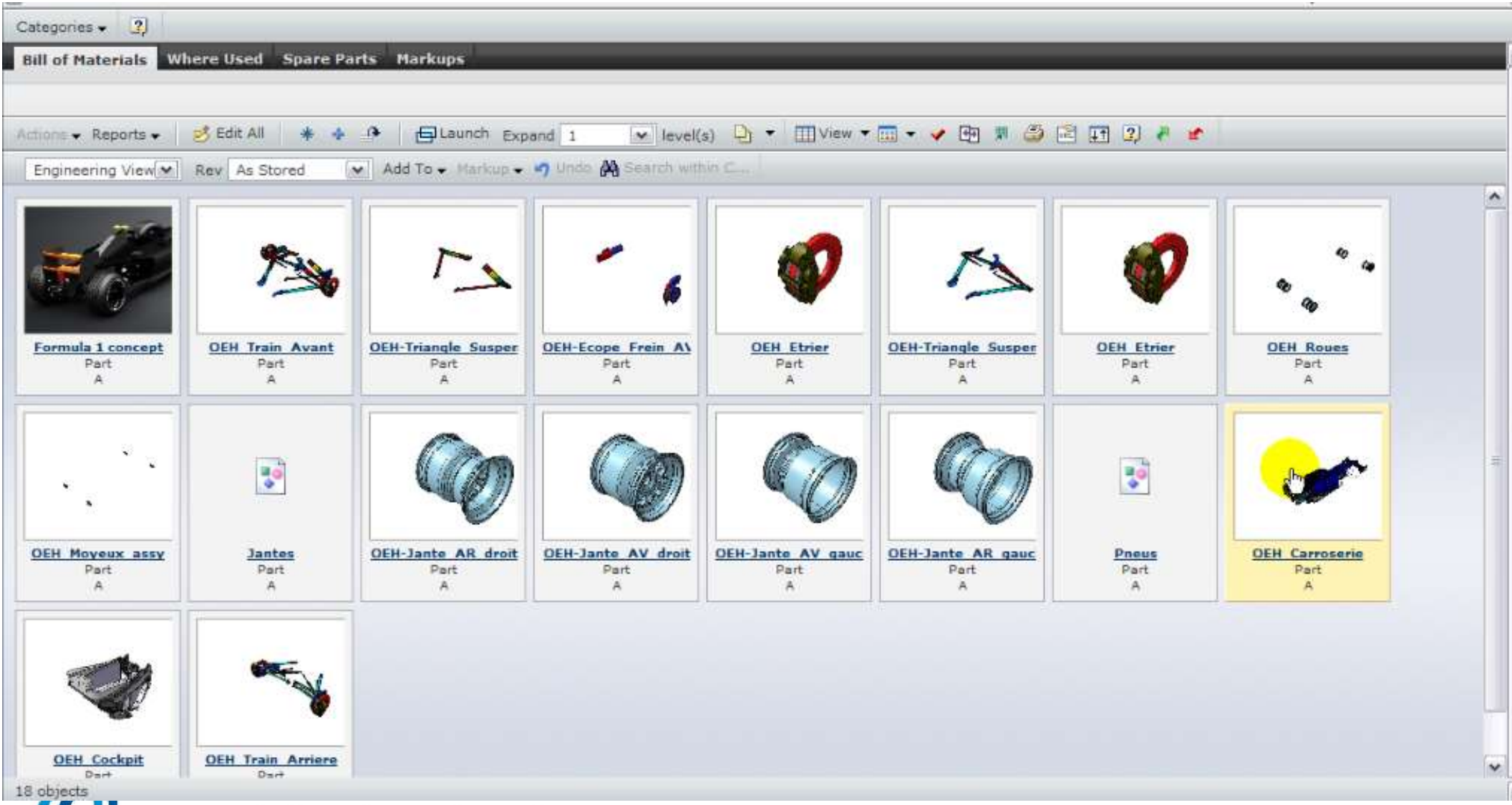
Our goal here can be: We can get proper visualization of the detailed CAD design in order to make all data available for other team members. (tooling, managers, sales, logistics, etc.)

PRODUCT LIFECIRCLE MANAGEMENT (PLM)

ENOVIA

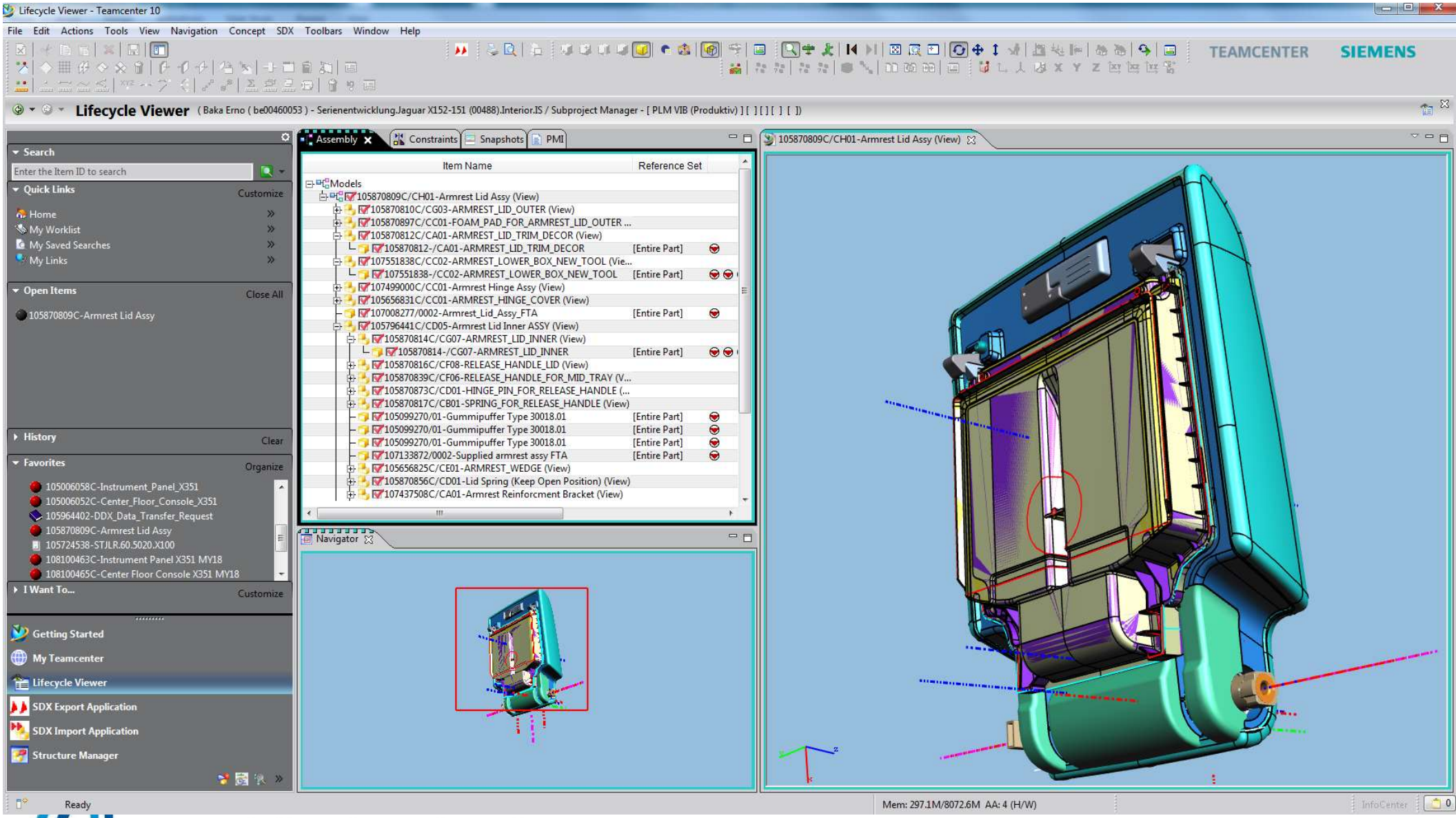


Searching upon Bill of Materials



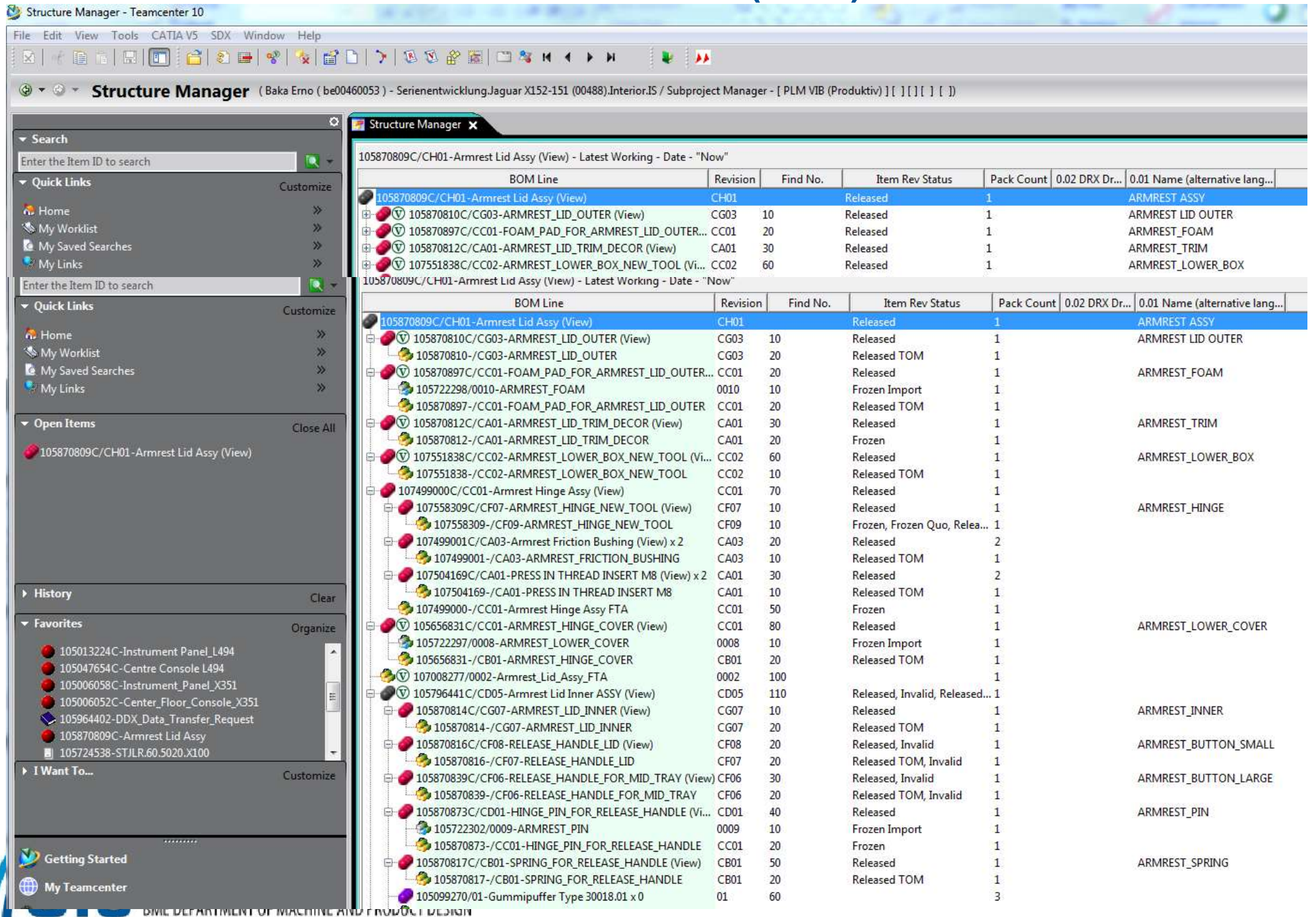
PRODUCT LIFECIRCLE MANAGEMENT (PLM)

SIEMENS



PRODUCT LIFECIRCLE MANAGEMENT (PLM)

SIEMENS



PRODUCT DATABASE MANAGEMENT (PDM)

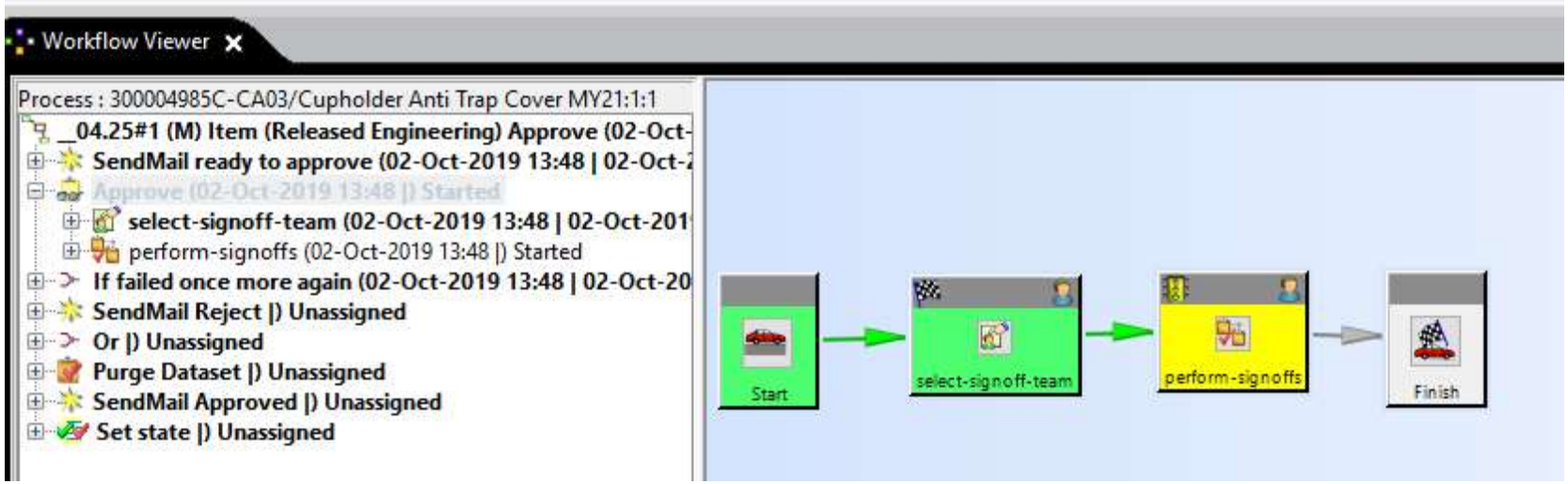
PDM systems provide graphical visualization of the data with the following features:

- displaying the 3D data with customizable views (using rotation, zoom, pan functions)
- the assemblies can be exploded to view the individual components
- hide/show components
- customizable cross sections
- measurements on the 3D model
- remarking with geometry attached notes

PRODUCT DATABASE MANAGEMENT (PDM)

Tracking the engineering changes is one of the most important function of the PDM systems. This function encloses the following features:

- **version tracking**: storing the product versions and iterations, option to restore a previous version
- **log function**: logging the data access and change and other activities
- **change management**: handling the change requests and notifications and the related approver workflows



PRODUCT DATABASE MANAGEMENT (PDM)

The PDM systems support, an important element of the concurrent engineering, the teamwork. This kind of groupware functions are:

- unique access for modifying a specific data in the DB
- access rights for avoiding the unauthorized data accesses
- e-mail notification about the DB actions (modification, approval of a version, creation of a new object, etc.)
- supporting the electronic signatures
- other decision supporting functions (data collecting and visualization, making of statistics, reports, etc.)

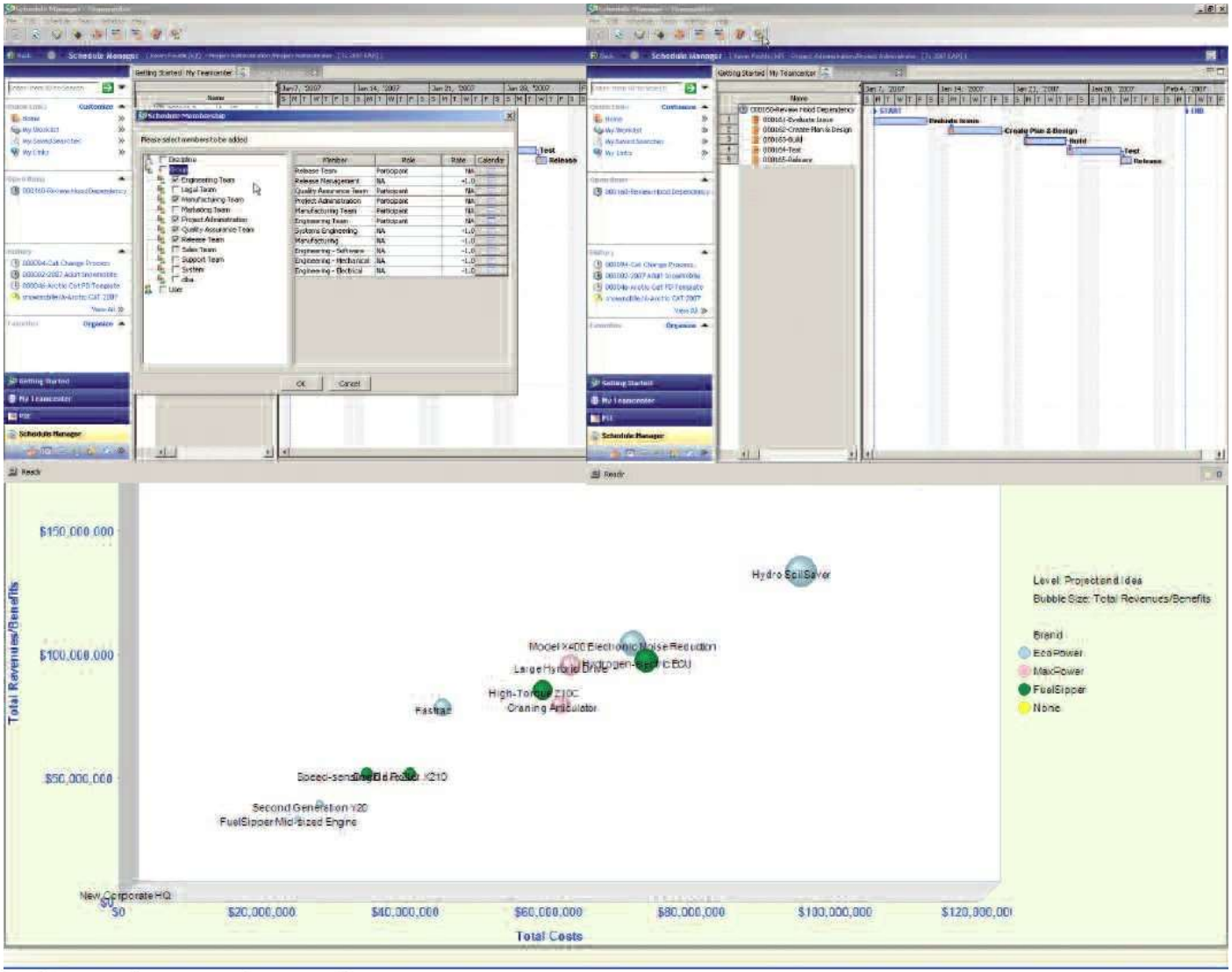
PRODUCT DATABASE MANAGEMENT (PDM)

The highest level control of the procedures in a PDM systems is the process management with the following features:

- definition of the participants and the roles of the processes
- tasklist definition (participants, activities, milestones and notifications)
- process automation with automatic running of the tasklist steps
- process trekking with visualization of the status and the decision points
- support of complex product lifecycles build from automated processes and special gate processes

PRODUCT DATABASE MANAGEMENT (PDM)

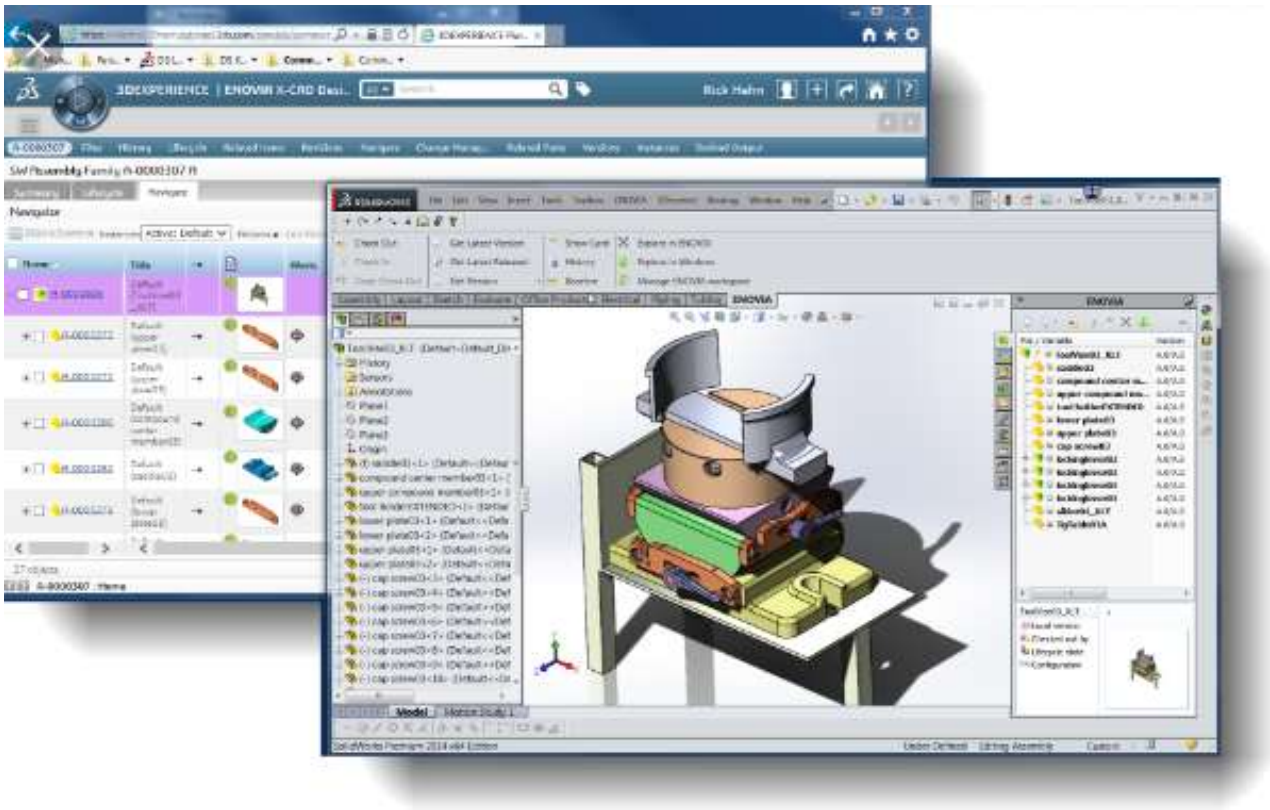
Derivative process data for teamwork support, this is not so visual



PRODUCT LIFECYCLE MANAGEMENT (PLM)

The PLM systems extend the PDM systems to the full lifecycle of the product. The PLM systems additionally control the following areas:

- prototype making
- manufacturing
- spare part manufacturing
- service



PRODUCT LIFECYCLE MANAGEMENT (PLM)

Areas of the PLM systems:
common platform for
everyone

PRODUCT LIFECYCLE MANAGEMENT (PLM)

The main advantages of the application of the PLM systems:

- significant decreasing in the time to market period
- better product quality
- lower prototype costs
- more accurate forecasts for time and costs
- easier identification of the market opportunities
- savings with recycling of the existing products
- framework for product optimization
- less reject and waste
- saving with integration of the overall design process
- help in creating documents for compliance with different standards
- data sharing with manufacturing subcontractors

PRODUCT LIFECYCLE MANAGEMENT (PLM)

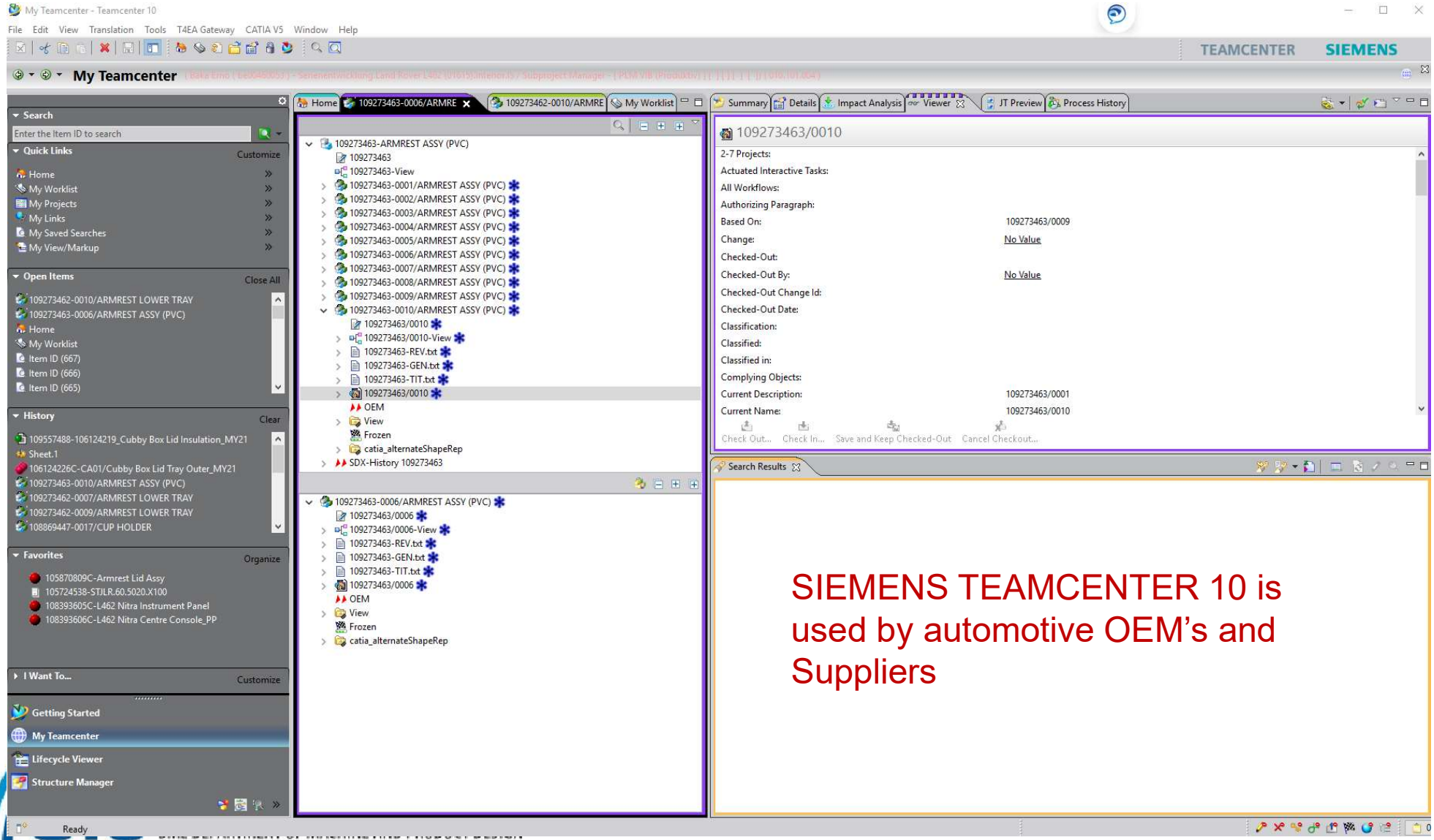
Additional specialized software modules of the PLM systems:

- **Systems Engineering, SE**
  Process and system planing based on the consumer requirement.
- **Product and Portfolio Management, PPM**
  The module monitors the running and suspended projects and helps the decision makers in the organization of the projects.
- **Product Design, CAX**
  Different mechanical (MCAD) and electronic (ECAD) design software, simulation systems (FEA, CFD). These software provide the virtual testing opportunities of the product.
- **Manufacturing Process Management, MPM**
  This module speeds up the manufacturing preprocessing and helps the optimization of the running manufacturing sequences.

PRODUCT LIFECYCLE MANAGEMENT (PLM)

Systems Engineering, SE

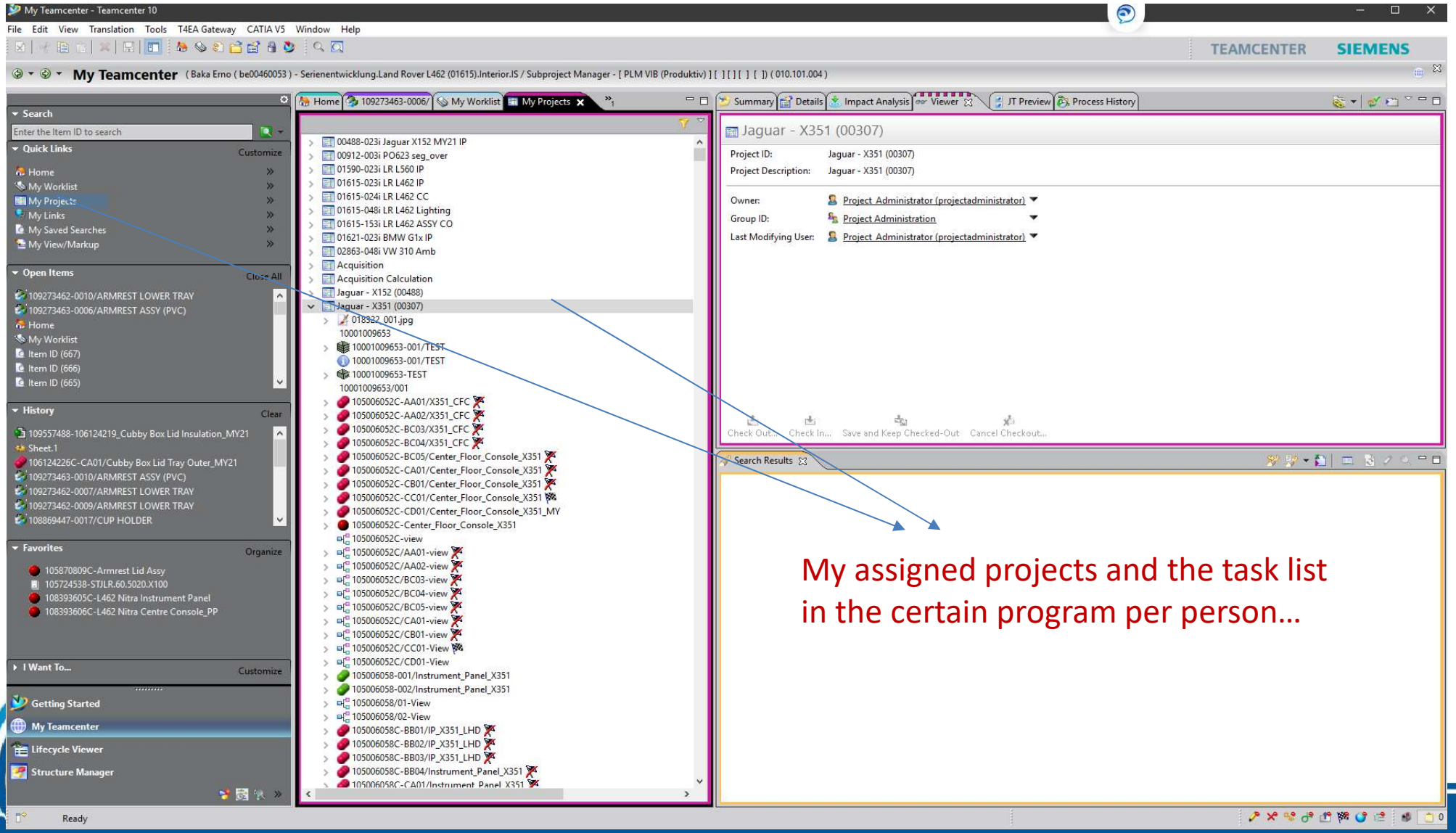
Process and system planing based on the customer requirement. We (suppliers) align the system or use the same system what customer uses



PRODUCT LIFECYCLE MANAGEMENT (PLM)

Product and Portfolio Management, PPM

The module monitors the running and suspended projects and helps the decision makers in the organization of the projects. It gives status from all assigned project under the engineer or teamleader or project leader name (roles are defined)



PRODUCT LIFECYCLE MANAGEMENT (PLM)

Product and Portfolio Management, PPM

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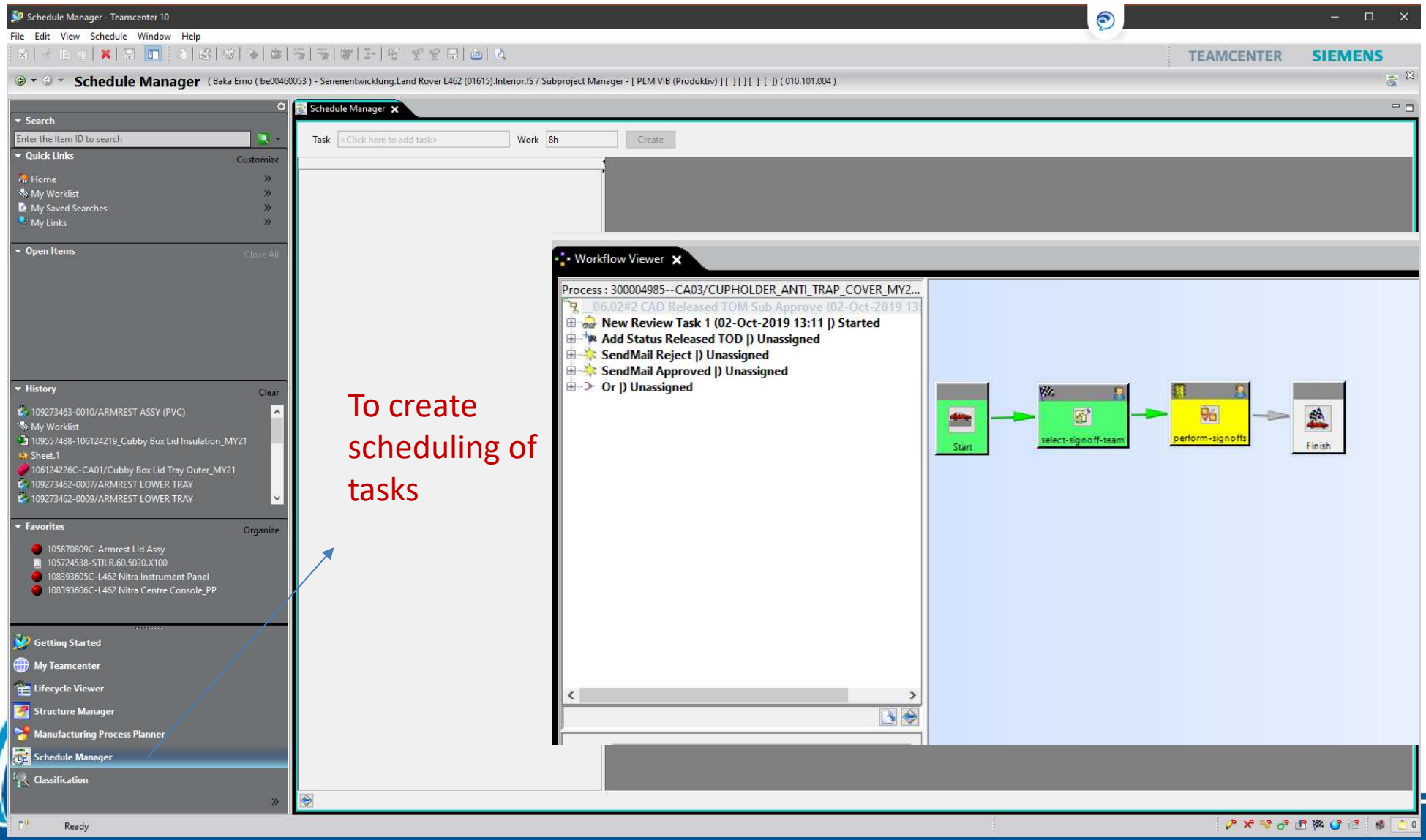
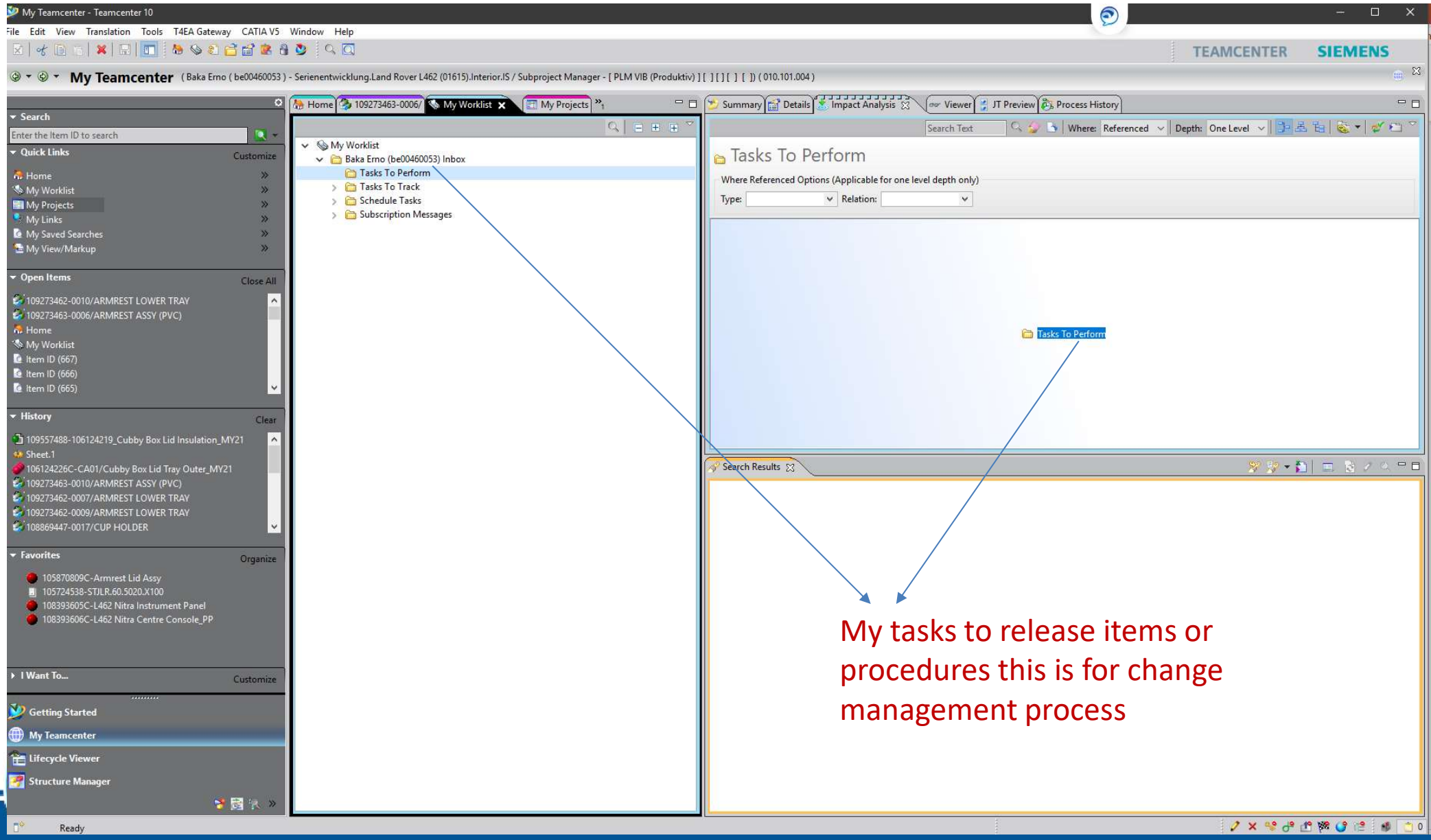


PRODUCT LIFECYCLE MANAGEMENT (PLM)

Product Design&Development

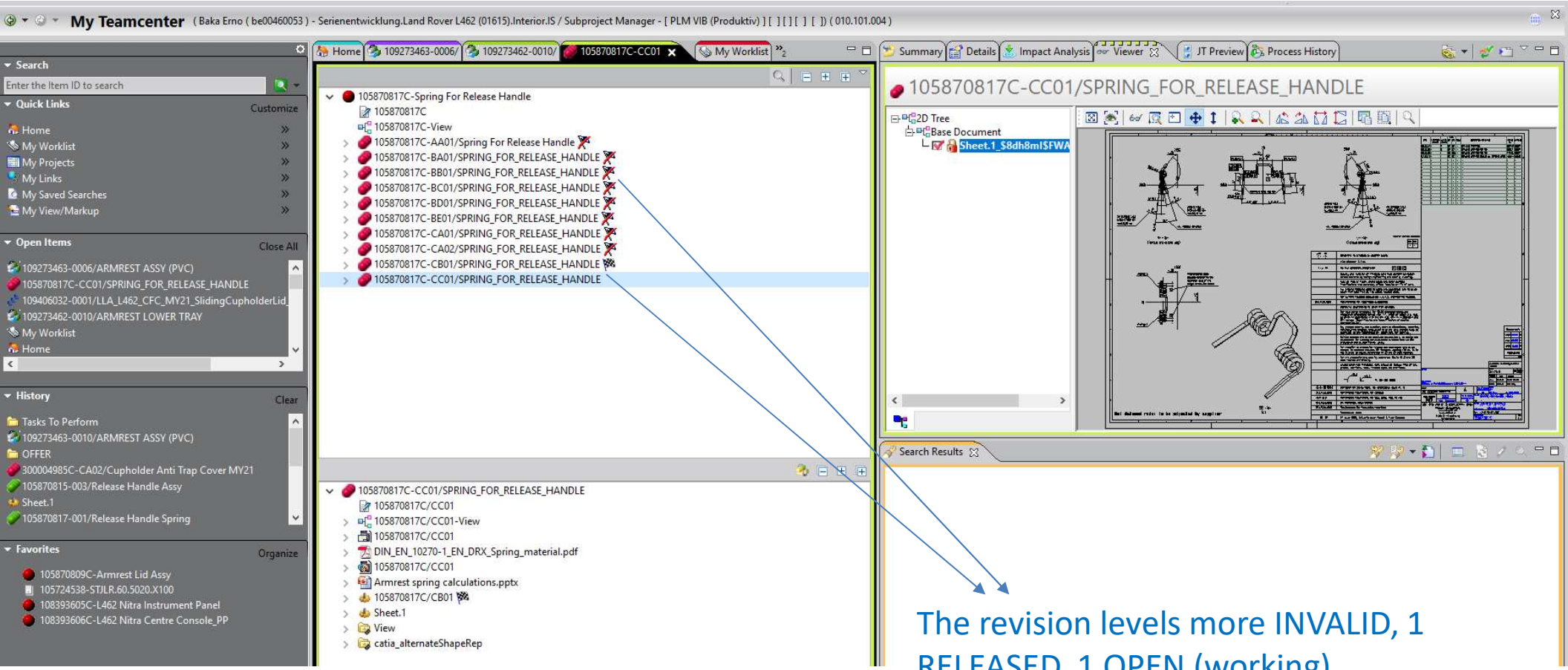
Different mechanical and electronic design software, simulation systems (FEA, CFD).
These software provide the virtual testing opportunities of the product. **DoE**



PRODUCT LIFECYCLE MANAGEMENT (PLM)

Product Design&Development

The main advantage of structurized way of working is the REVISON levels which show the development steps of our process…



The revision levels more INVALID, 1 RELEASED, 1 OPEN (working) STRICHT conditions therefore hard to generate PARALLEL concepts!!!

PRODUCT LIFECYCLE MANAGEMENT (PLM)

Product Design&Development CAD levels as the way of MATURITY

CDL 1 – Initial Geometry

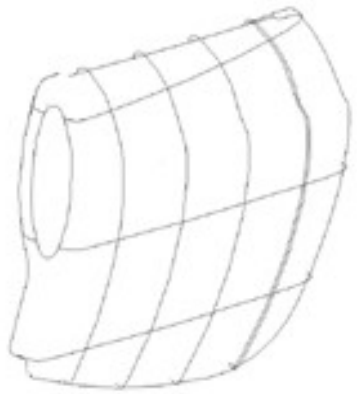
Geometric Requirements:

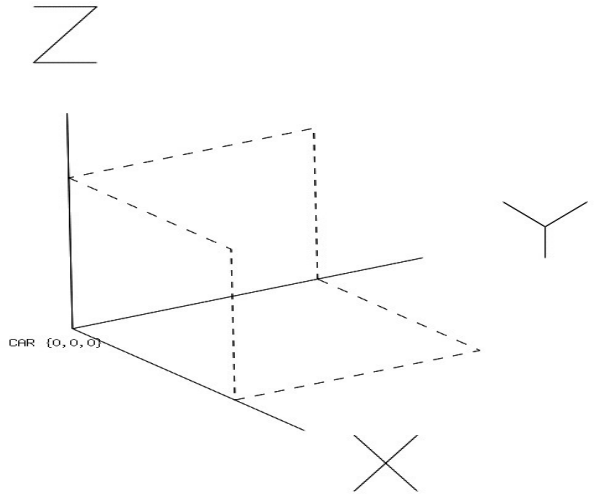
Package & Body Sections Available

Wire-frame Outlines / Block Solids

Engineering Properties:

- Safety & CAE Requirements Identified & Understood





PRODUCT LIFECYCLE MANAGEMENT (PLM)

Product Design&Development CAD levels as the way of MATURITY

CDL 2 – Package Sections

Geometric Requirements

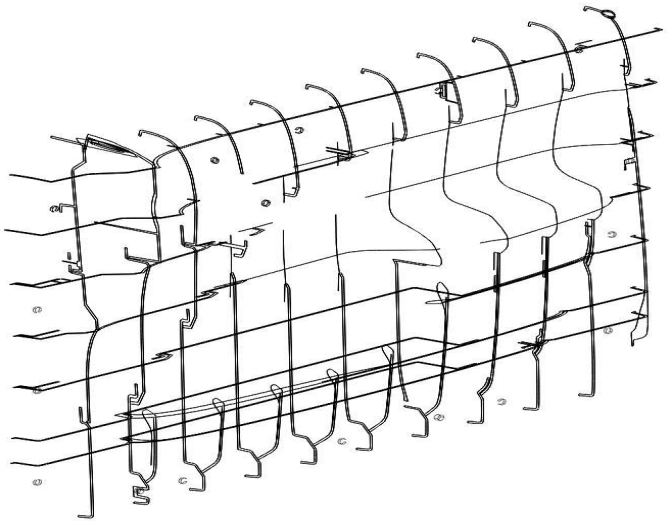
Master, Hardpoint & Package Sections

Early Clay Section Scan Data

Component Form Identified by Block Shapes & Surfaces

Package Envelopes (Wheel & Tyre,

(Hinge/Mechanism Centre Lines etc.)



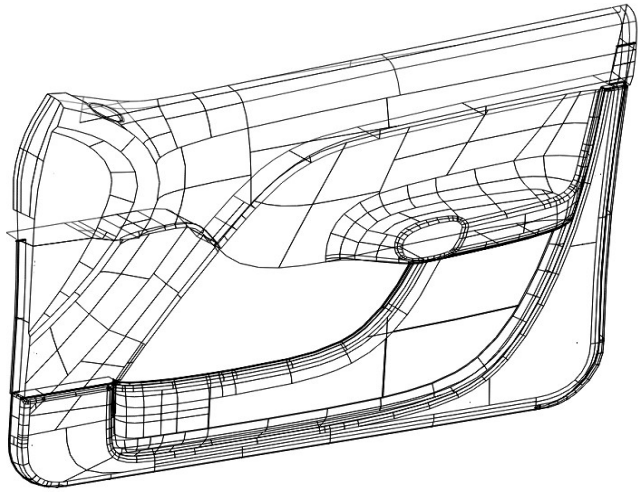
PRODUCT LIFECYCLE MANAGEMENT (PLM)

Product Design&Development CAD levels as the way of MATURITY

CDL3 – Concept (QUO)

Geometric Requirements:

Basic Shape, Critical Fasteners & Attachment Areas Defined.
Trimmed Surfaces/Solids
Hole Positions +/- 5mm
Major Fillets Defined (>20mm)
Weld Positions Established
Major fixings defined



Engineering Properties :

- Component weight (Target)
- Centre of Gravity
- Torque values for major fixings
- Critical Assembly Motion Sequences Established
- Suitable for Initial CAE Analysis
  - Material
  - Thickness
  - Mass Properties
  - Non flexible parts clash free

PRODUCT LIFECYCLE MANAGEMENT (PLM)

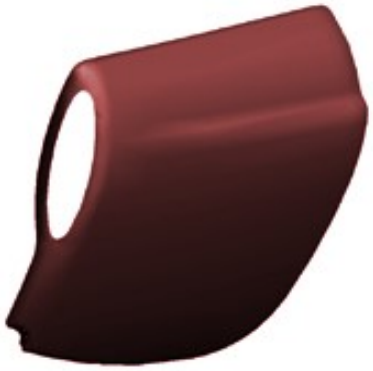
Product Design&Development CAD levels as the way of MATURITY

CDL 4 – Interfaces

Geometric Requirements:

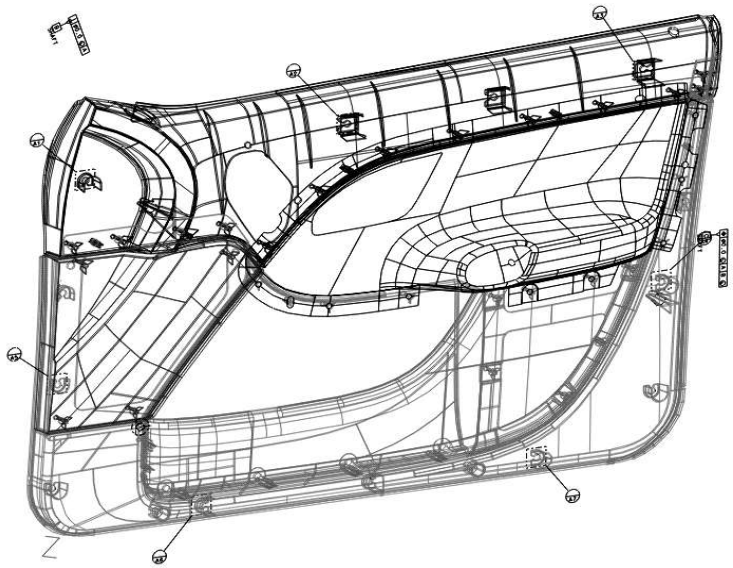
Fully Surfaced/Solid Material Defined
Interfaces With Surrounding Parts designed (e.g. Locator Holes & Pads Defined)
All Fillets <20mm Defined
All Fixings Defined (inc adhesive)

Styled surfaces derived from design master (Clay)
'B' Surface
Ribs
Sealant runs



Engineering Properties :

- Component weight (calculated)
- Centre of Gravity
- Torque values for all fixings



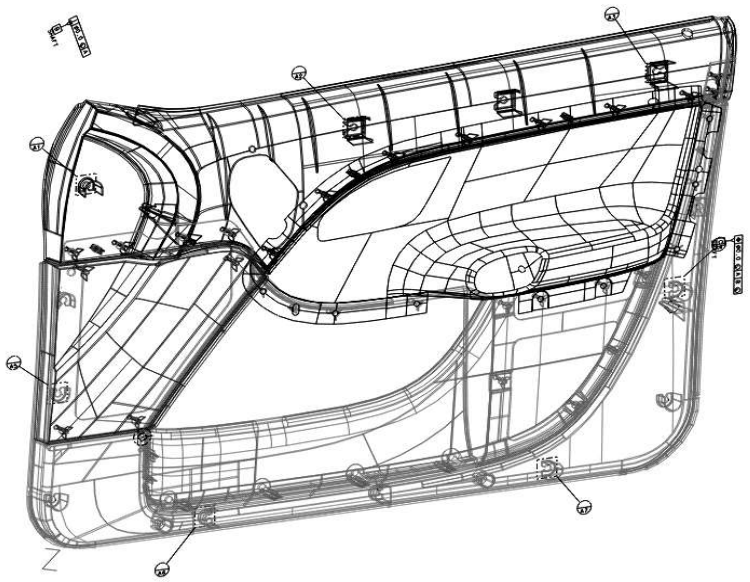
PRODUCT LIFECYCLE MANAGEMENT (PLM)

Product Design&Development CAD levels as the way of MATURITY

CDL 5 – Class #1 Surface (TOD)

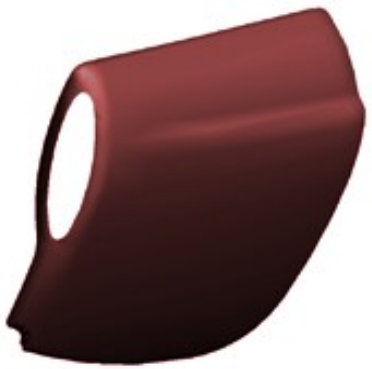
Geometric Requirements:

Final ‘A’ Surface Release Model (Does Not Include Engineering Detail – Holes, ‘B’ Surface etc.)



Engineering Properties :

- Body 80% feasibility complete & definition suitable for final Body CAE analysis (including Locator Holes & Pads Defined).
- Craftsmanship Interfaces Agreed



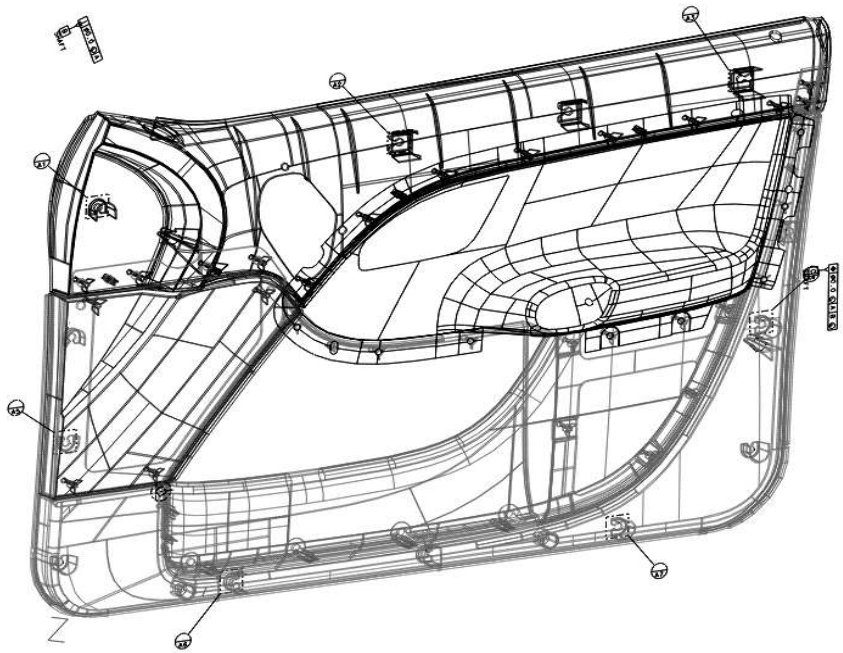
PRODUCT LIFECYCLE MANAGEMENT (PLM)

Product Design&Development CAD levels as the way of MATURITY

CDL 6 – Pre Release

Geometric Requirements:

- Final Release Class ‘A’ Surface Integrated.



Engineering Properties:

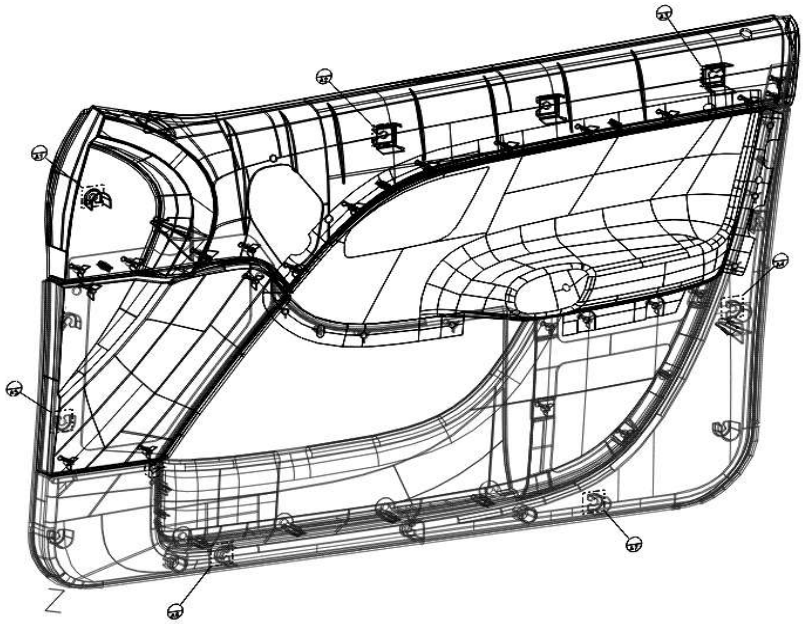
Component definition that is assembly/manufacturing feasible,
Component Definition Suitable for Production Part and/or Final CAE Analysis.
Component Sign-Off Against All Previously Identified Attributes (e.g. Craftsmanship, Section Book, Interfaces etc.)

Kick off tool design.

PRODUCT LIFECYCLE MANAGEMENT (PLM)

Product Design&Development CAD levels as the way of MATURITY

CDL 7 – Release (TOM)



Engineering Properties:

Complete Definition Suitable for Production.

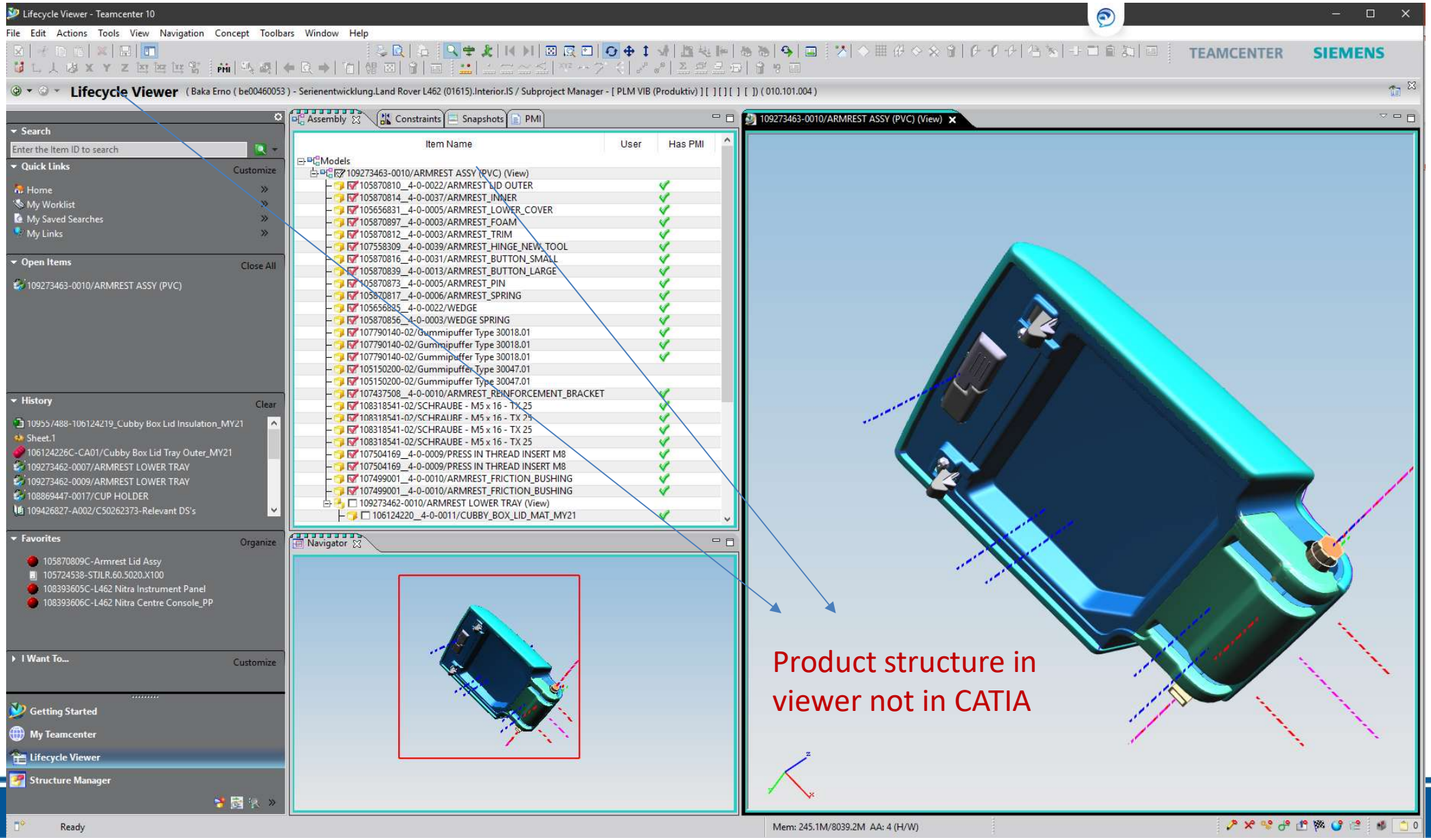
Final Engineering Release (Drawing Format As Required)

All Targets Met

PRODUCT LIFECYCLE MANAGEMENT (PLM)

Product Design&Development

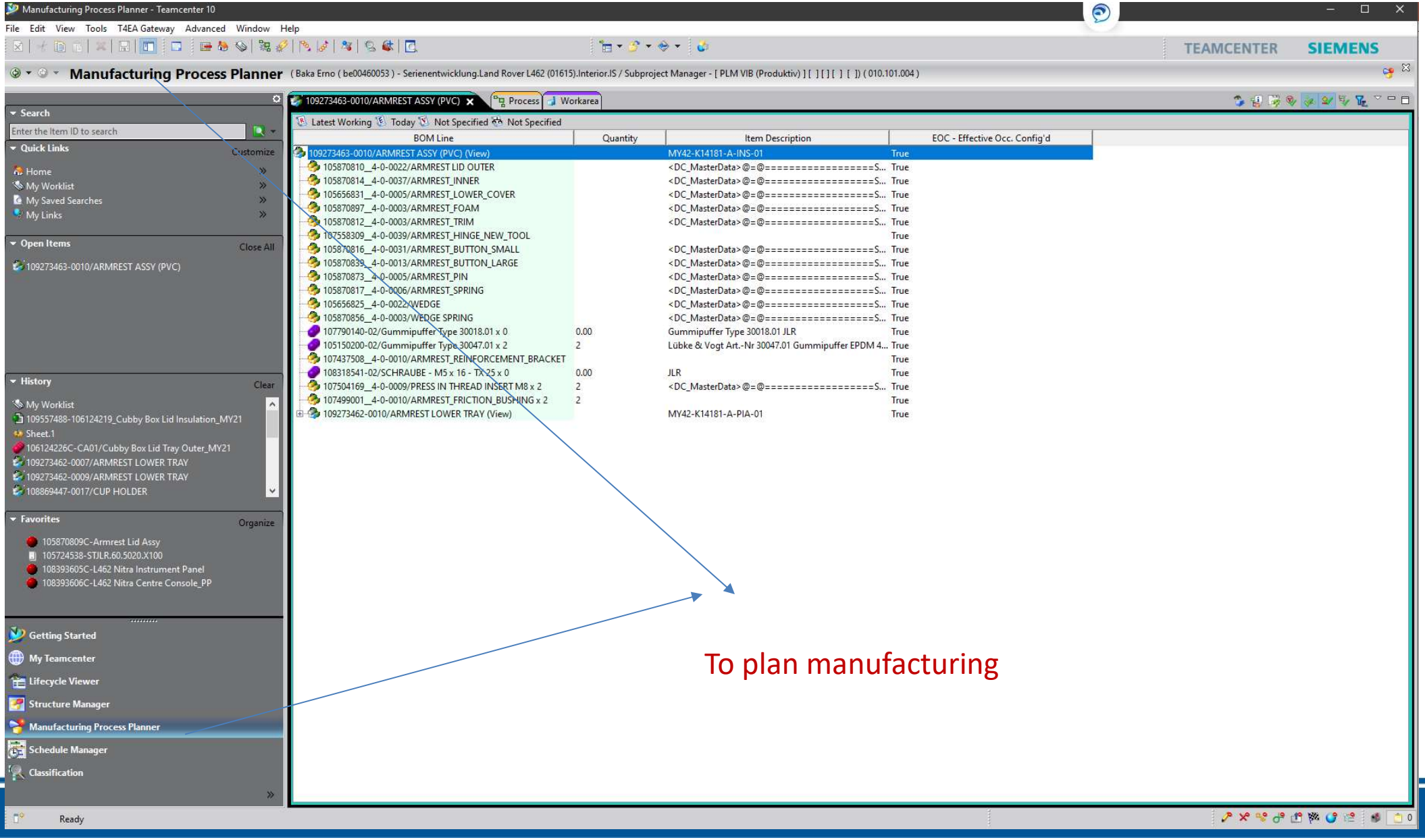
Different mechanical and electronic design software, simulation systems (FEA, CFD).
These software provide the virtual testing opportunities of the product. **DoE**



PRODUCT LIFECYCLE MANAGEMENT (PLM)

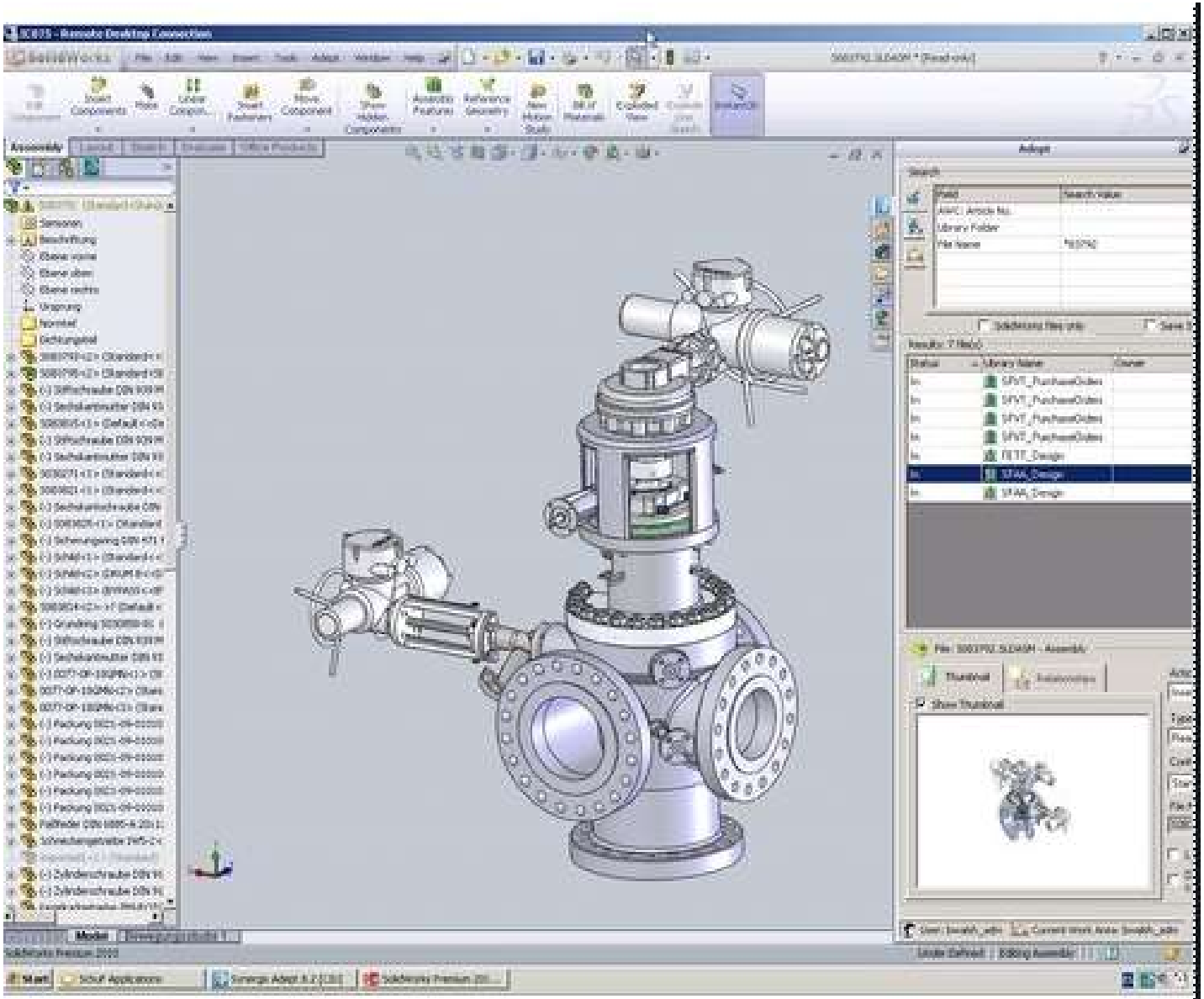
Manufacturing Process Management, MPM

This module speeds up the manufacturing preprocessing and helps the optimization of the running manufacturing sequences, everybody works in the SAME database (PLATFORM)



PRODUCT LIFECYCLE MANAGEMENT (PLM)

Application of the PLM systems in case of another complex product…



THANK YOU FOR YOUR ATTENTION!