



DEXPI - P&ID Data Exchange

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Evonik

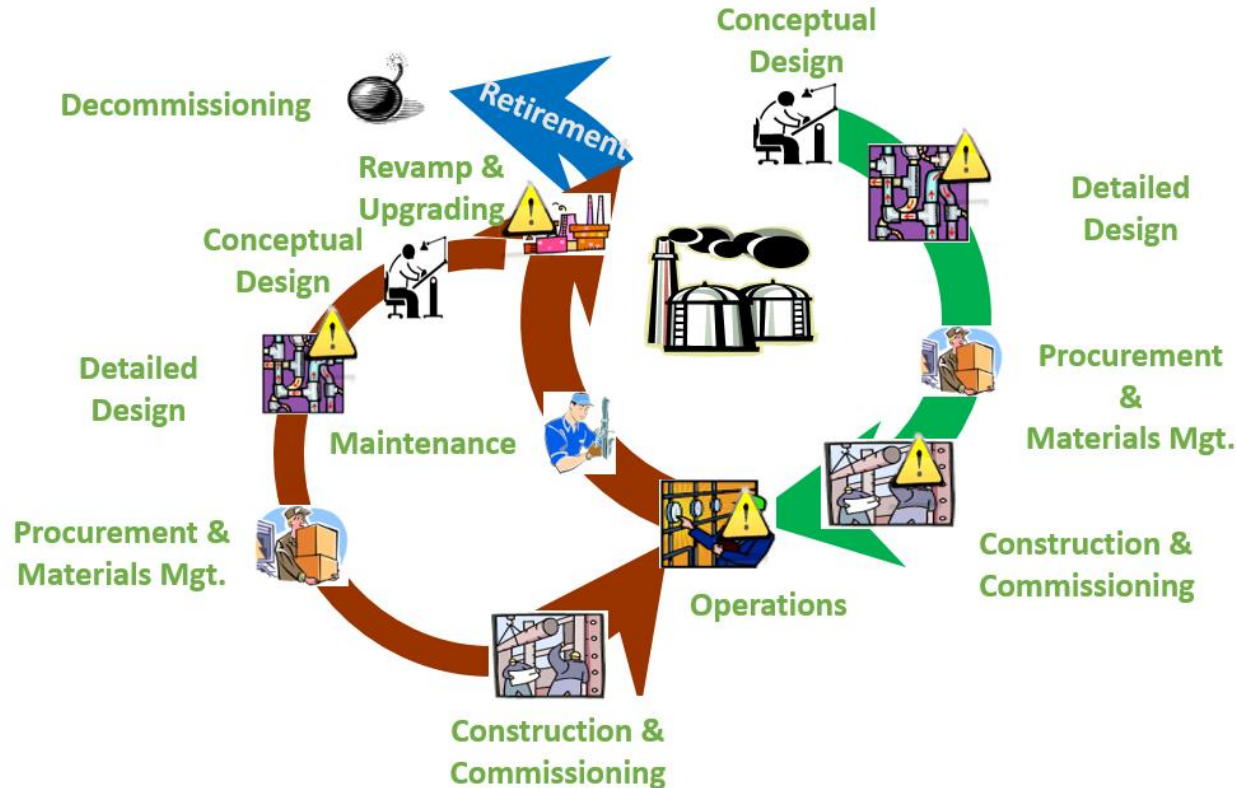
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Motivation statement

Data Exchange in Plant Life Cycle

Process Industry



Still typical work method

Between stakeholders like organizations or disciplines





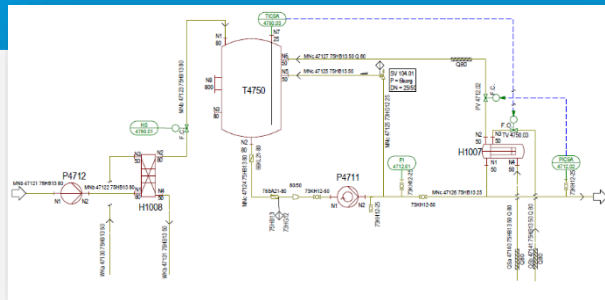
DEXPI group

DEXPI Mission

What we do

We work to create an **open**, neutral and reliable **data exchange standard** for the **process industry** to establish a future-proof **digitalized collaboration**.

... and we started with the P&ID



DEXPI approach

Think global, start with limited scope



Methodology: ISO 15926 + Proteus (XMpLant) scheme

All main CAE software vendors involved

Use existing standards (Do not re-invent the wheel)

Bottom up, pragmatic approach

International coverage, not only local

DEXPI – A Successful Team

International *Multi Sides Team*

Software Vendors

- Aucotec
- Autodesk
- Aveva
- Bilfinger
- Hexagon
- Siemens
- X-Visual
- eVision
- PTC

Owner / Operators

- BASF
- Bayer
- Covestro
- Equinor
- Evonik
- Merck

EPC

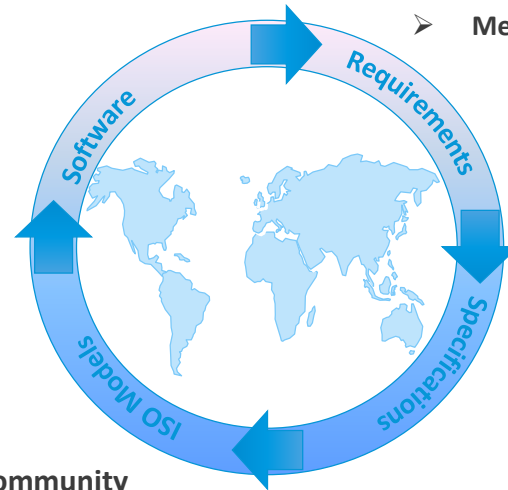
- Air Liquide

Research Organizations

- AixCAPE e.V.
- VTT of Finland
- TU Berlin
- RWTH Aachen University
- Tecgraf/ PUC-Rio
- Kyungpook National University

International Community

- ISO TC 184 SC4
- FIATECH / CII / POSC Caesar
- OPC Foundation
- CFIHOS
- DECHEMA / NAMUR / DKE / VDMA



DEXPI Organization

Open community

- DEXPI f2f meetings (6 per yr)
Frankfurt
- DEXPI hackathons (2 per yr)
- DEXPI marketing and technical
web meetings
- DEXPI annual management
meeting





DEXPI Deliverables

Deliverables

public license concept: cc-by-sa

1. DEXPI Specification for Exchange of PIDs (Version 1.2)
2. Extension for the Proteus Schema (resulting in Version 4.0.1)
3. Tools & Test cases
4. CAE Interfaces of the leading PID software

Face to the community



NEWS MEMBERS SPECIFICATIONS & SERVICES PUBLICATIONS CALENDAR

The objective of the DEXPI initiative is to develop and promote a general data exchange standard for the process industry, covering all phases of the lifecycle of a (petro-)chemical plant, ranging from specification of functional requirements to assets in operation. Currently, the focus of the DEXPI initiative is the exchange of Piping and Instrumentation diagrams (P&IDs).

DEXPI Data Exchange in the Process Industry

The objective of the DEXPI initiative is to develop and promote a general data exchange standard for the process industry, covering all phases of the lifecycle of a (petro-)chemical plant, ranging from specification of functional requirements to assets in operation. Currently, the focus of the DEXPI initiative is the exchange of Piping and Instrumentation diagrams (P&IDs).



Upcoming Events

- May 07 till 31, 2019
DEXPI @ Interoperability Summit hosted by the LCDM Project

Latest News

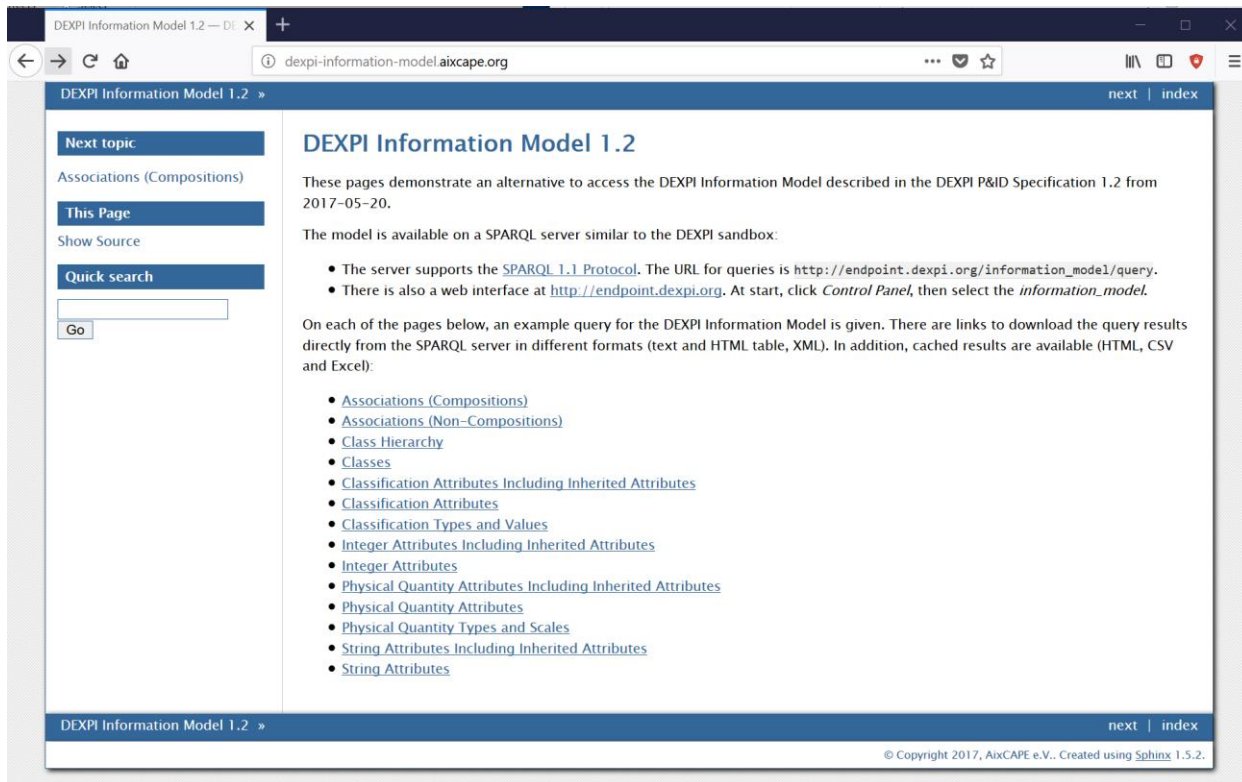
- May 03, 2019
DEXPI @ Fiatech meeting
- March 14, 2019
DEXPI Management Meeting 2019 - Summary
- December 11, 2018
Cooperation with KNU

Latest Publications

- January 17, 2019
Article in CIT: ENPRO Data Integration: Extending DEXPI Towards the Asset Lifecycle
- June 12, 2018
PraxisForum Data exchange in the process industry @ AICHEMA 2018
- November 20, 2017
DEXPI release presentation at PAAT 2017

DEXPI Information Model published

<http://dexpi-information-model.aixcape.org/>



The screenshot shows a web browser displaying the DEXPI Information Model 1.2 website. The browser's address bar shows the URL dexpi-information-model.aixcape.org. The website has a blue header with the title "DEXPI Information Model 1.2" and navigation links "next" and "index". On the left side, there is a sidebar with sections: "Next topic" (Associations (Compositions)), "This Page" (Show Source), and "Quick search" (with a search input field and a "Go" button). The main content area is titled "DEXPI Information Model 1.2" and contains the following text:

These pages demonstrate an alternative to access the DEXPI Information Model described in the DEXPI P&ID Specification 1.2 from 2017-05-20.

The model is available on a SPARQL server similar to the DEXPI sandbox:

- The server supports the [SPARQL 1.1 Protocol](#). The URL for queries is http://endpoint.dexpi.org/information_model/query.
- There is also a web interface at <http://endpoint.dexpi.org>. At start, click *Control Panel*, then select the *information_model*.

On each of the pages below, an example query for the DEXPI Information Model is given. There are links to download the query results directly from the SPARQL server in different formats (text and HTML table, XML). In addition, cached results are available (HTML, CSV and Excel):

- [Associations \(Compositions\)](#)
- [Associations \(Non-Compositions\)](#)
- [Class Hierarchy](#)
- [Classes](#)
- [Classification Attributes Including Inherited Attributes](#)
- [Classification Attributes](#)
- [Classification Types and Values](#)
- [Integer Attributes Including Inherited Attributes](#)
- [Integer Attributes](#)
- [Physical Quantity Attributes Including Inherited Attributes](#)
- [Physical Quantity Attributes](#)
- [Physical Quantity Types and Scales](#)
- [String Attributes Including Inherited Attributes](#)
- [String Attributes](#)

The footer of the website shows "DEXPI Information Model 1.2" and "next | index" links, along with a copyright notice: "© Copyright 2017, AixCAPE e.V.. Created using [Sphinx](#) 1.5.2."

SPARQL Endpoint Service

DEXPI ENDPOINT (fuseki)



Server Management

[Control Panel](#)

Documentation

[Fuseki documentation](#)

Validators

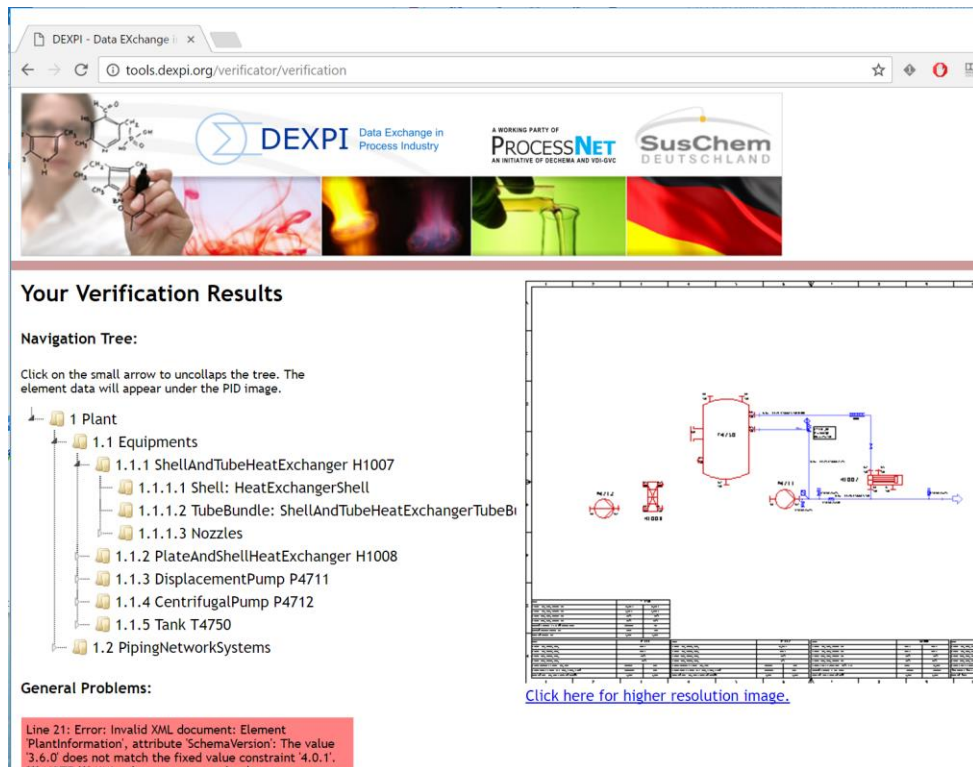
- [SPARQL query validator](#)
- [SPARQL update validator](#)
- [RDF data validator](#)
- [IRI validator](#)

Standards

- [SPARQL 1.1 Query](#)
- [SPARQL 1.1 Update](#)
- [SPARQL 1.1 Protocol](#)
- [SPARQL 1.1 Uniform HTTP Protocol for Managing RDF Graphs](#)

DEXPI Verificator

As offline versions available



Your Verification Results

Navigation Tree:

Click on the small arrow to uncollapse the tree. The element data will appear under the PID image.

- 1 Plant
 - 1.1 Equipments
 - 1.1.1 ShellAndTubeHeatExchanger H1007
 - 1.1.1.1 Shell: HeatExchangerShell
 - 1.1.1.2 TubeBundle: ShellAndTubeHeatExchangerTubeB
 - 1.1.1.3 Nozzles
 - 1.1.2 PlateAndShellHeatExchanger H1008
 - 1.1.3 DisplacementPump P4711
 - 1.1.4 CentrifugalPump P4712
 - 1.1.5 Tank T4750
 - 1.2 PipingNetworkSystems

General Problems:

Line 21: Error: Invalid XML document: Element 'PlantInformation', attribute 'SchemaVersion': The value '3.6.0' does not match the fixed value constraint '4.0.1'.

DEXPI Tools by AixCAPE®

DEXPI Verificator

The DEXPI verificator for Proteus XML files can be used from the command line or with a GUI. Both v same results: an HTML verification report (model structure and detected errors) and a separate error log can be read with recent versions of LibreOffice or Excel, for example). In some cases, Windows will ask use certain system ports when either program is used for the first time. You may need to have administra this permission.

dexpi-verificator.exe

Command line version of the verifier. The only required argument is the name or path of the Proteus : Run the program from a console with option -h to get more information.

dexpi-verificator-gui.exe

GUI version of the verifier.

Distributions

Current Version

- [Version 0.7 \(2018-04-17\)](#)


Older Versions

- [Version 0.6 \(2018-03-30\)](#)
- [Version 0.5 \(2018-01-25\)](#)
- [Version 0.4.2 \(2017-09-05\)](#)
- [Version 0.4.1 \(2017-06-19\)](#)
- [Version 0.4 \(2017-05-30\)](#)









[Home](#)

Test Cases

Free available on <https://gitlab.com/dexpi/TrainingTestCases>

 **Public Training Test Cases**
Project ID: 8453791

[Add license](#) [320 Commits](#) [9 Branches](#) [0 Tags](#) [20.5 MB Files](#)

| | |
|---|---|
|  C01V01-HEX.EX03-VER.IM01.html | SHAPE LIBRARY AND PLANT STRUCTURE ADD |
|  C01V01-HEX.EX03.png | SHAPE LIBRARY AND PLANT STRUCTURE ADD |
|  C01V01-HEX.EX03.xml | SHAPE LIBRARY AND PLANT STRUCTURE ADD |
|  C01V01-SAG.EX01.XML | Added SAG V01EX01 |
|  C01V01-SAG.EX02.XML | Upload C01V01-SAG.EX02.XML |
|  C01V01-SAG.EX02.pdf | Upload C01V01-SAG.EX02.PDF |
|  C01V01.pptx | Description of the new complete DEXPI P&ID |
|  readme.md | Update readme.md to point to conformance te |

  Star 1  Fork 1 [Clone](#)

stability experimental

DEXPI Interoperability Matrix








Automatically created by DEXPI-Matrix-Crawler version 0.3 Tue Jul 17 19:28:00 CEST 2018

Interoperability Matrix:

| — | AUD | AVV | HEX | SAG | VTT | XVT |
|-----|-------|------|-----|-------|-------|------|
| AUD | 0% | 0% | 0% | 1,8% | 14,3% | 1,8% |
| AVV | 7,1% | 0% | 0% | 5,4% | 14,3% | 3,6% |
| HEX | 19,6% | 0% | 0% | 10,7% | 17,9% | 5,4% |
| SAG | 21,4% | 1,8% | 0% | 3,6% | 17,9% | 1,8% |
| VTT | 0% | 0% | 0% | 0% | 0% | 0% |
| XVT | 0% | 0% | 0% | 0% | 0% | 0% |

DEXPI interfaces of software systems

CAE and smart applications

| CAE Vendor | Product | DEXPI Interface |
|--|-------------------|-----------------|
| Autodesk  AUTODESK | AutoCAD P&ID 2019 | Import & Export |
| Aucotec  AUCOTEC | Engineering Base | Export |
| Aveva  AVEVA <small>CONTINUAL PROGRESSION</small> | Aveva PID | Import & Export |
| Bilfinger  BILFINGER | PIDGraph | Export |
| Hexagon  HEXAGON | SmartPlant PID | Export |
| PCT  ptc | ThingWorx | Import |
| Siemens SIEMENS | Comos PID | Import & Export |
| VTT  VTT | Apros | Import |
| X-Visual  VISUAL | PID | Import |



DEXPI Technical Design Principles

DEXPI and the ENPRO Lifecycle

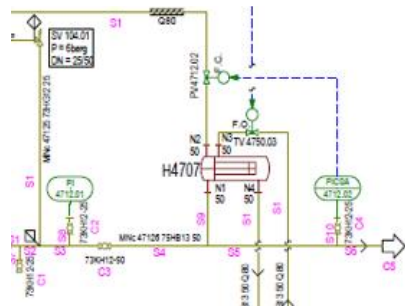
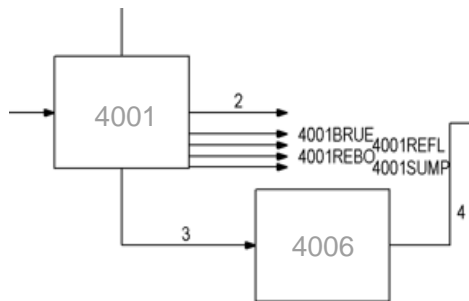
The asset lifecycle is separated into four aspects with three underlying data structures

**Functional
Requirements**

**Functional
Design**

**Asset
Specification**

**Asset
in Operation**



Process Structure

Plant Structure

Asset Structure

Design Principles

The DEXPI activities are driven by several basic development guidelines

Openness and transparency of the data model, test cases and communication

Usage of international accepted standards

Relation to different life cycle aspects

Digitalization = step from Documents to Data

Separation between engineering content and graphics

use of UML concepts like specialization and decomposition for the modelling of engineering and plant objects

P&ID main components

Data, graphics and topology

Piping

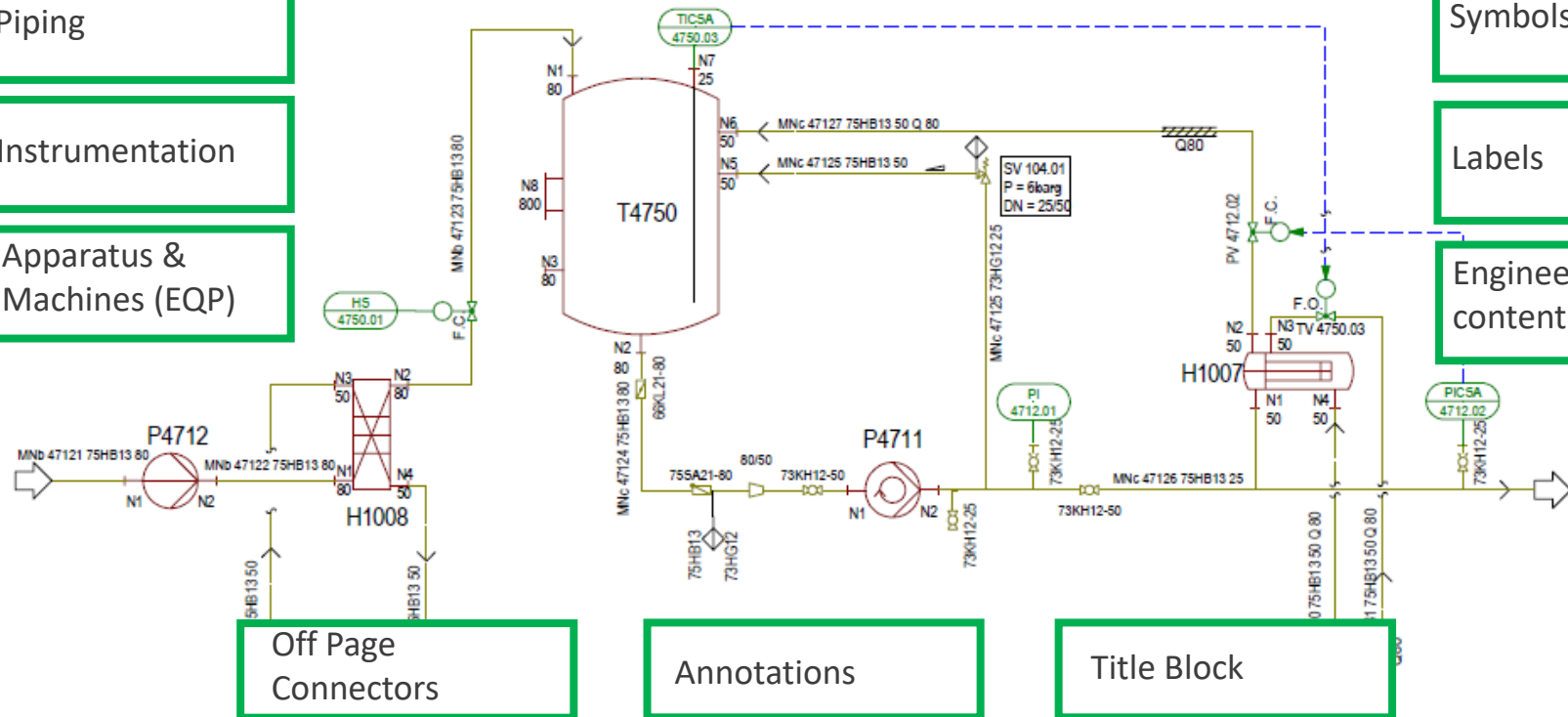
Instrumentation

Apparatus & Machines (EQP)

Symbols

Labels

Engineering content



International Standards

ISO and IEC

- **DEXPI specification based on international standards**
- **Applicable for IEC, ISA and DIN based P&IDs**

| Plant Structure | Apparatus / Machines | Piping components | Instrumentation | Communication |
|------------------------|-----------------------------|--------------------------|------------------------|----------------------------------|
| ISO 10209 | ISO 10628 | ISO 10628 | IEC 62424 | ISO 15926 |
| | | | IEC 61987 | Proteus 4.0.1 (formerly XMPlant) |

Plant Breakdown Structure

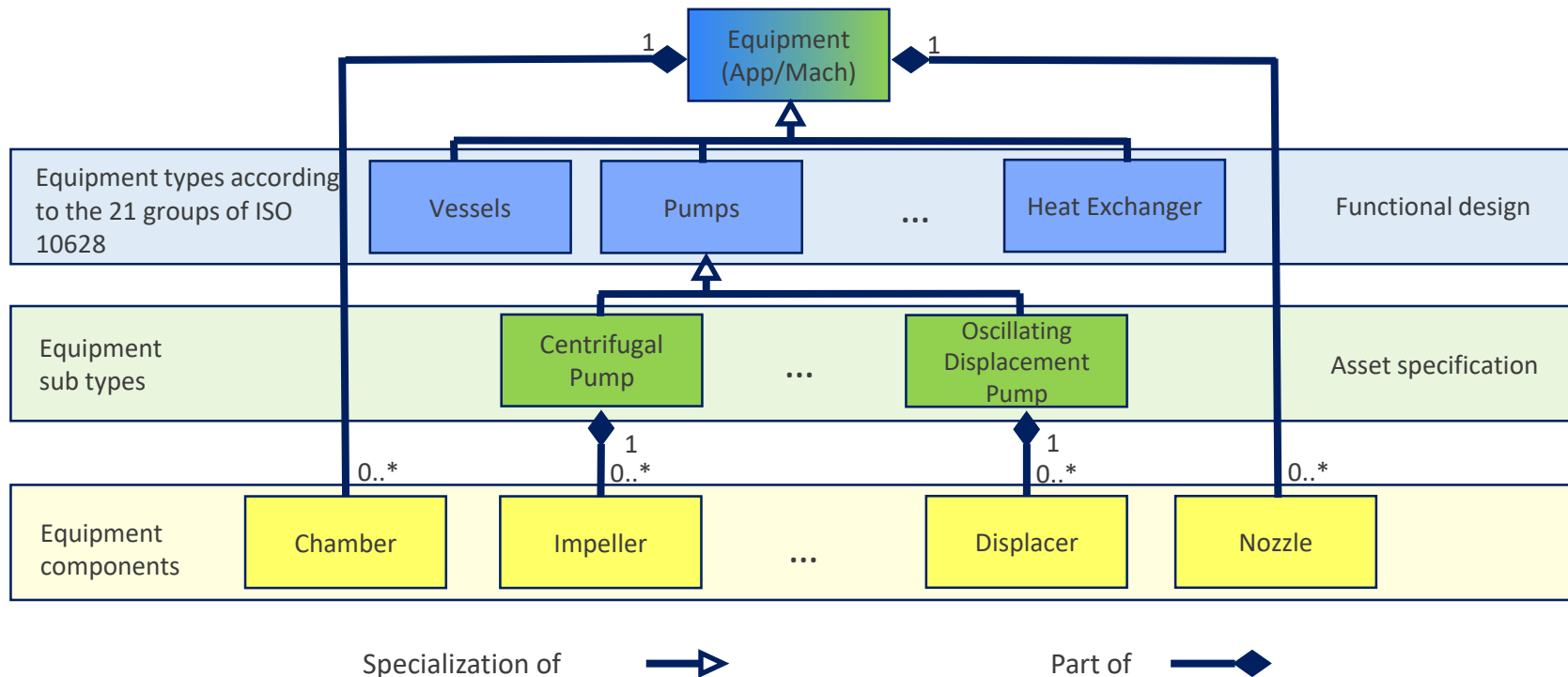
Based on ISO 10209

Elements of the identification system for a process plant

| ISO 10209:2012 | | ISA 95 | DIN 28000-3 | | DEXPI | |
|--------------------|-----------------------------|--------------|----------------------------|-----------------------------|--------------------|------------|
| en | de | | en | de | major | additional |
| | | Enterprise | | | Enterprise | |
| works | Werk | Site | Site | Standort | Site | |
| | | Area | | | | Area |
| industrial complex | Anlagenkomplex | | Industrial Complex | Anlagenkomplex, Betrieb | Industrial Complex | |
| process plant | verfahrenstechnische Anlage | Process Cell | Process Plant/Plant Unit | Verfahrenstechnische Anlage | Process Plant | |
| plant | Anlage | | | | | |
| plant section | Teilanlage | Unit | Subprocess/Plant Component | Teilanlage | Plant Section | |
| Equipment | Anlagenteil | | Technical Item | Technische Einrichtung | Plant Item | |

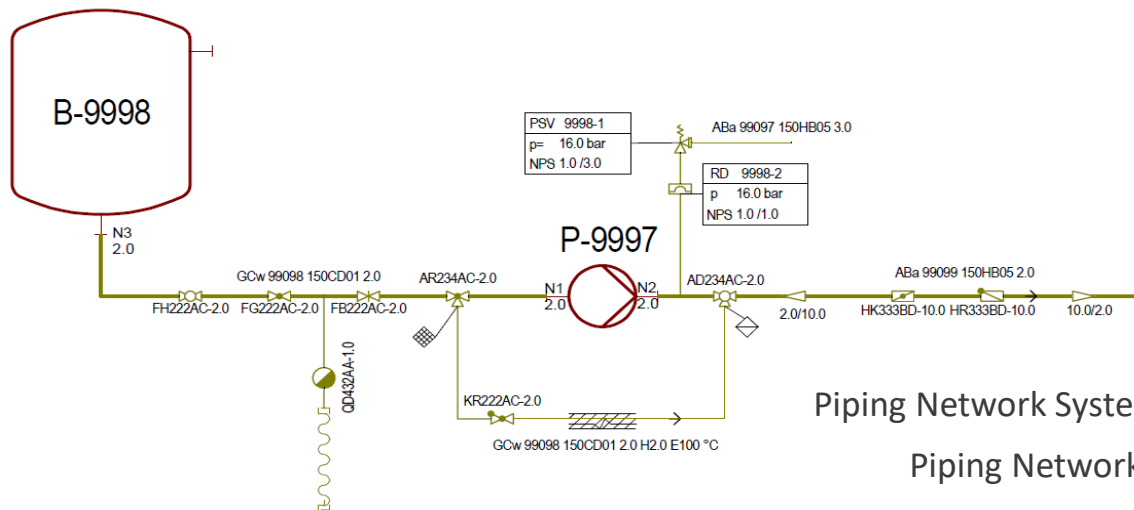
Equipment Taxonomy

Based on ISO 10628 and ISO 14224



Piping Taxonomy

Based on ISO 10628



Piping Network System

Piping Network Segment

Piping Components (ISO 10628:2012)

| | |
|----|--|
| 21 | Valves |
| 22 | Check valves |
| 23 | Valves and fittings with safety function |
| 24 | Fittings |

Class referencing

Use of ISO 15926 industry sandboxes

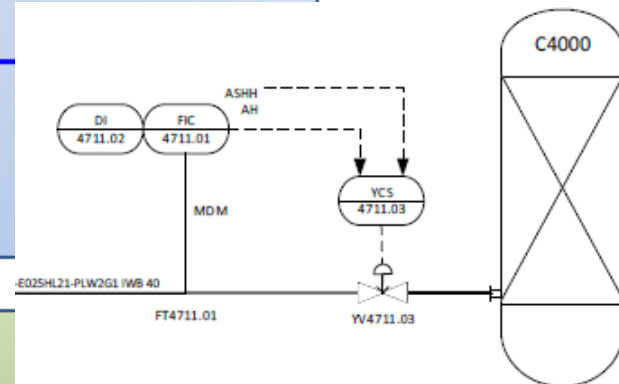
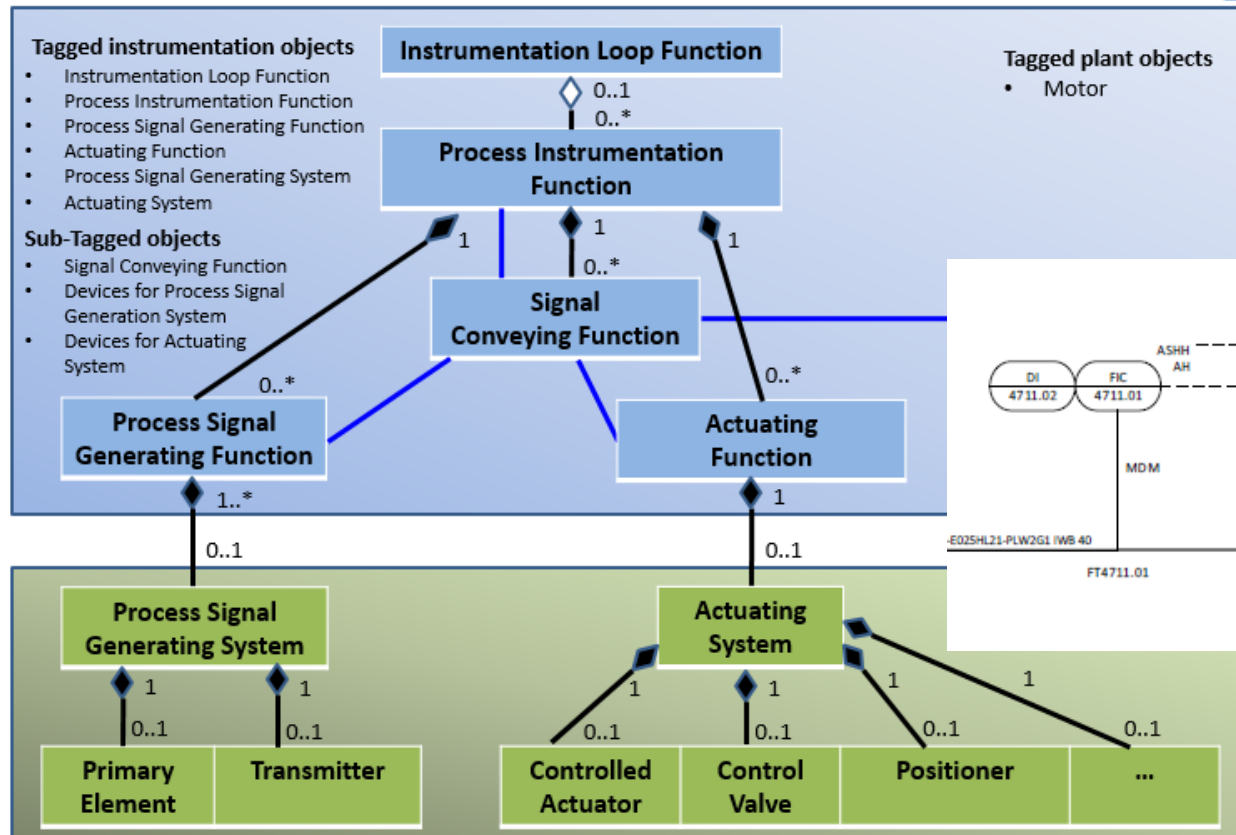
Examples for Equipment Subtypes:

| EQP Type | EQP Sub Type | RDL Class |
|----------|-----------------|---|
| VESSEL | | http://data.posccaesar.org/rdl/RDS414674 |
| | PRESSURE VESSEL | http://data.posccaesar.org/rdl/RDS427229 |

| EQP Type | EQP Sub Type | RDL Class | |
|----------------|--------------------------------|---|--------------------|
| VESSEL | | http://data.posccaesar.org/rdl/RDS414674 | 45139 |
| | PRESSURE VESSEL | http://data.posccaesar.org/rdl/RDS427229 | 322399 |
| | TANK | http://data.posccaesar.org/rdl/RDS445139 | acialVessel |
| | SILO | http://data.posccaesar.org/rdl/RDS1022399 | 34199 |
| | SPECIAL VESSEL | http://sandbox.dexpi.org/rdl/data/SpecialVessel | 19084 |
| HEAT EXCHANGER | | http://data.posccaesar.org/rdl/RDS304199 | 41719 |
| | SHELL AND TUBE HEAT EXCHANGER | http://data.posccaesar.org/rdl/RDS419084 | ralHeatExchanger |
| | PLATE AND SHELL HEAT EXCHANGER | http://data.posccaesar.org/rdl/RDS441719 | 4070475 |
| | <u>SpiralHeatExchanger</u> | http://sandbox.dexpi.org/rdl/data/SpiralHeatExchanger | 77379 |
| | ELECTRIC HEATER | http://data.posccaesar.org/rdl/RDS14070475 | ThinFilmEvaporator |
| | AIR COOLING SYSTEM | http://data.posccaesar.org/rdl/RDS277379 | 27239 |
| | <u>ThinFilmEvaporator</u> | http://sandbox.dexpi.org/rdl/data/ThinFilmEvaporator | 16834 |
| | | | 16969 |
| | | | 20749 |
| | | | 30624 |
| | | | acialPump |
| | | | 4286497 |
| | | | 17194 |
| | | | 17284 |
| | | | 35374 |
| | | | 17239 |
| | | | 770157 |
| | | | acialCompressor |

Instrumentation

based on:
IEC 62424



based on:
IEC 61987

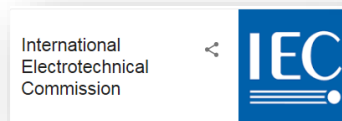


DEXPI Collaboration

DEXPI's Influence and cooperation

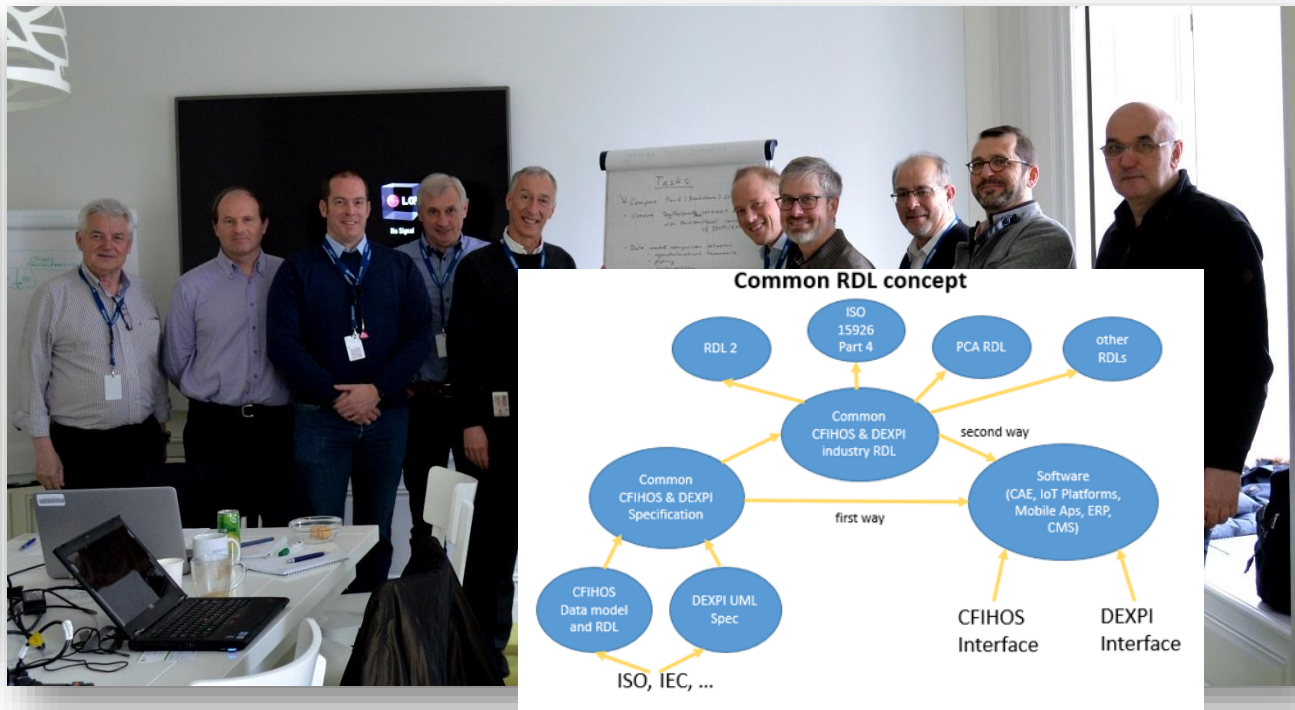


Other big player

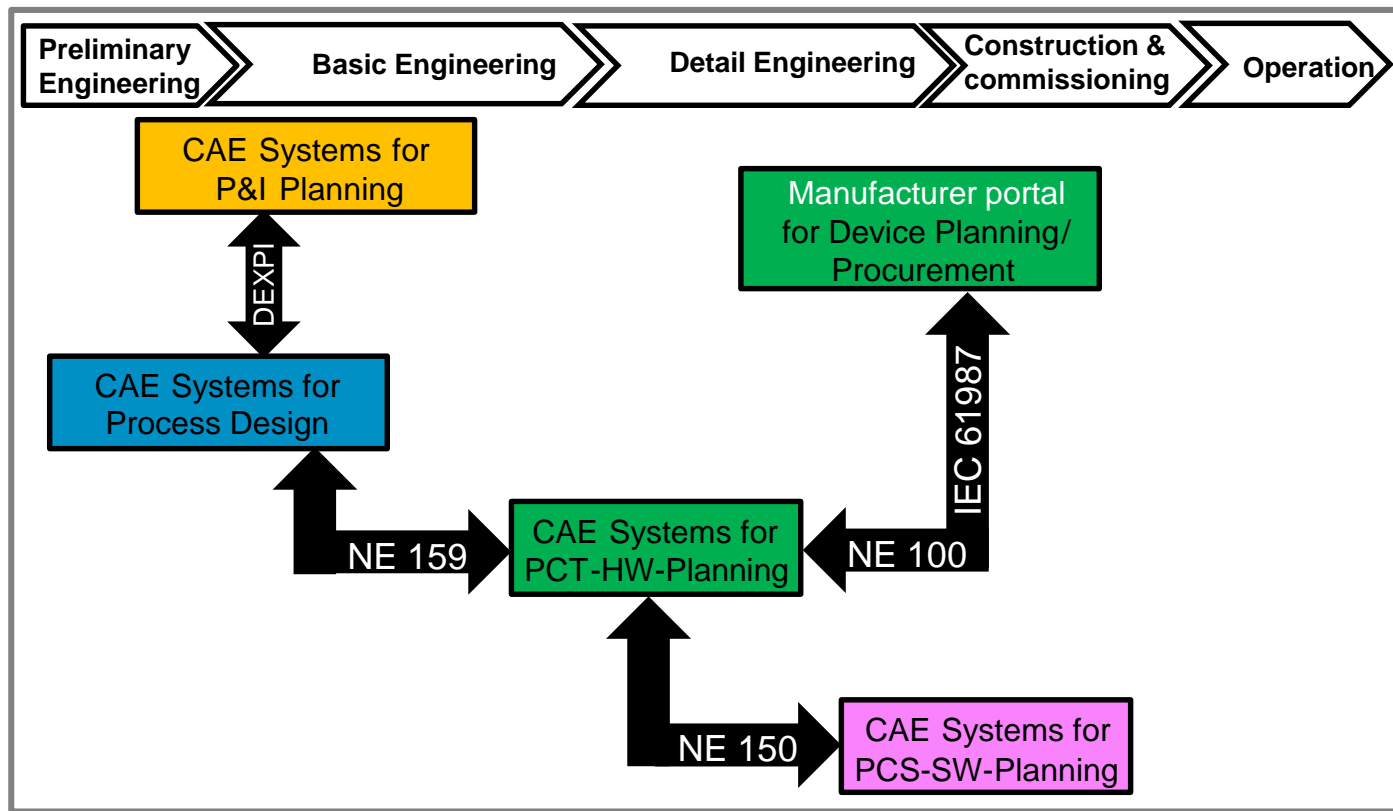


DEXPI & CFIHOS

Working closer together: MoU signed and content alignment takes place



Instrumentation data models aligned with DEXPI



NAMUR and DEXPI

Outlook: Instrumentation – international standardization





Next steps

Next steps

DEXPI into the daily business

- use in capital projects
 - P&ID exchange
 - Interface to other disciplines like cost estimation, instrumentation, 3D, ...
 - Handover together with CFIHOS
 - Generation of the Plant Maintenance structure
 - smart construction and maintenance support
 - Data analysis by use of OPC UA adapter – predictive maintenance
 - ...
- DEXPI product management: operation, maintenance and extensions
- future cooperation with CFIHOS, NAMUR, OPC UA, ...
- more global presence