DEXPI®
Data Exchange in
the Process Industry

DEXPI and CAPE-OPEN
Progress and Prospects One Year On

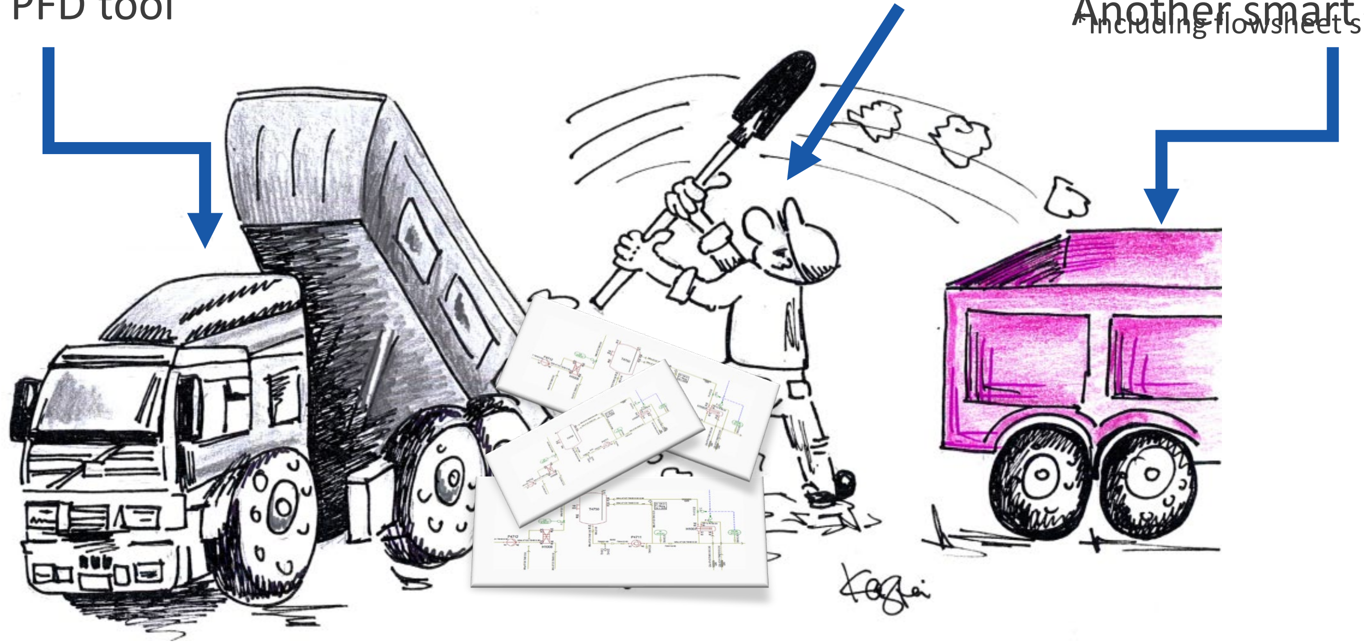
David Cameron
University of Oslo

Gregor Tolksdorf
Evonik

Why DEXPI (+ CAPE-OPEN/COLaN)?

DEXPI Problem Statement

PFD – Process Flow Diagram



Smart PFD tool

You

Another smart PFD tool*

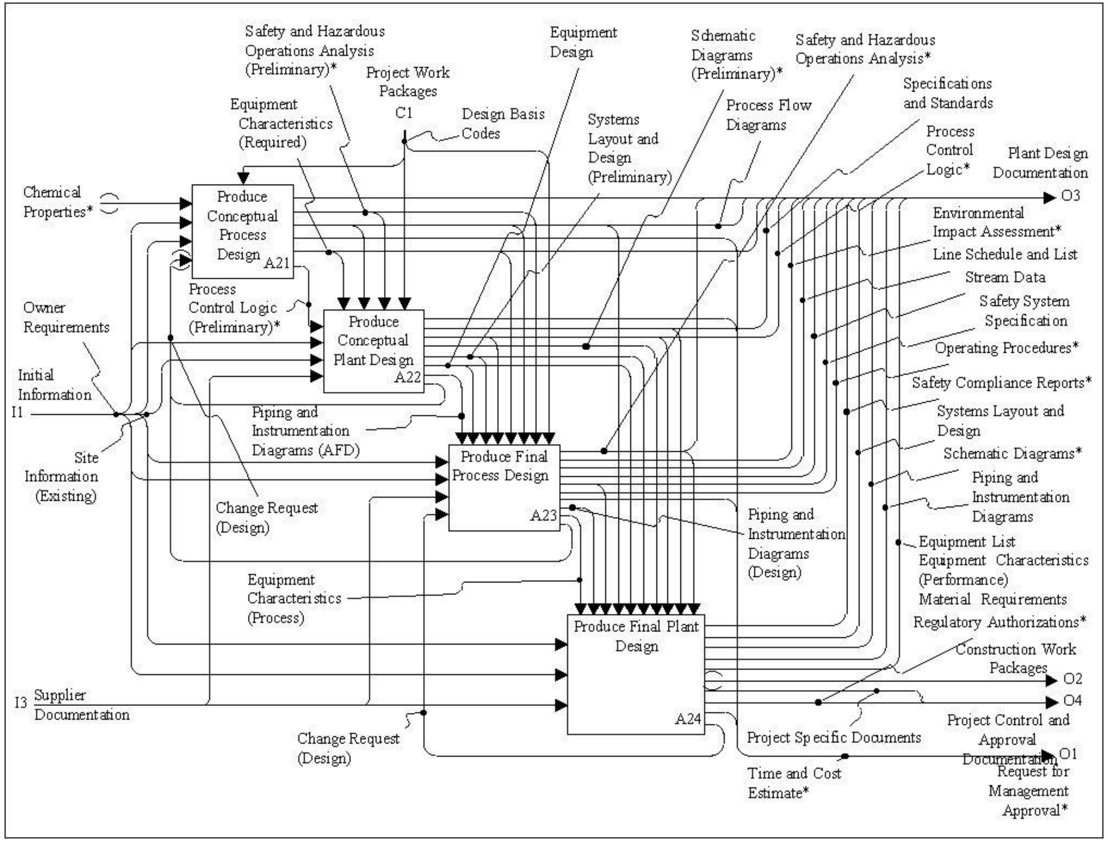
Another smart PFD tool*

*including flowsheet simulation

Back to the Future

What we are trying to avoid

ISO 10303-221:2007(E) Application protocol: Functional data and their schematic representation for process plants


Safety and Hazardous Operations Analysis (Preliminary)*
Project Work Packages
C1
Equipment Characteristics (Required)
Design Basis Codes
Equipment Design
Schematic Diagrams (Preliminary)*
Safety and Hazardous Operations Analysis*
Specifications and Standards
Systems Layout and Design (Preliminary)
Process Flow Diagrams
Process Control Logic*
Plant Design Documentation
O3
Chemical Properties*
Produce Conceptual Process Design
A21
Process Control Logic (Preliminary)*
Owner Requirements
Initial Information
I1
Site Information (Existing)
Produce Conceptual Plant Design
A22
Piping and Instrumentation Diagrams (AFD)
Change Request (Design)
Produce Final Process Design
A23
Equipment Characteristics (Process)
Environmental Impact Assessment*
Line Schedule and List
Stream Data
Safety System Specification
Operating Procedures*
Safety Compliance Reports*
Systems Layout and Design
Schematic Diagrams*
Piping and Instrumentation Diagrams
Piping and Instrumentation Diagrams (Design)
Equipment List
Equipment Characteristics (Performance)
Material Requirements
Regulatory Authorizations*
Produce Final Plant Design
A24
Construction Work Packages
O2
O4
I3 Supplier Documentation
Change Request (Design)
Project Specific Documents
Project Control and Approval Documentation
O1
Time and Cost Estimate*
Request for Management Approval*

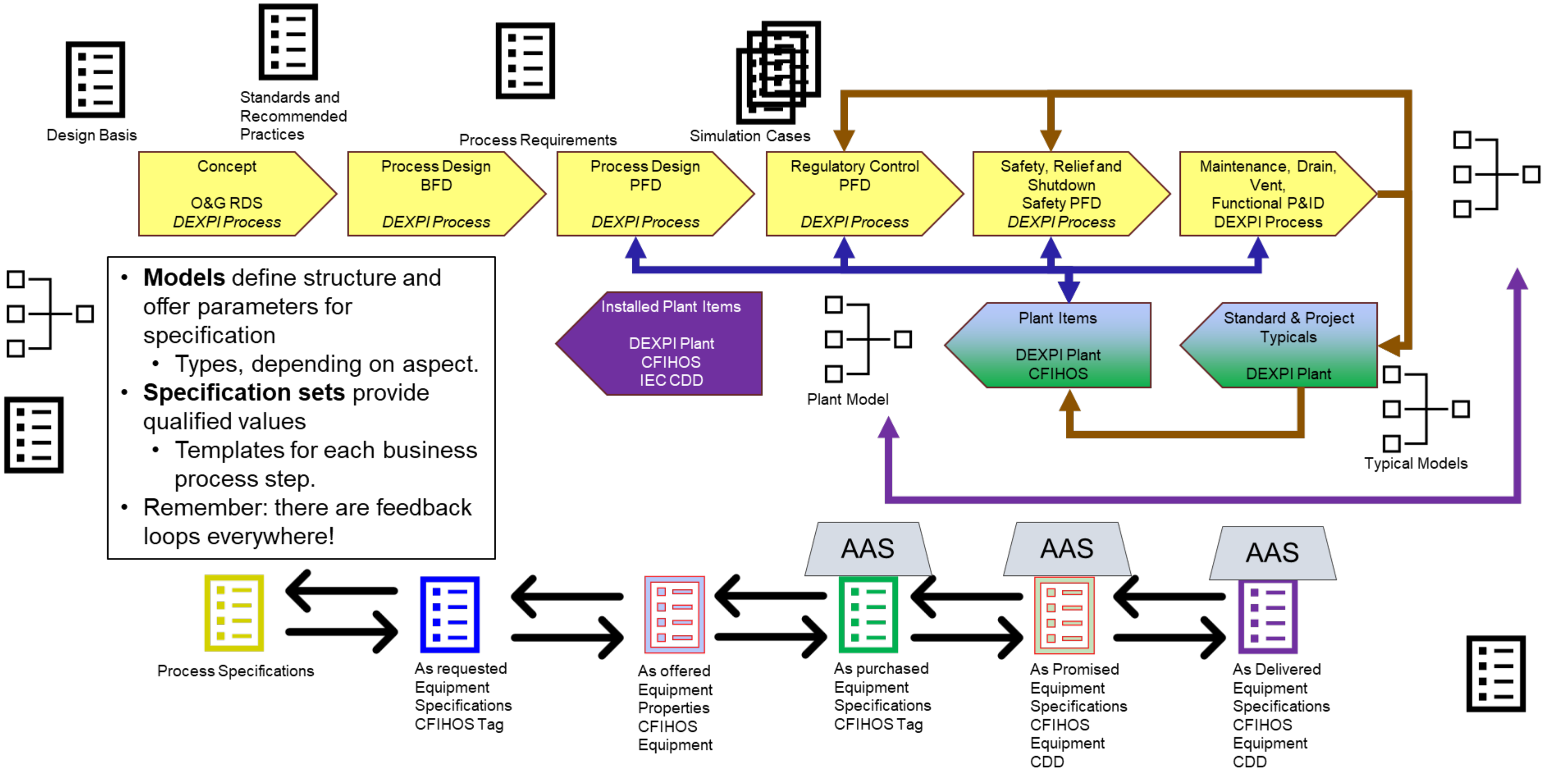
DEXPI® Data Exchange in the Process Industry

DEXPI is a data model, not just a document exchange format!

DEXPI Process and Plant

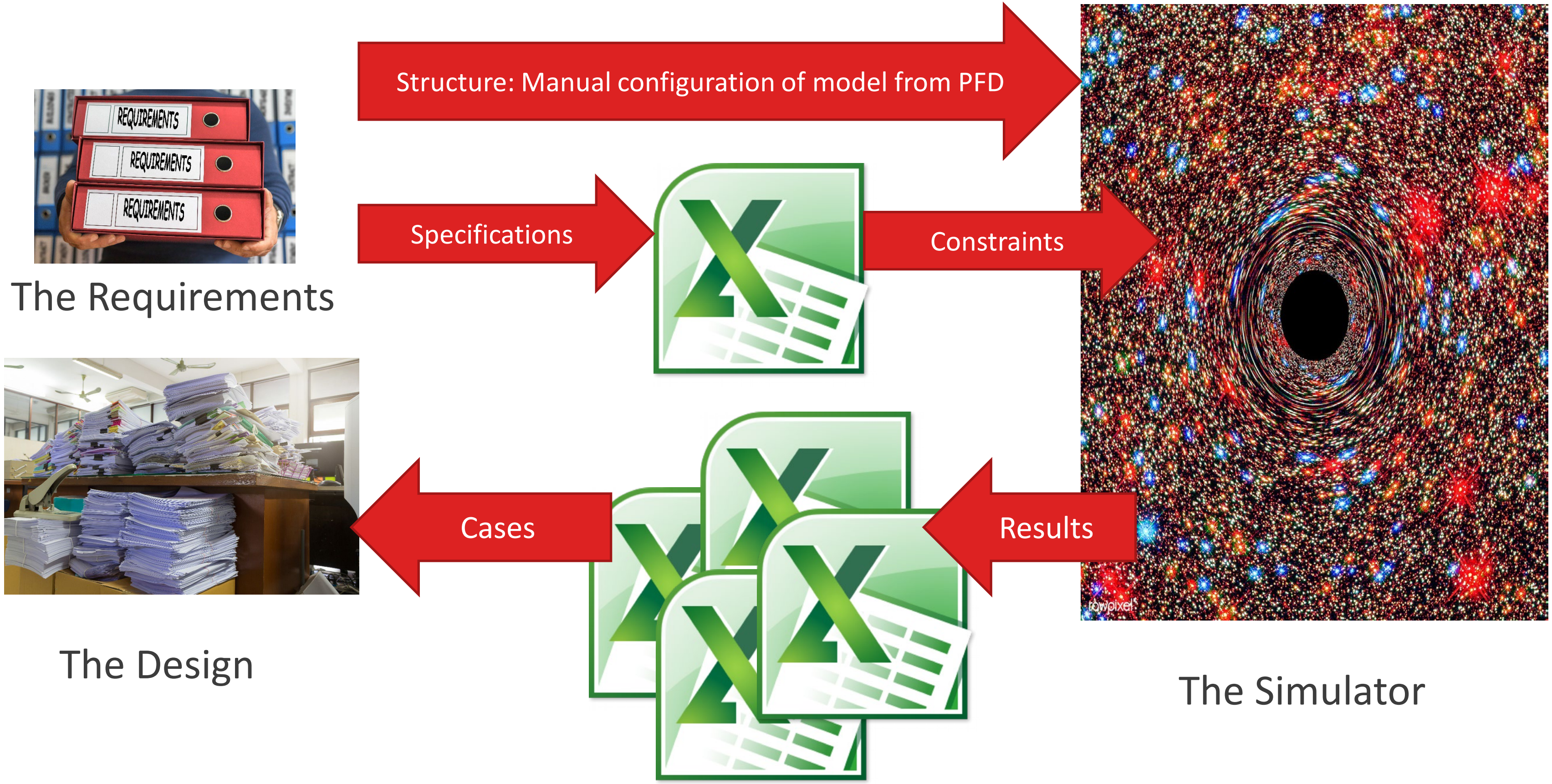
DEXPI® Data Exchange in the Process Industry

A Framework for Storing and Exchanging Process and Plant Design


Design Basis
Standards and Recommended Practices
Process Requirements
Simulation Cases
Concept
O&G RDS
DEXPI Process
Process Design
BFD
DEXPI Process
Process Design
PFD
DEXPI Process
Regulatory Control
PFD
DEXPI Process
Safety, Relief and Shutdown
Safety PFD
DEXPI Process
Maintenance, Drain, Vent,
Functional P&ID
DEXPI Process
Installed Plant Items
DEXPI Plant
CFIHOS
IEC CDD
Plant Model
Plant Items
DEXPI Plant
CFIHOS
Standard & Project Typicals
DEXPI Plant
Typical Models
AAS
AAS
AAS
Process Specifications
As requested Equipment Specifications CFIHOS Tag
As offered Equipment Properties CFIHOS Equipment
As purchased Equipment Specifications CFIHOS Tag
As Promised Equipment Specifications CFIHOS Equipment CDD
As Delivered Equipment Specifications CFIHOS Equipment CDD

- **Models** define structure and offer parameters for specification
  - Types, depending on aspect.
- **Specification sets** provide qualified values
  - Templates for each business process step.
- Remember: there are feedback loops everywhere!

Today’s Process Design Approach



Structure: Manual configuration of model from PFD

Specifications

Constraints

Results

Cases

The Requirements

The Design

The Simulator

Aspects of a Plant

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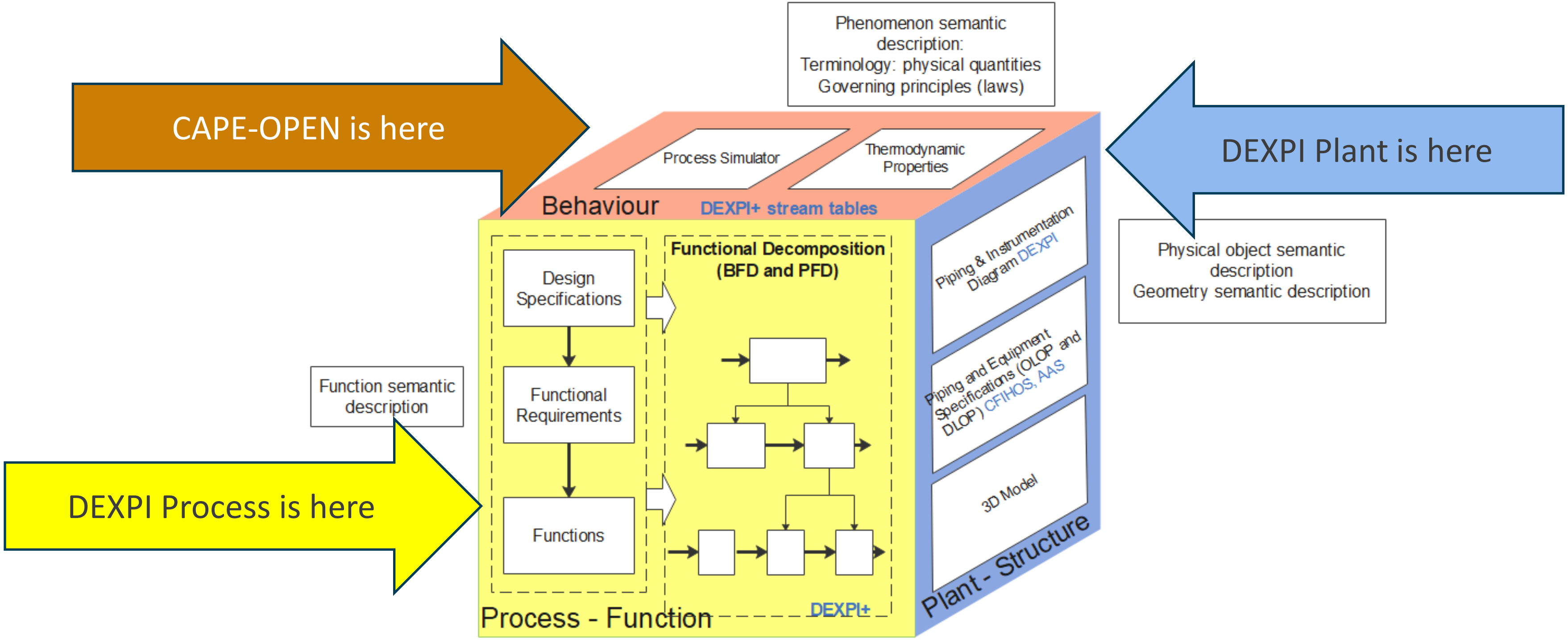
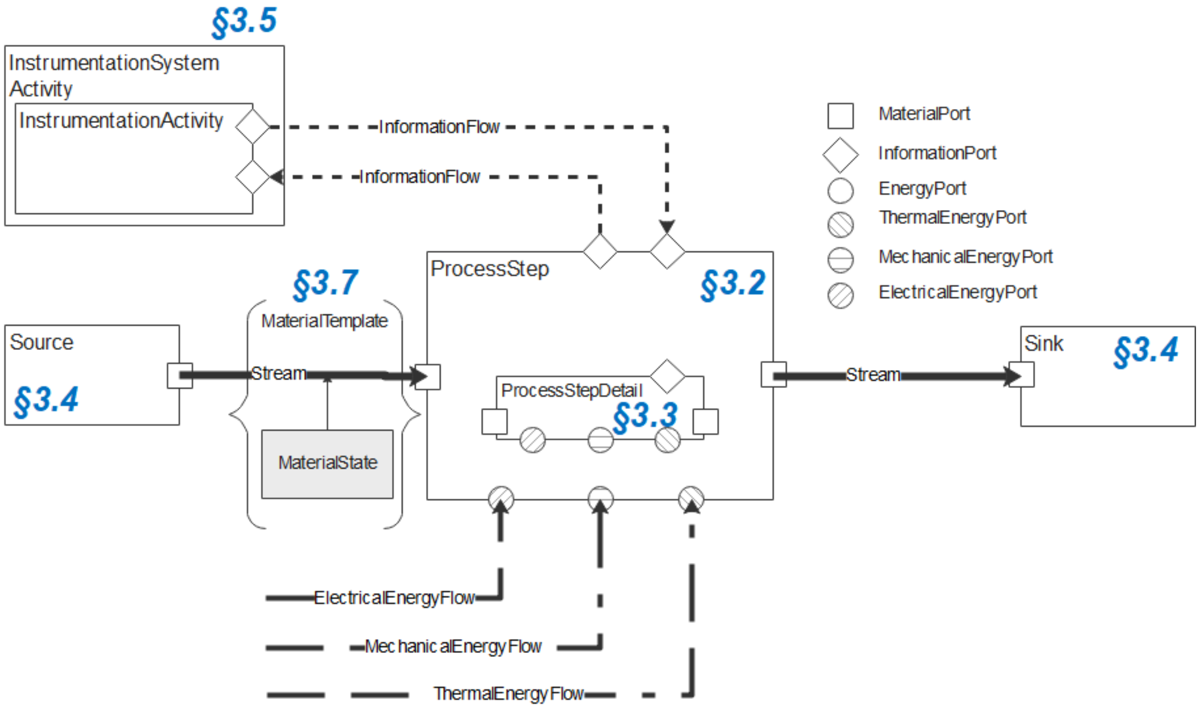
Three aspects: function (process), behaviour and structure (plant)



CAPE-OPEN is here
Phenomenon semantic description:
Terminology: physical quantities
Governing principles (laws)
DEXPI Plant is here
Process Simulator
Thermodynamic Properties
Behaviour
DEXPI+ stream tables
Physical object semantic description
Geometry semantic description
Design Specifications
Functional Requirements
Functions
Functional Decomposition (BFD and PFD)
Piping & Instrumentation Diagram DEXPI
Piping and Equipment Specifications (OLOP and DLOP) CFIHOS, AAS
3D Model
Function semantic description
DEXPI Process is here
Process - Function
DEXPI+
Plant - Structure

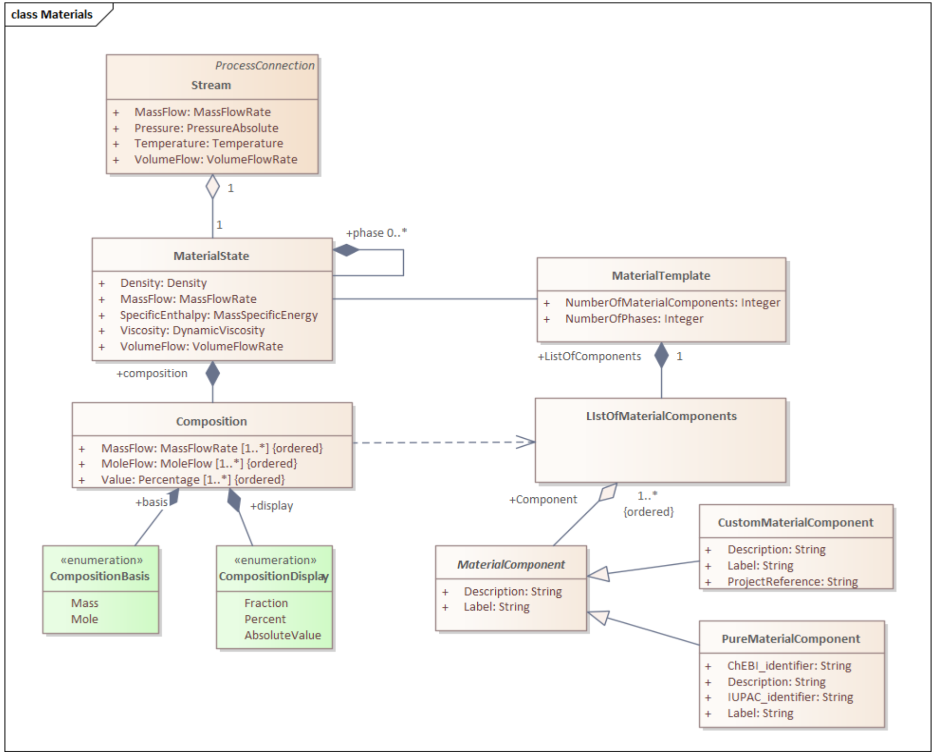
The DEXPI Process core objects

Connected blocks and parameters



Streams provide support for a flexible stream table

Philosophy built on CAPE-OPEN and OntoCAPE



A **Material Template** defines the structure of a family of streams.

The **Material State** object can be configured to contain data for total streams and each phase.

This offers potential for data exchange with simulators. With a CAPE-OPEN specification?

A hierarchy of process steps

Characterized by reference data for *activities,* verbs, not things, nouns.

- Generate Flow: Compressing and Pumping.
- Mix.
- Split.
- Transport Material and Energy.
- Store.
- Supply Materials and Energy.
- Supply Exchange of Thermal Energy.
  - Heating, Cooling, Exchange of Heat.
- Separation.
  - Phase separation, Thermal processes, Filtering, Electromagnetics, Physical Processes.
- Process solids.
  - Reduce size, Increase size, Form material.
- React Chemicals.
- Packaging.

PROCESS STEP /
Technical Systems

What must be done?
Separate, Transport, Compress...

Unit Operations /
Component Systems

What must be done?
How?
Separate by distillation, Transport in piping, Compress by centrifugal motion

Using DEXPI Process files to Store Design Cases

Model	Characterizations
Dataset containing **structure** of the process - ProcessSteps with Ports Parameters - ProcessConnections	Datasets containing **specifications** of the process - ProcessSteps with Parameter values - ProcessConnections with Specified values in MaterialState, EnergyFlow or InformationFlow values
	Datasets containing **results, the behaviour** of the process - ProcessSteps with Parameter values - ProcessConnections with calculated values in MaterialState, EnergyFlow or InformationFlow values

Interactions with Simulator

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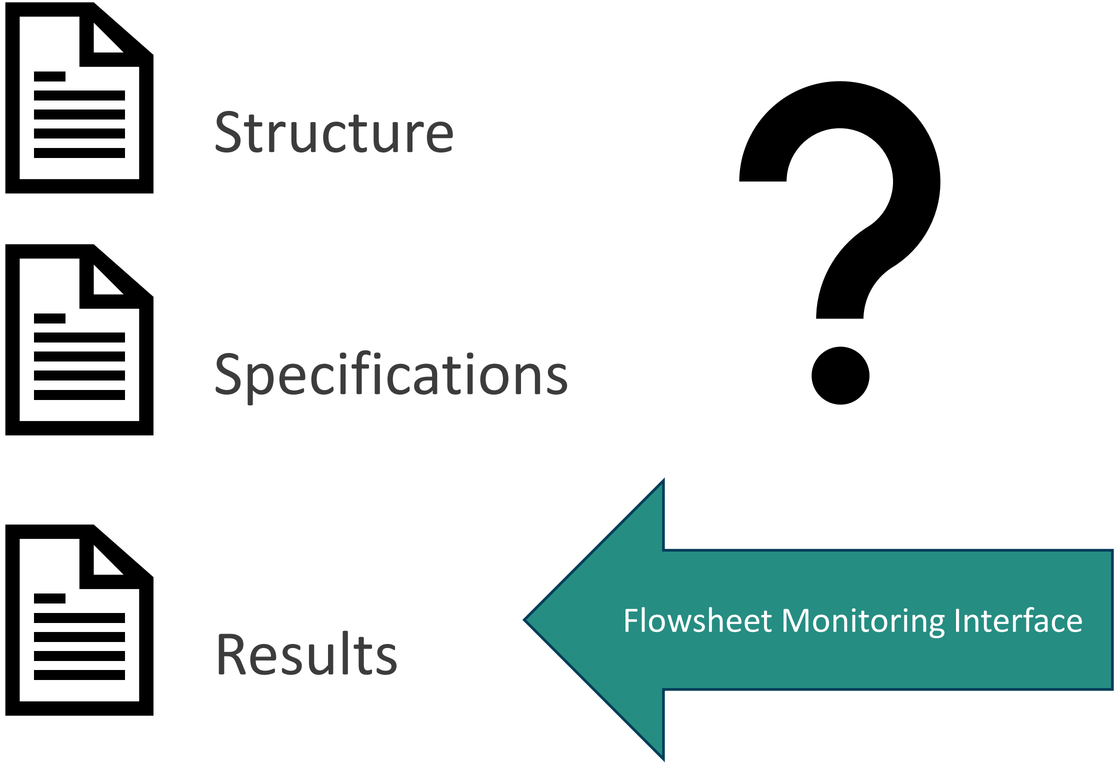

Structure

Specifications

Results

Flowsheet Monitoring Interface

- Manual, simulator-specific mapping of DEXPI Process Steps to Unit Operations in Library.
- Manual mapping of stream identifiers.
- Manual mapping of Material Template structures.
- No configuration or writing of parameters to PME in CAPE-OPEN

Could be automated once mappings are done.

Interaction Points for the Monitoring Interface

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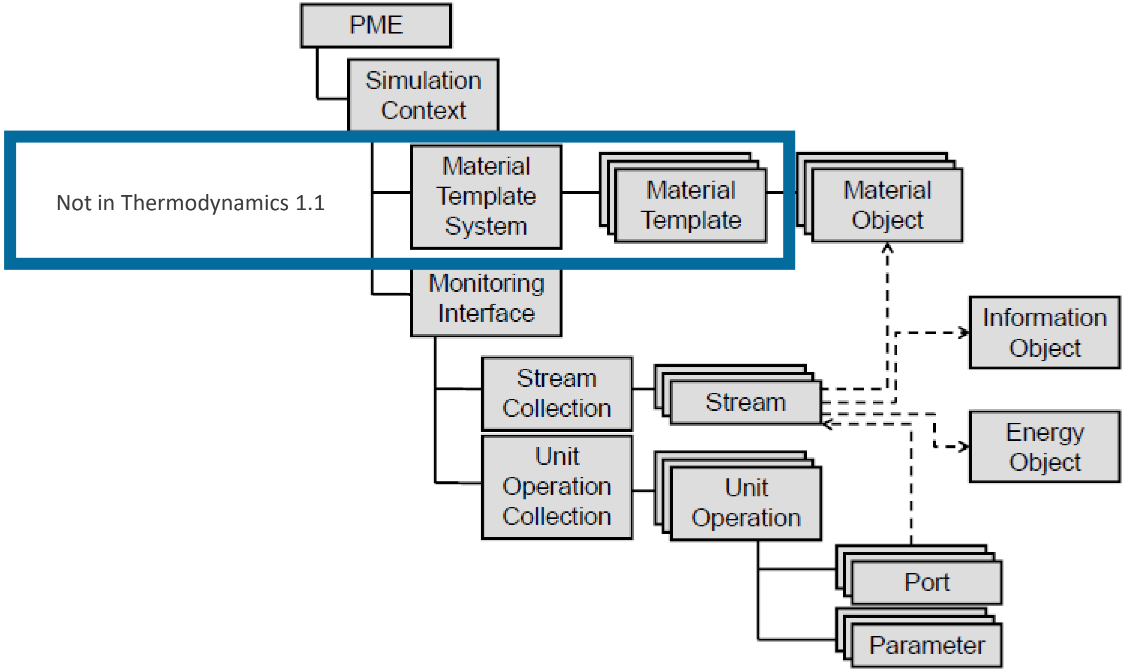
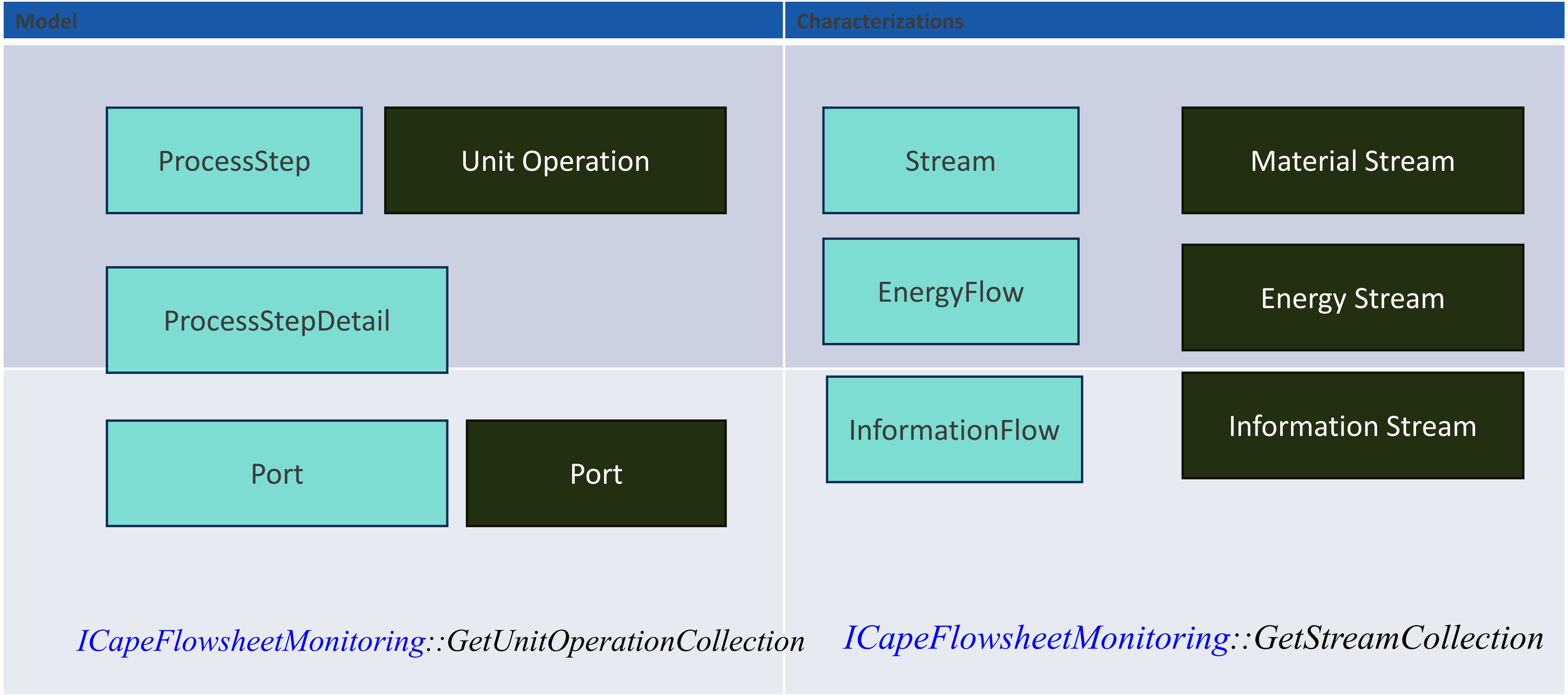


DEXPI Process Structures and CAPE-OPEN objects



Model

ProcessStep

Unit Operation

ProcessStepDetail

Port

Port

ICapeFlowsheetMonitoring::GetUnitOperationCollection

Characterizations

Stream

Material Stream

EnergyFlow

Energy Stream

InformationFlow

Information Stream

ICapeFlowsheetMonitoring::GetStreamCollection

Extracting Process Information from Simulators

Preliminary work (for each of your preferred simulators) – mapping **types**.

- Map **ProcessStep types** in DEXPI standard to library **Unit Operations** in process simulator.
- Map standard **port** structures in DEXPI standard to library Unit Operation ports in process simulator.
- Map block **Parameters** with exposed parameters from each library Unit Operation.

Project-specific work – mapping instances

- Map **DEXPI Material Template** with **CAPE-OPEN Material Object** structure.
- Map DEXPI ProcessStep identifiers with Unit Operation identifiers.
- Map DEXPI Parameter identifiers (if necessary) with exposed Parameter identifiers.
- Map DEXPI Stream, EnergyFlow and InformationFlow identifiers with Unit Operations identifiers.
- Map **CAPE-OPEN Material Objects** with DEXPI Material State objects.