Data Exchange in the Process Plant Industry:
P&ID Exchange through DEXPI and ISO 15926

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Global Business Development Process Plant

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Class summary

DEXPI is the German industry initiative to support and promote the ISO 15926 standard for plant data transfer, and it has reached a major milestone: the definition of standard specification covering a complete piping and instrumentation diagram (P&ID).

Autodesk developed a proof-of-concept application for **AutoCAD P&ID** software to import/export P&ID data fully implementing this DEXPI specification.

Key learning objectives

At the end of this class, you will – hopefully - be able to understand:

- Challenges and opportunities of implementing a data exchange standard for semantic PI&Ds
- ISO 15926 / DEXPI in the context of P&ID data exchange
- Autodesk DEXPI/ISO15926 strategy and implementation
- The rationale and benefits of a close partnership between industry and Autodesk

These are NOT Key learning objectives

- What a PID is (Hope you know it though)
- How to use AutoCAD P&ID
- How to develop an interface for AutoCAD
- How to win the US presidential elections

Agenda

Problem Statement
Data – Information - Knowledge
Data exchange in Process Plant
IFC & BuildingSMART
ISO15926
DEXPI/ISO15926 Initiative
Cooperation w/ Industry Groups
Summary, Q&A

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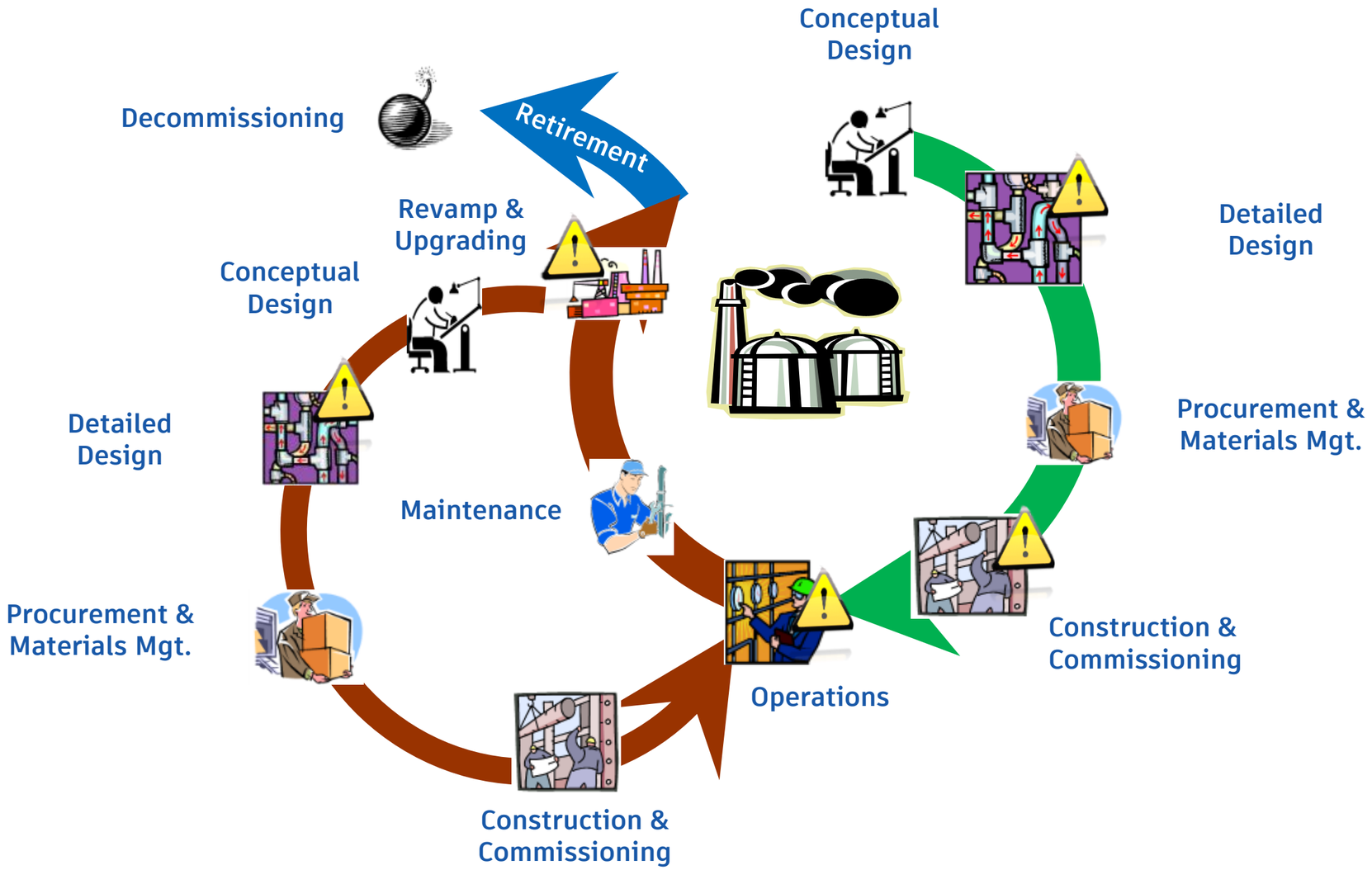
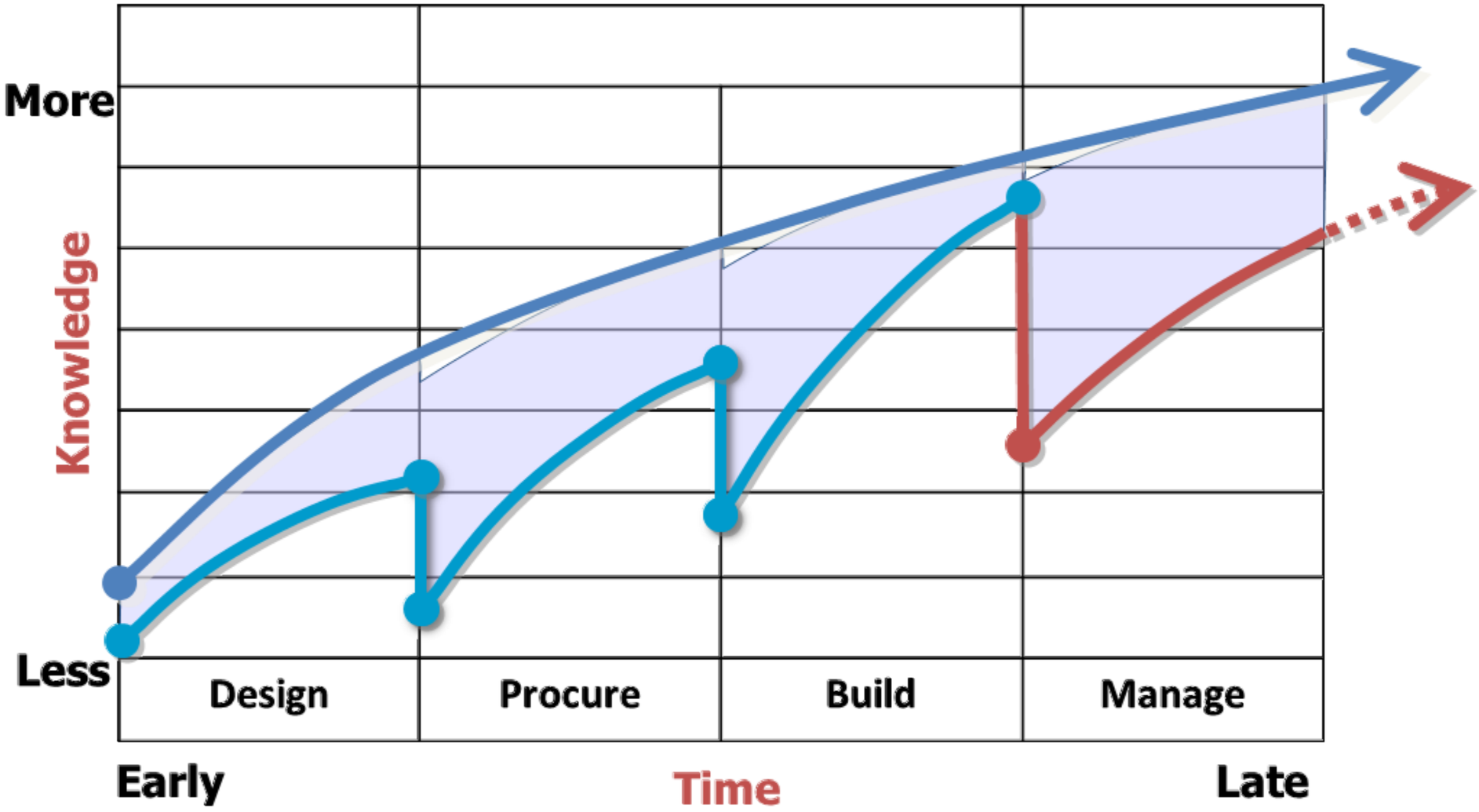
Data exchange in plant life cycle



Loss of information during life cycle



Loss of information during life cycle

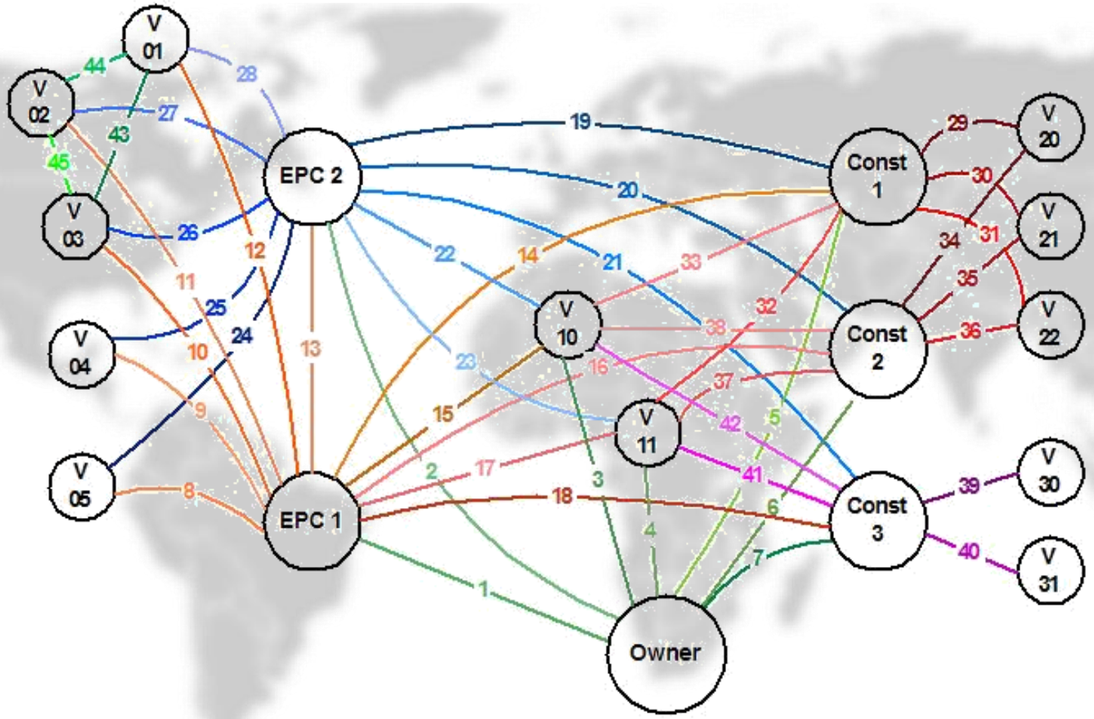
“To do data handover from design to operations in our last project - 100,000 man hours“

Martin Rittmeister, October 2013

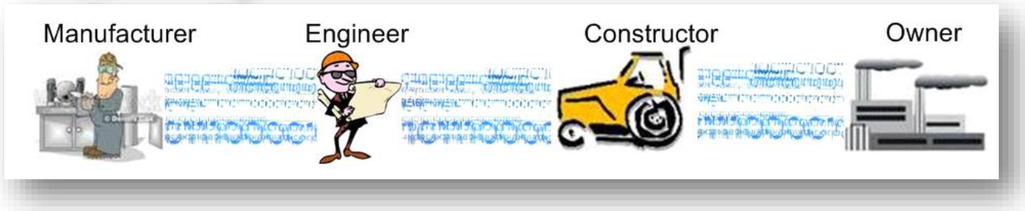
VP of Engineering @ Linde Engineering

http://www.linde-engineering.com/en/index.html

Project in Process Plant
who with whom what why and how



- Projects are complex and global with permanent data exchange
- Multiple of:
  - Interfaces
  - Communication paths
  - Languages incl. barriers



Communication paths and media

Paper

Data media (CDRW, USB)

FTP

E-Mail

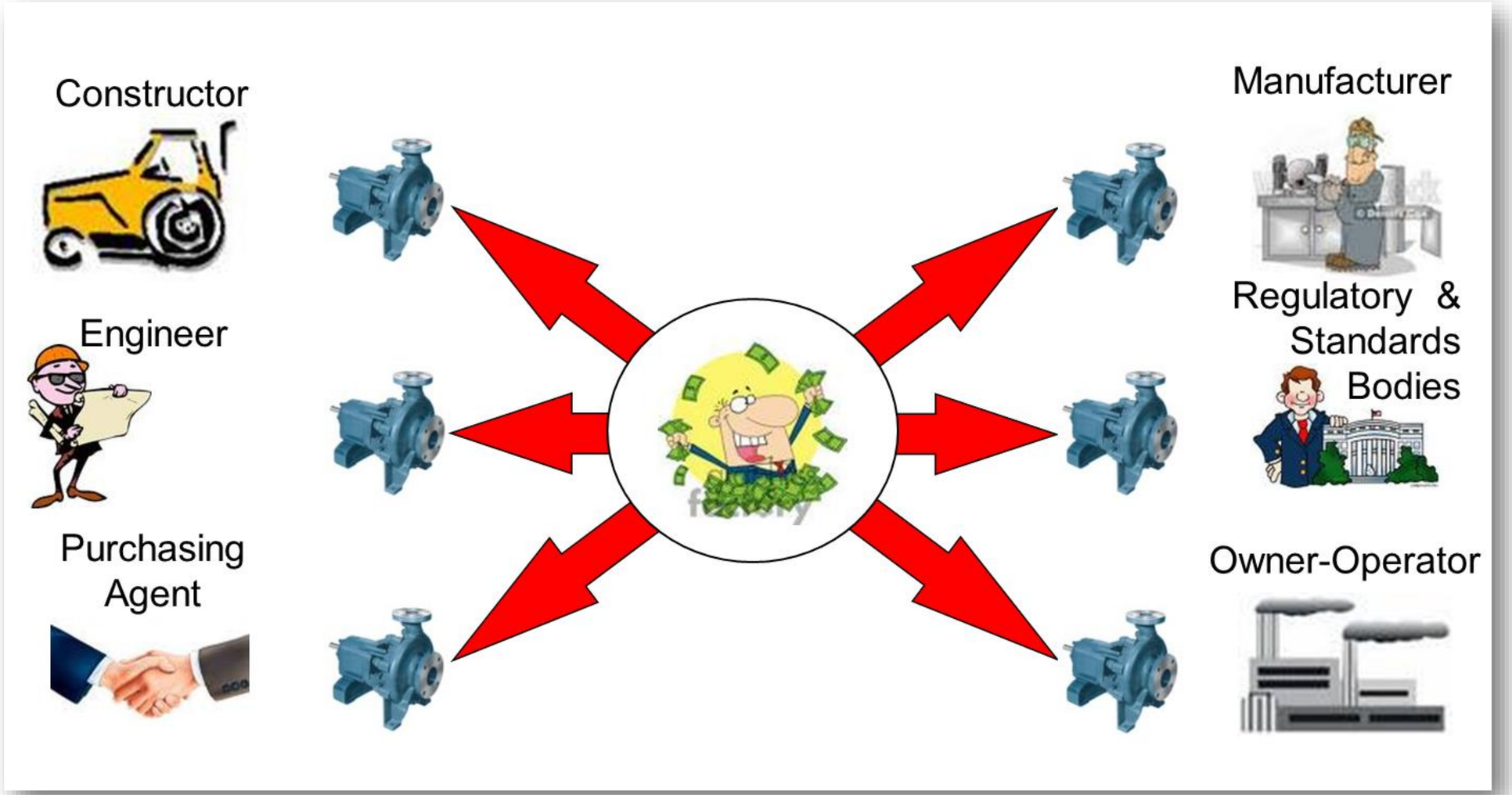
VPN

Cloudstorage

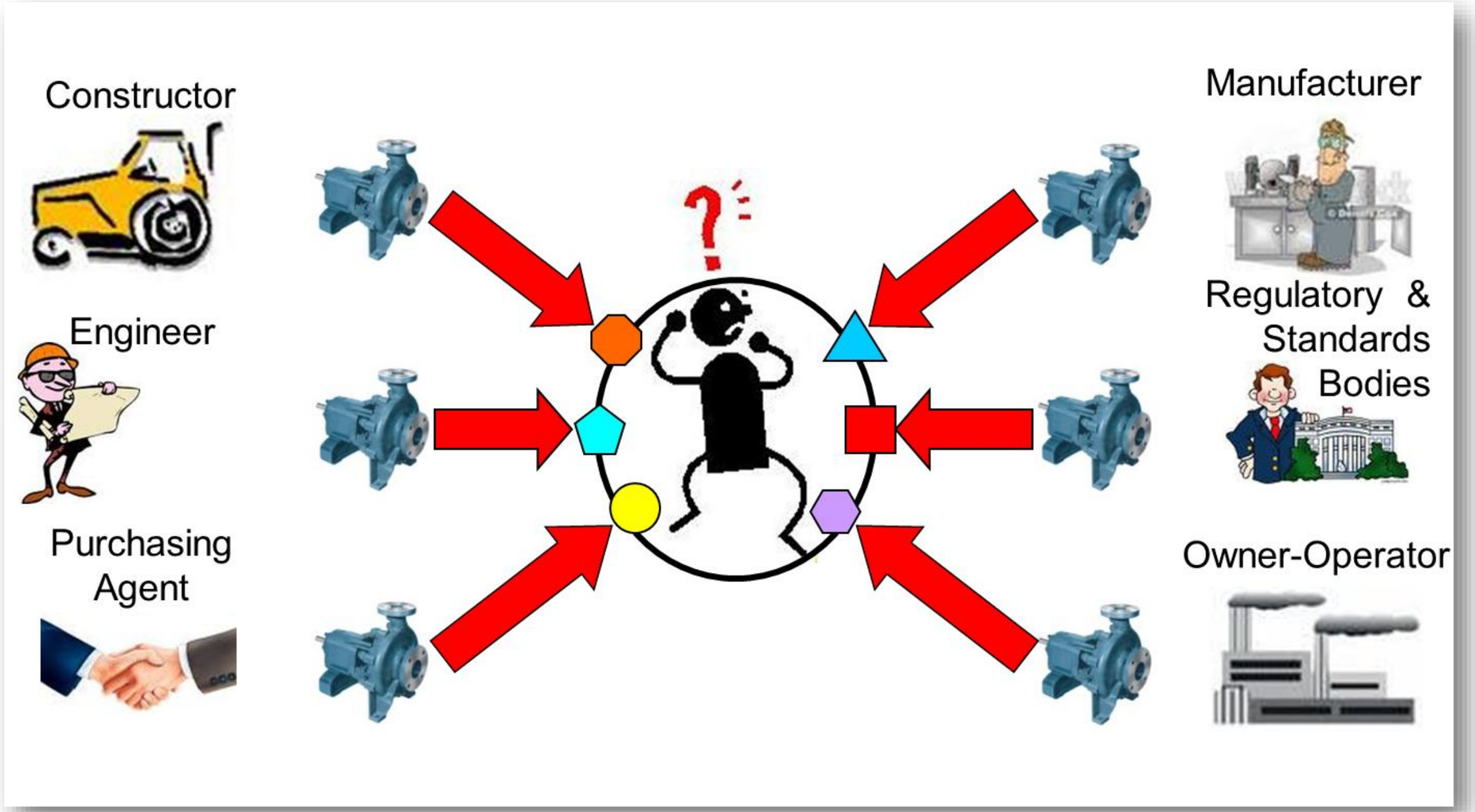
slack

Social Networks

How Information Exchange is Supposed to Work



How Information Exchange Actually Works



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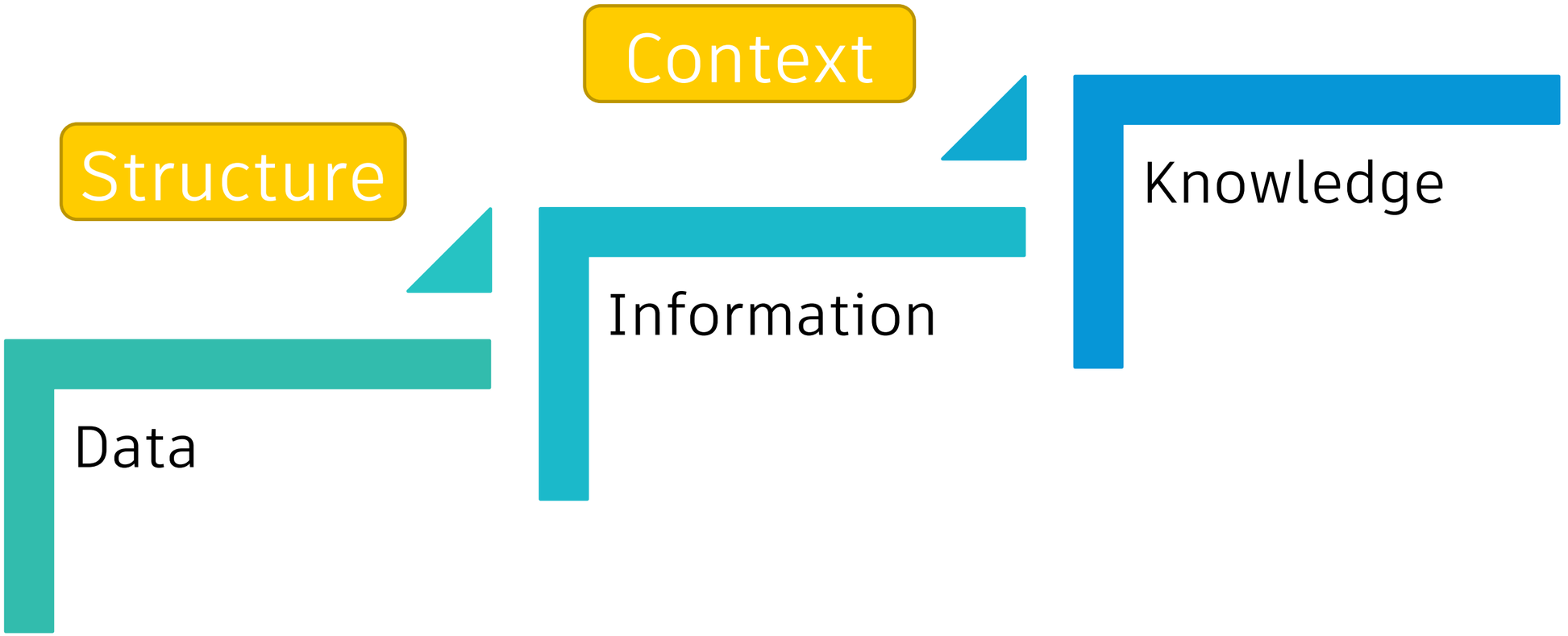
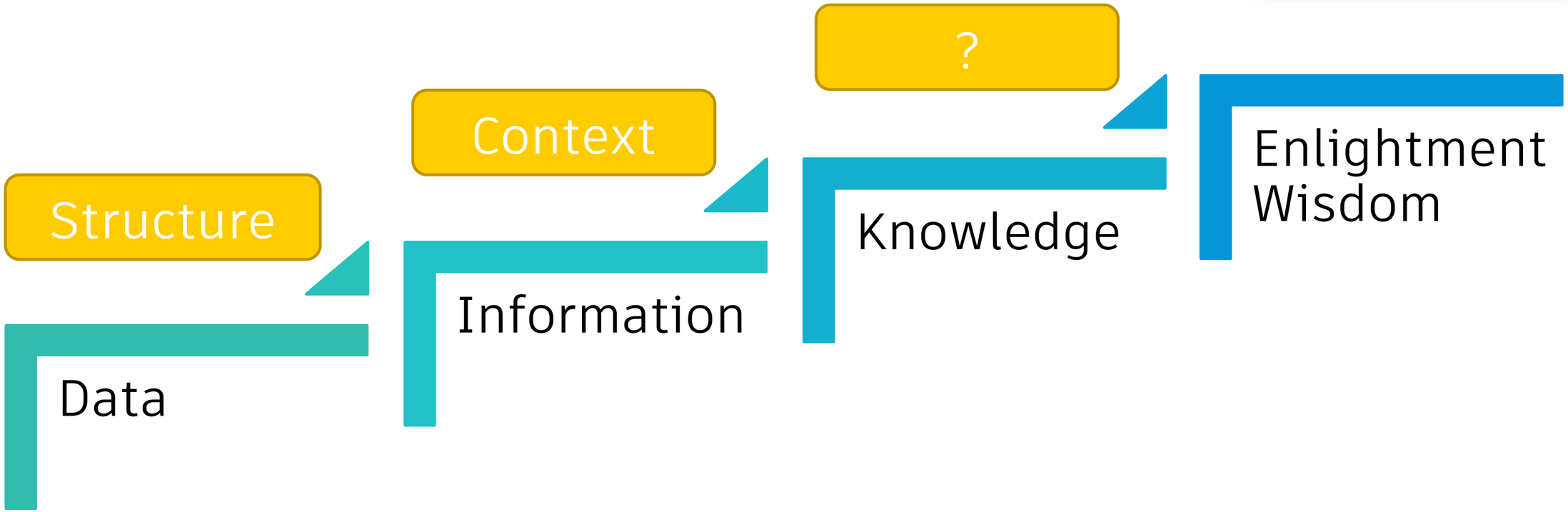
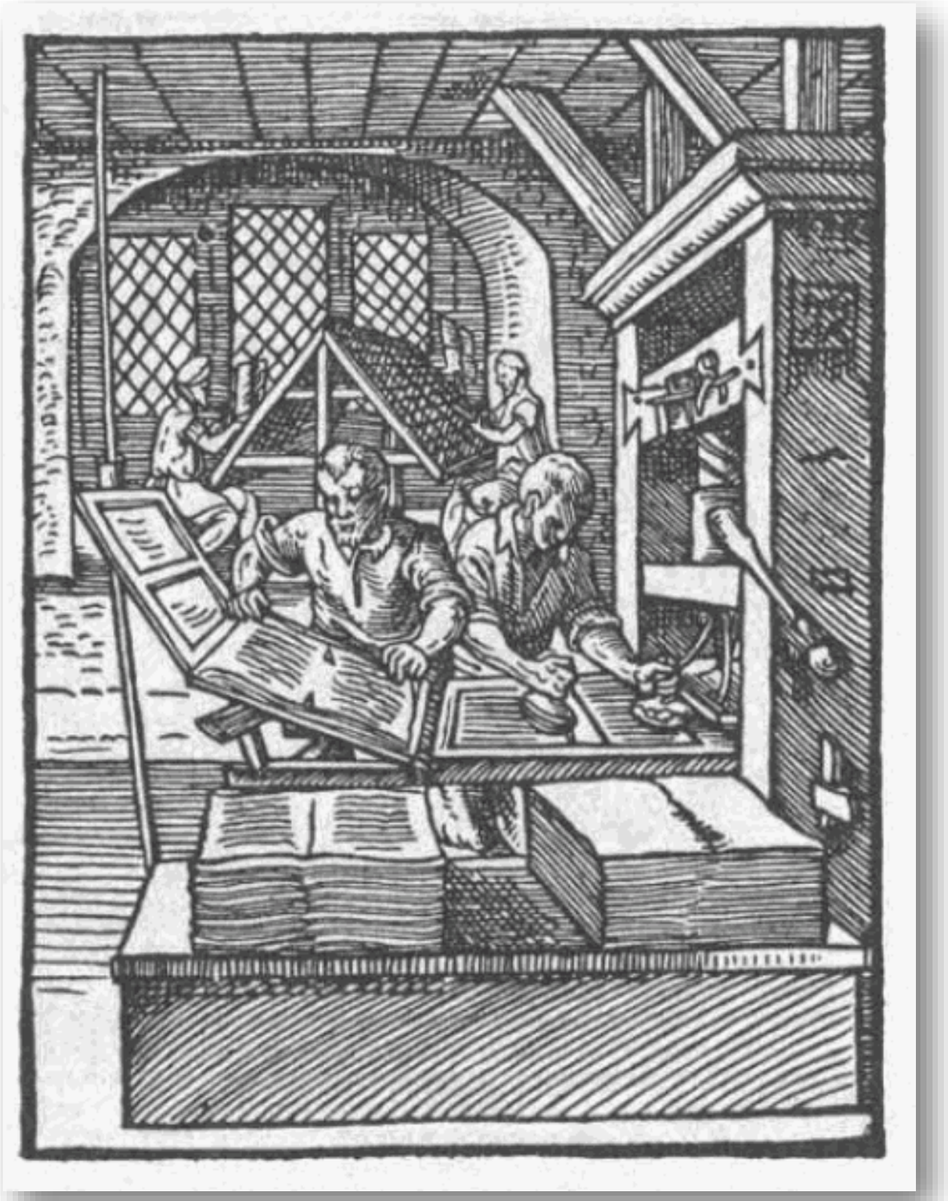
Data, Knowledge, Information



Logic is the beginning of wisdom, not the end.

Lt. Spock, USS Enterprise






IBM
IBM
IBM

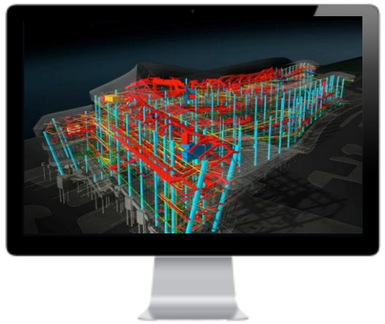
Three eras of technological disruption

Era 1:
Documentation
(Measurement)

Drafting

80s-90s

Era 2:
Optimization
(Performance)



Modeling

2000-
now

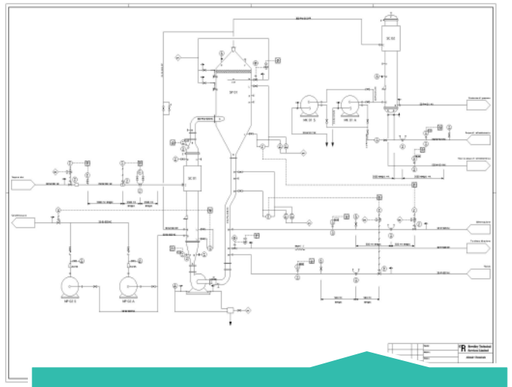
Era 3:
Connection
(Outcomes)

Context

Moving
to
Future

Different types of data

Documents

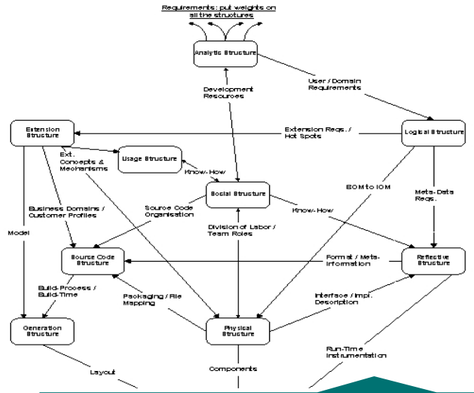


Graphics (2D, 3D)

Stückliste zur Schubstange Zeichnung Nr. . .

Zeichen	Gegenstand	Stück-zahl	Material	Bemerkungen
A	Schubstange	1	Siemens-Martin-Stahl	Im Gabelende Keilnut.
B	Verschlußstück	1	" " "	
C	Bolzen	2	Schmiedeeisen	Mit 3/4″-Gewinde und je zwei Muttern O und N nebst Sicherung M.
D	Lagerschalenhälfte	2	Bronze	Neues Modell, ausgießen mit Lagermetall.
E	Zwischenlagen	2	Messing	
F	Kreuzkopfbolzen	1	Stahl	Mit 3/4″-Gewinde und Keilnut.
G	Scheibe	1	Schmiedeeisen	
H	Mutter	1	"	3/4″-Gewinde.
J	Keil	1	Stahl	
K	Scheibe	1	Schmiedeeisen	
L	Kopfschrauben	4	"	5/16″-Gewinde.
M	Sicherungsschraube	2	Stahl	
N	Mutter	2	Schmiedeeisen	} S. a. C
O				
P				

Lists



Structures

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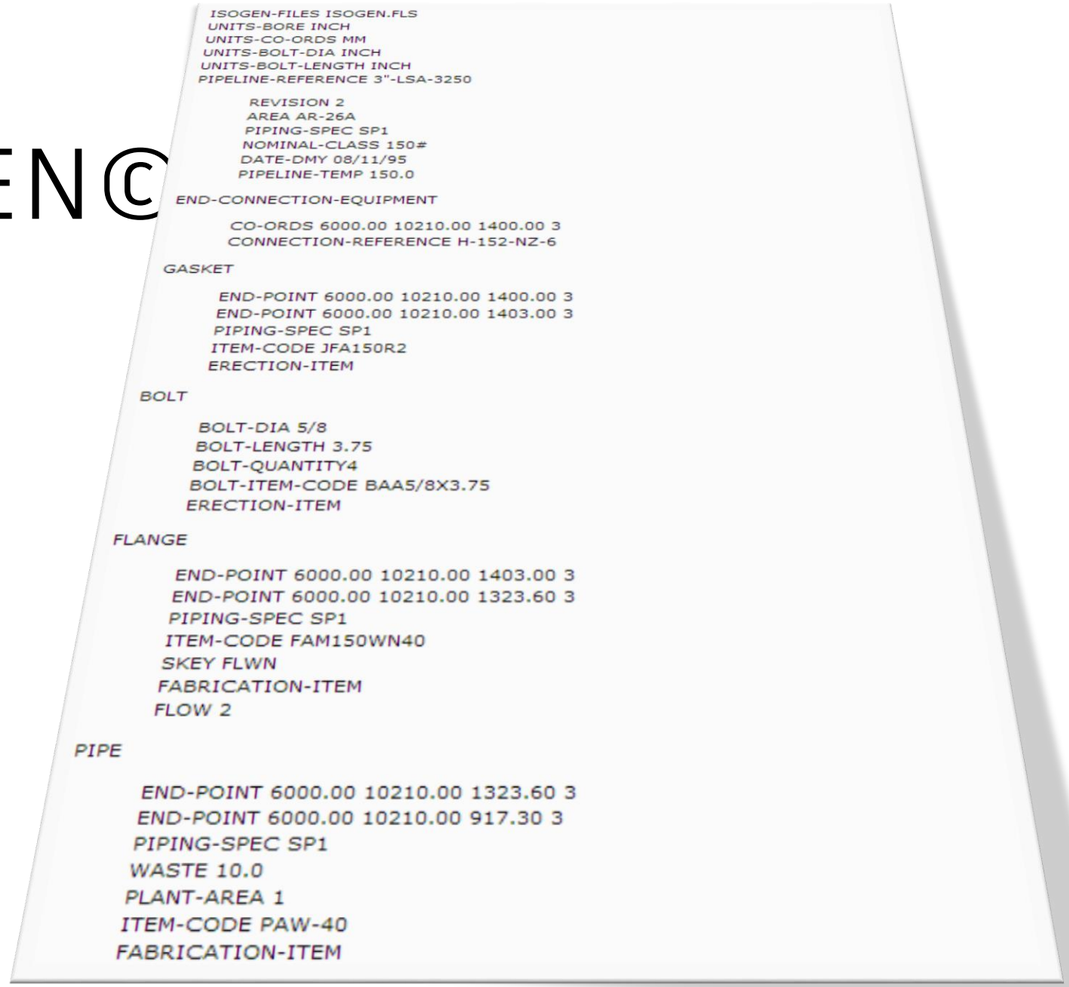
PCF
Piping Component File

- Originally input for ISOGEN©
- Exchange of pipelines
- Additional uses:
  - Stress calculation
  - Spool creations

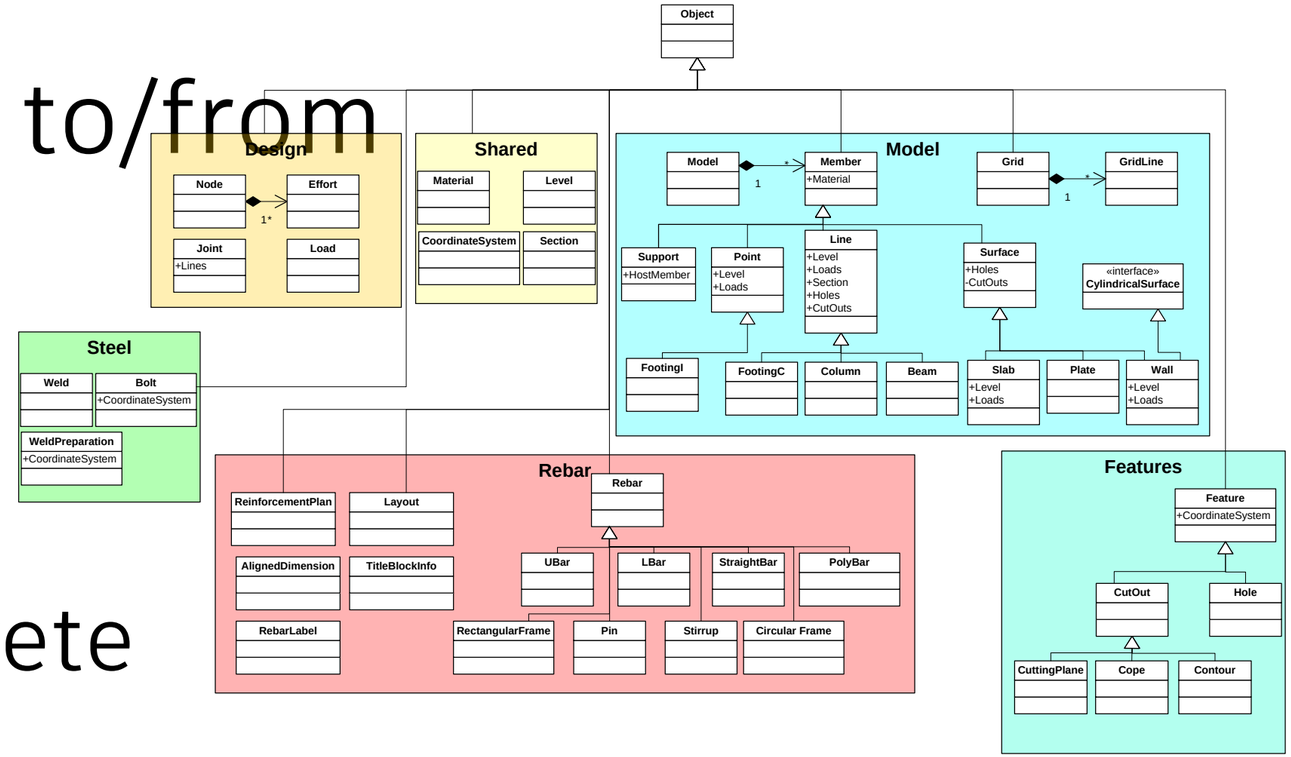


```
ISOGEN-FILES ISOGEN.FLS
UNITS-BORE INCH
UNITS-CO-ORDS MM
UNITS-BOLT-DIA INCH
UNITS-BOLT-LENGTH INCH
PIPELINE-REFERENCE 3"-LSA-3250
      REVISION 2
      AREA AR-26A
      PIPING-SPEC SP1
      NOMINAL-CLASS 150#
      DATE-DMY 08/11/95
      PIPELINE-TEMP 150.0
END-CONNECTION-EQUIPMENT
      CO-ORDS 6000.00 10210.00 1400.00 3
      CONNECTION-REFERENCE H-152-NZ-6
GASKET
      END-POINT 6000.00 10210.00 1400.00 3
      END-POINT 6000.00 10210.00 1403.00 3
      PIPING-SPEC SP1
      ITEM-CODE JFA150R2
      ERECTION-ITEM
BOLT
      BOLT-DIA 5/8
      BOLT-LENGTH 3.75
      BOLT-QUANTITY4
      BOLT-ITEM-CODE BAA5/8X3.75
      ERECTION-ITEM
FLANGE
      END-POINT 6000.00 10210.00 1403.00 3
      END-POINT 6000.00 10210.00 1323.60 3
      PIPING-SPEC SP1
      ITEM-CODE FAM150WN40
      SKEY FLWN
      FABRICATION-ITEM
      FLOW 2
PIPE
      END-POINT 6000.00 10210.00 1323.60 3
      END-POINT 6000.00 10210.00 917.30 3
      PIPING-SPEC SP1
      WASTE 10.0
      PLANT-AREA 1
      ITEM-CODE PAW-40
      FABRICATION-ITEM
```

Quelle: http://www.alias.ltd.uk/pcf.asp (22.11.2013)

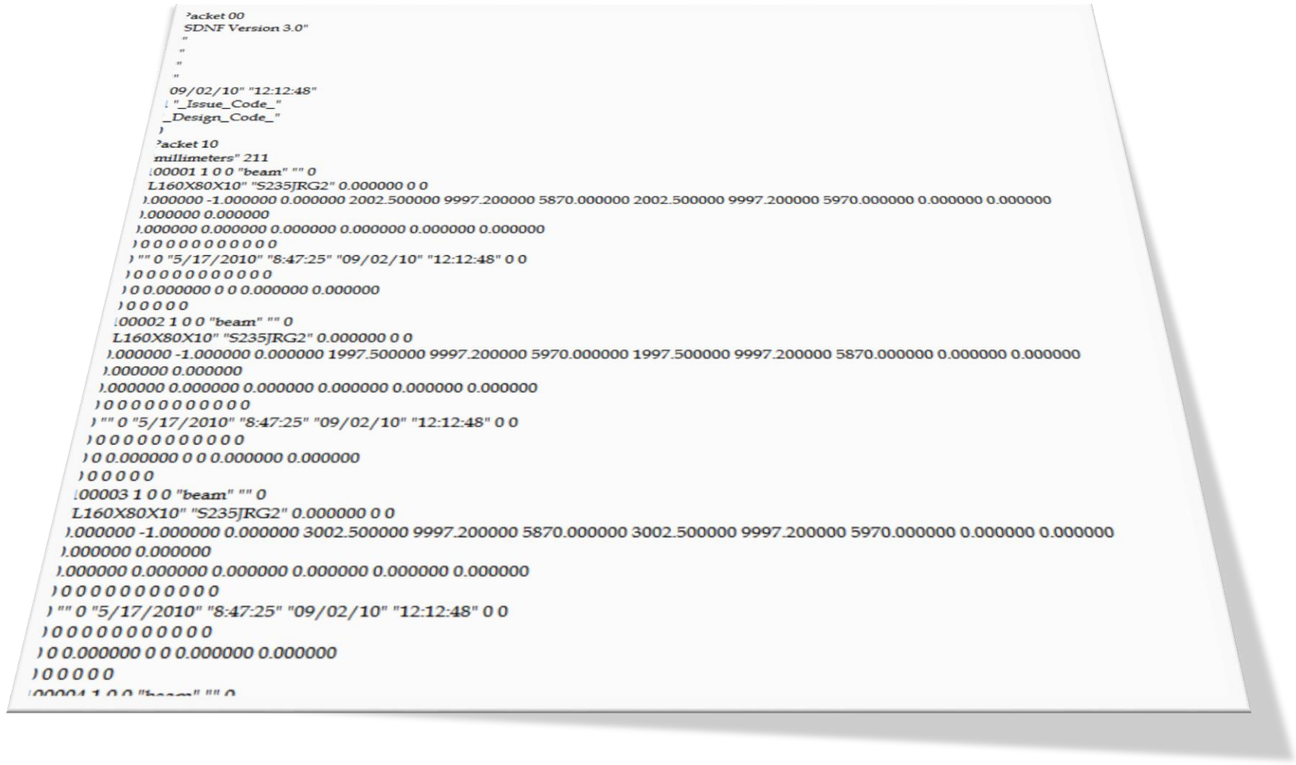
Graitec Model Objects

- http://www.graitec.com/us/gtc.asp
- Open XML format
- Transport Structures to/from
  - SDNF
  - CIS/2
  - Revit Structure
  - Advance Steel/Concrete
  - IFC 2x2



SDNF
Steel Detailing Neutral Format

- Originally developed by Intergraph FrameWork user community
- **Different Elements:**
  - Linear Elements
  - Plate Elements
  - Hole Elements
  - Loads
  - Connection Information
  - Raster Information
  - Bend Elements



Quellen (Internet am 22.11.2013): http://www.sdnf.de/
http://help.aveva.com/AVEVA_Everything3D/1.1/SDUVPDMS/wwhelp/wwhimpl/common/html/wwhelp.htm#href=OSUG3.32.01.html&single=true

XMpLant

- **XMpLant:** A brand name owned by Nextspace
- **XMpLant Schema**: An XML schema using ISO 15926 Part 4, released into the public domain by Noumenon in 2001.
- **Proteus:** The name given to a PCA/Fiatech project in 2008 which used the XMpLant Schema version 3.3.3.
- **Proteus Schema:** The new name for the XMpLant schema, published by the Proteus project as a valid schema for ISO 15926 at the Dictionary Compliance level.

Source: http://iringtoday.com/whats-the-difference-between-xmplant-and-proteus/

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There is only one buildingSMART's openBIM®

buildingSMART Members

AUTODESK.

Autodesk supports IFC and buildingSMART International openBIM

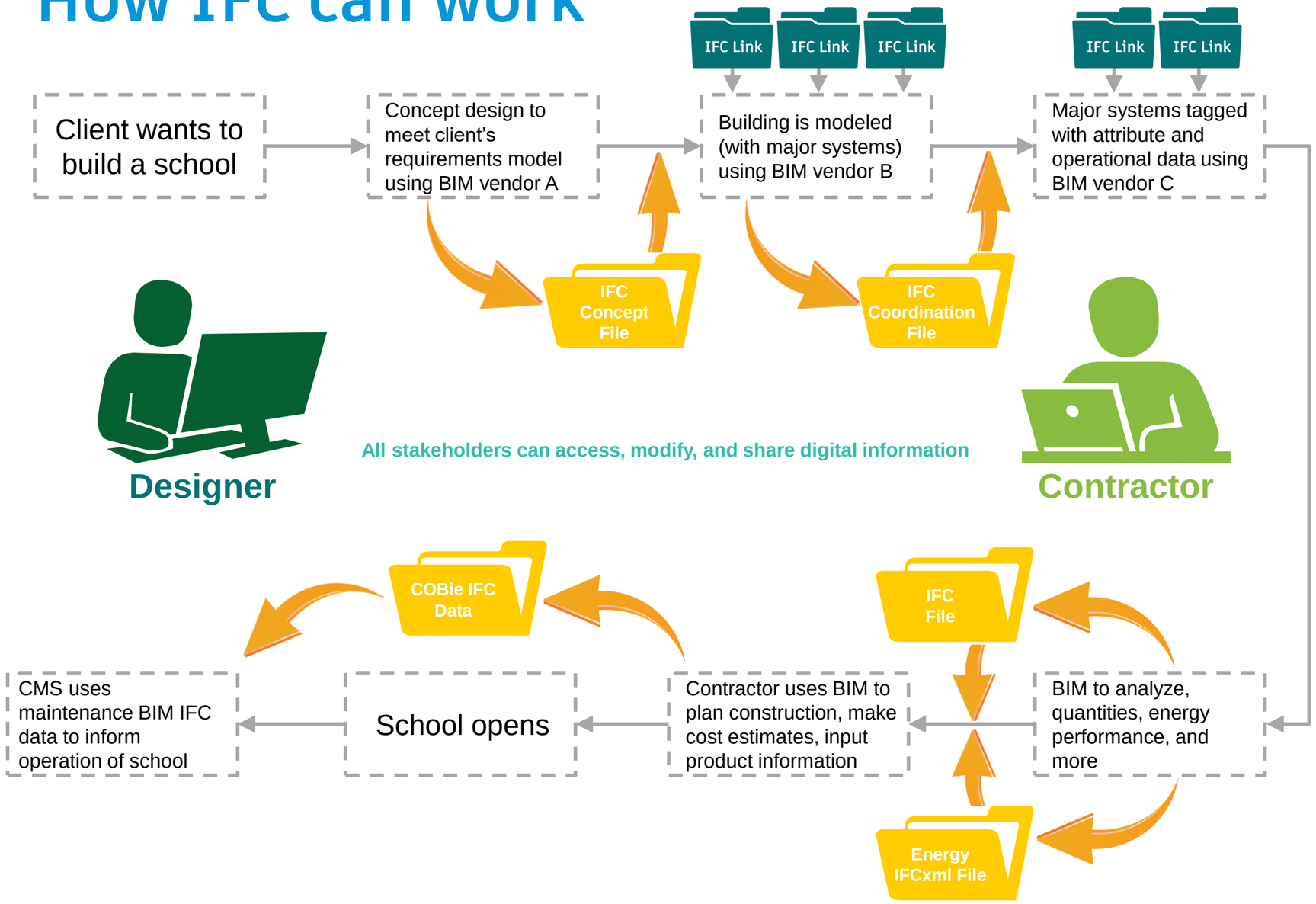
Actively participates in buildingSMART's Strategic Advisory Committee and Standards Committees

- Secured the rigorous IFC 2x3 Coordination View 2.0 certification in the first wave of vendors
- Includes IFC 4 capabilities in Autodesk® Revit® 2017
- Maintains the most IFC certifications of any vendor
- Made IFC import/export tool for Revit open source (only vendor)

14 Autodesk 2017 products that support IFC

- A360
- Advance Steel
- AutoCAD Architecture, MEP
- AutoCAD Civil 3D
- BIM360 Glue
- CADmep
- Fabrication ESTmep
- Infraworks
- Autodesk Inventor
- Navisworks solutions
- Autodesk Revit (Architecture, Structure, MEP) (IFC certified)
- Autodesk Revit LT (IFC certified)
- Robot Structural Analysis

How IFC can work



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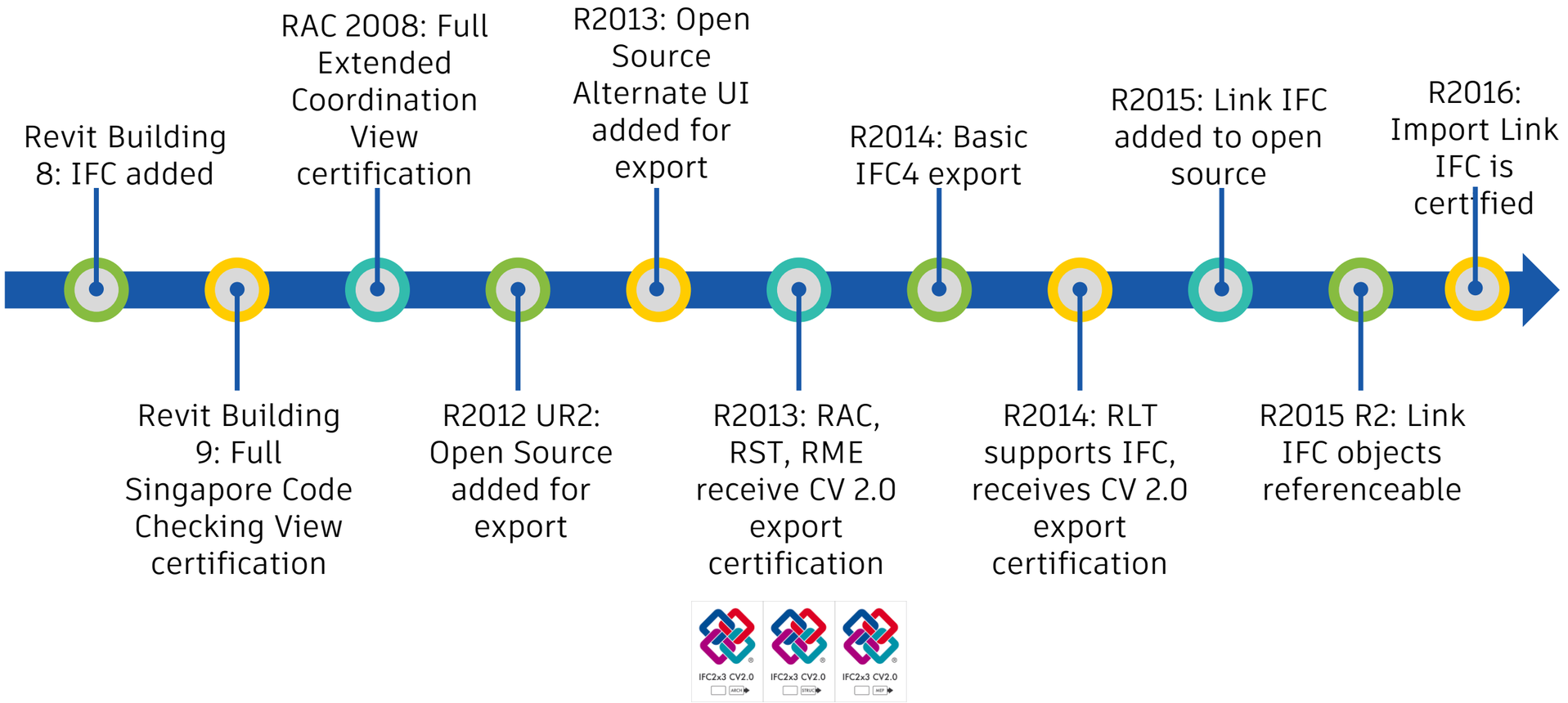
History of IFC in Revit (through R2016)



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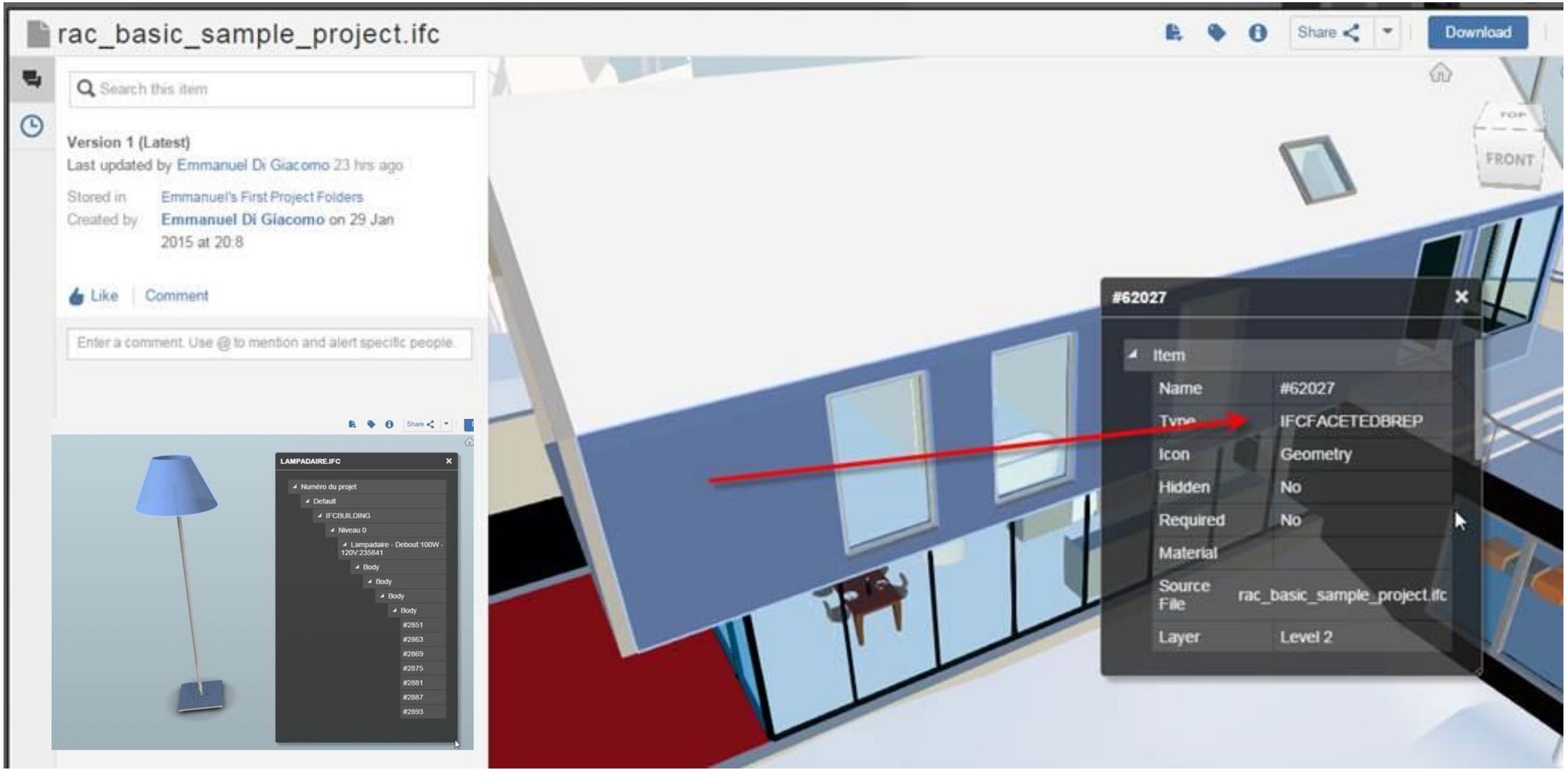
IFC Viewing - A360 Platform / BIM 360



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openBIM communication

EMEA openBIM URLs:

- www.autodesk.com/ifc
- www.autodesk.com/openbim
- www.autodesk.com/interoperability
- www.autodesk.fr/ifc
- www.autodesk.fr/openbim
- www.autodesk.fr/interoperability
- www.autodesk.de/ifc
- www.autodesk.de/openbim
- www.autodesk.de/interoperability

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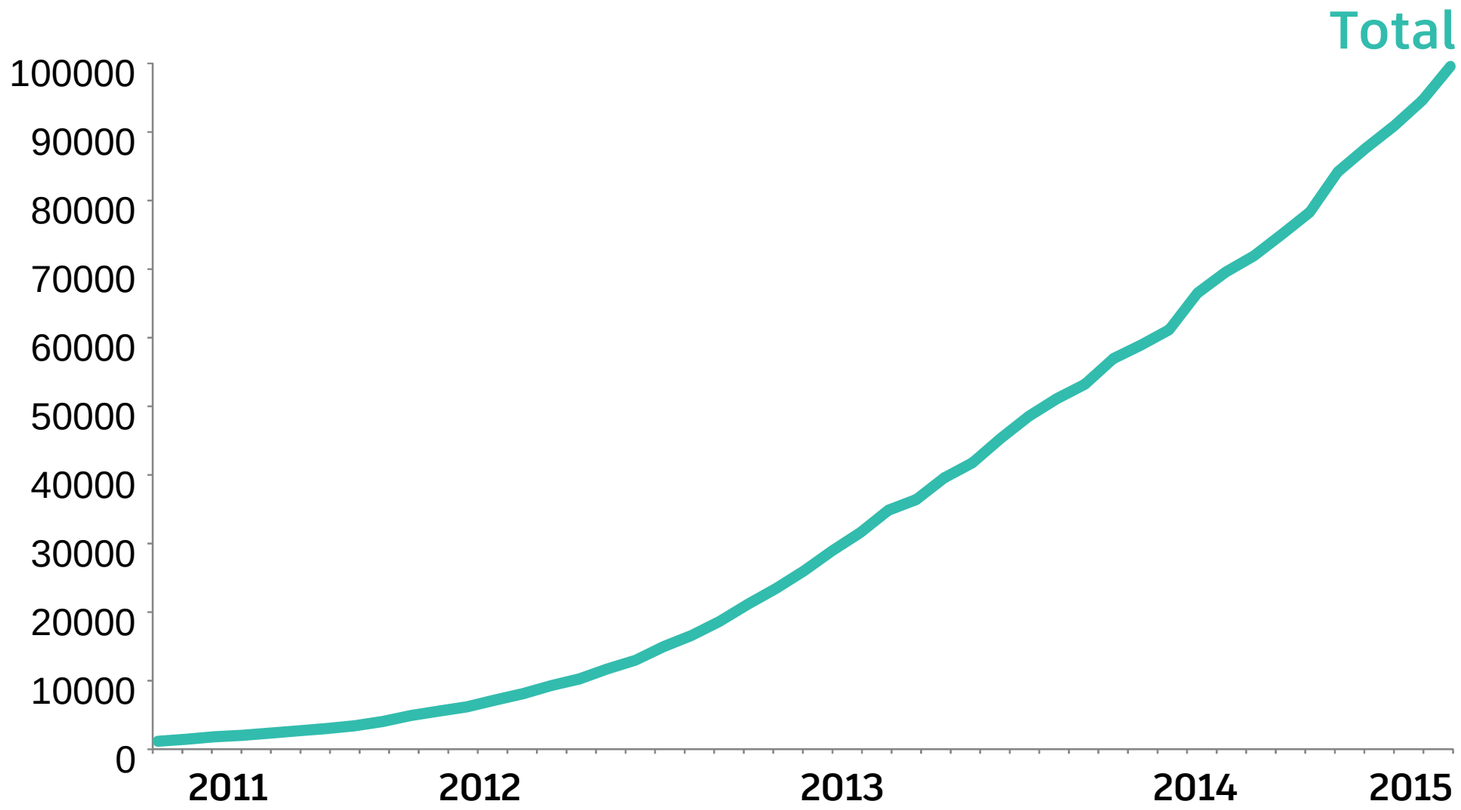
Autodesk Revit IFC is open source

Advantages of Autodesk Revit IFC open source

- Increase customer flexibility to add new property sets and data
- Updates are decoupled from Revit's release cycle with 40 software releases of the open source toolkit since its release.
- Provide a method for quick support of IFC standard extensions (MVD's) as they are introduced
- Allow others outside the Revit software development team to make contributions to IFC functionality

Revit IFC has 100,000 downloads

Download momentum is growing every day



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Where to get Revit IFC open source

http://sourceforge.net/projects/ifcexporter

- Only public location containing source code
- Contains all versions from Revit 2012 to 2016

http://apps.exchange.autodesk.com/RVT/Home/Index

- Contains all versions from Revit 2013 to 2016, no code

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Is there something like IFC for Plant?

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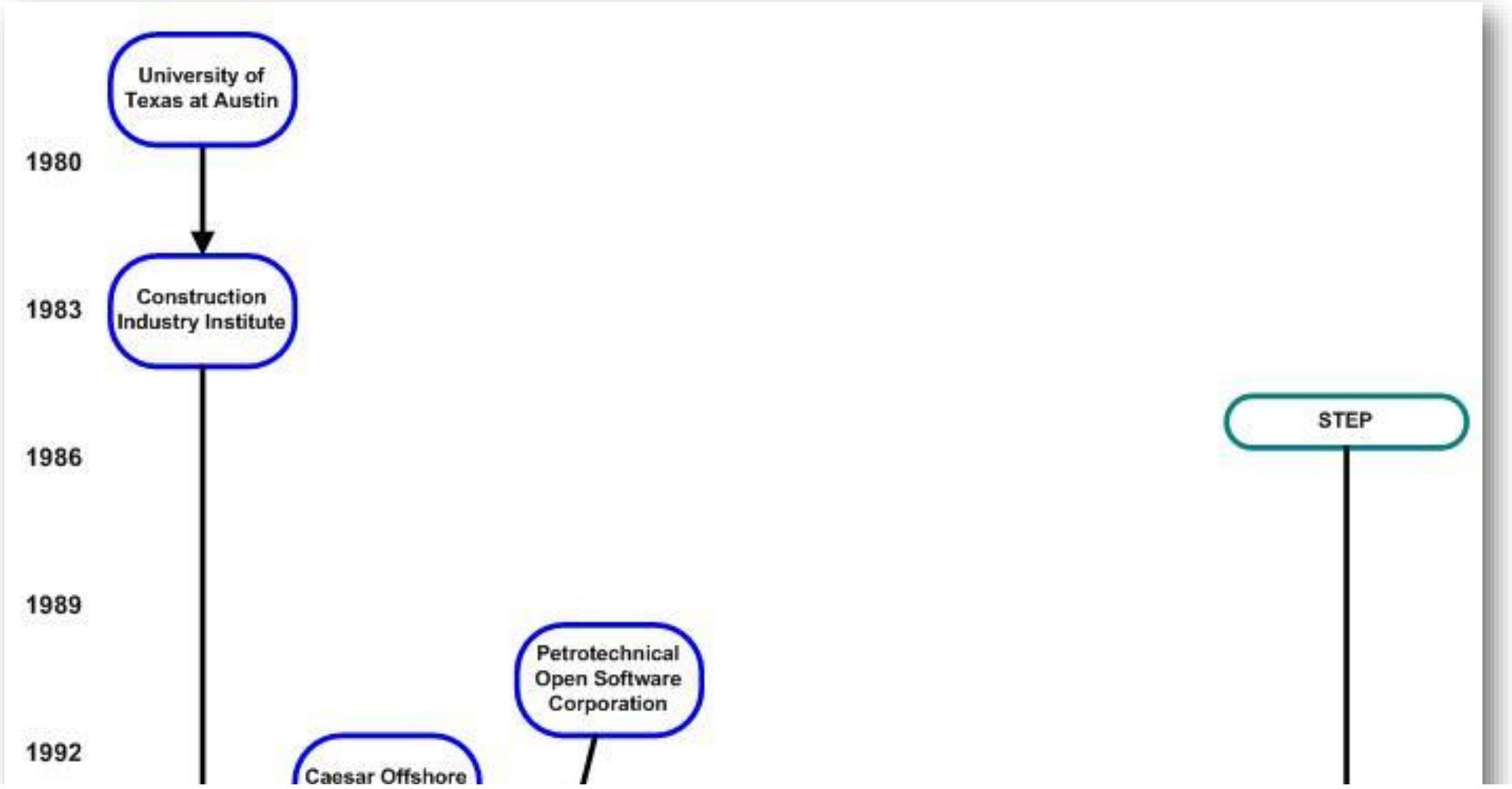
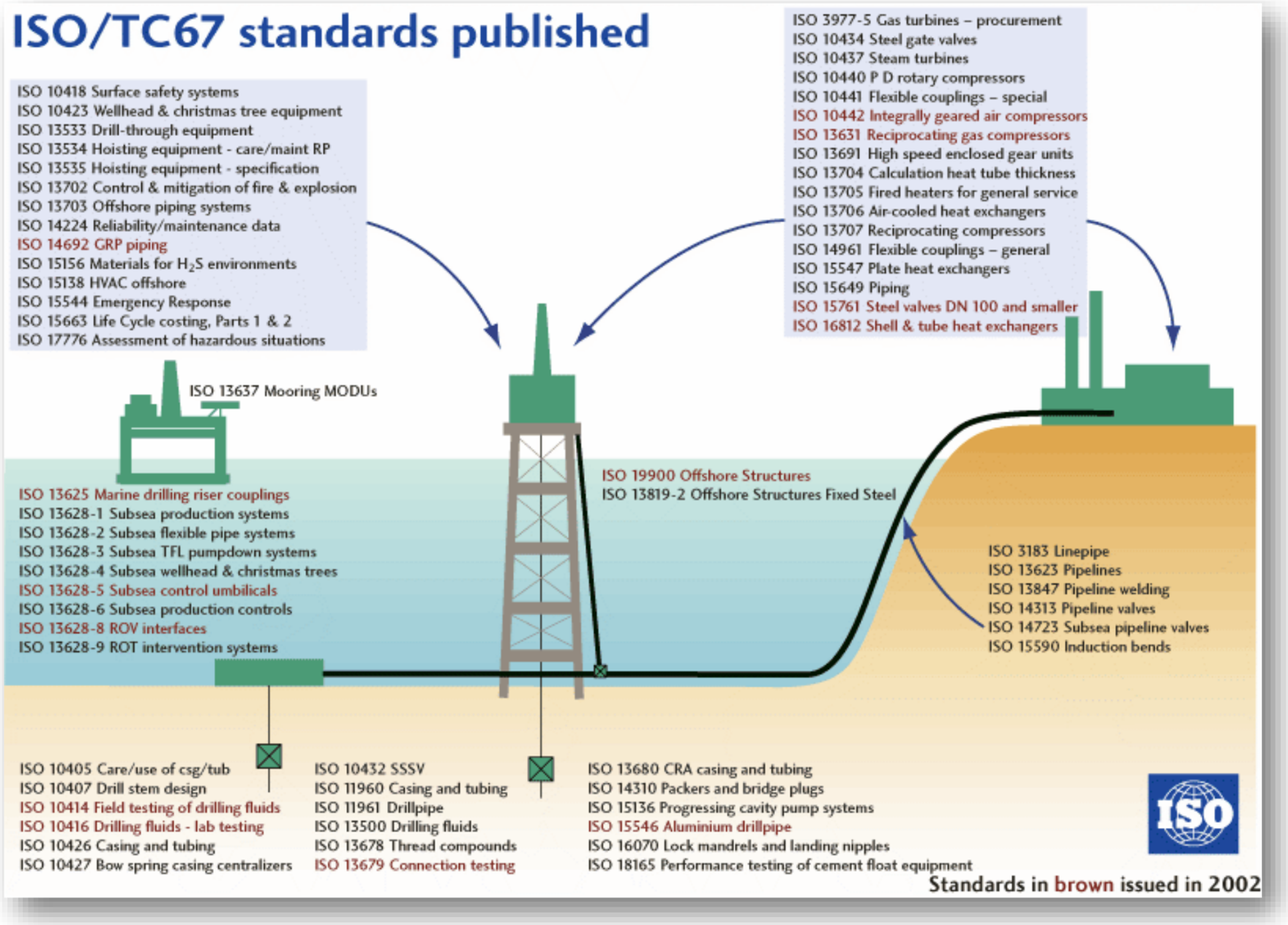
A bit of history

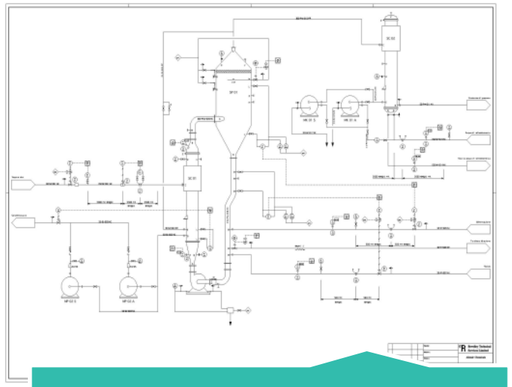


Data standards in O&G Process Plant



Different types of data

Documents



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H	Mutter	1	"	3/4"-Gewinde.
J	Keil	1	Stahl	
K	Scheibe	1	Schmiedeeisen	
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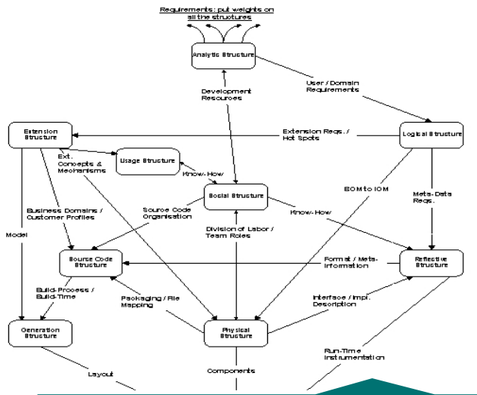
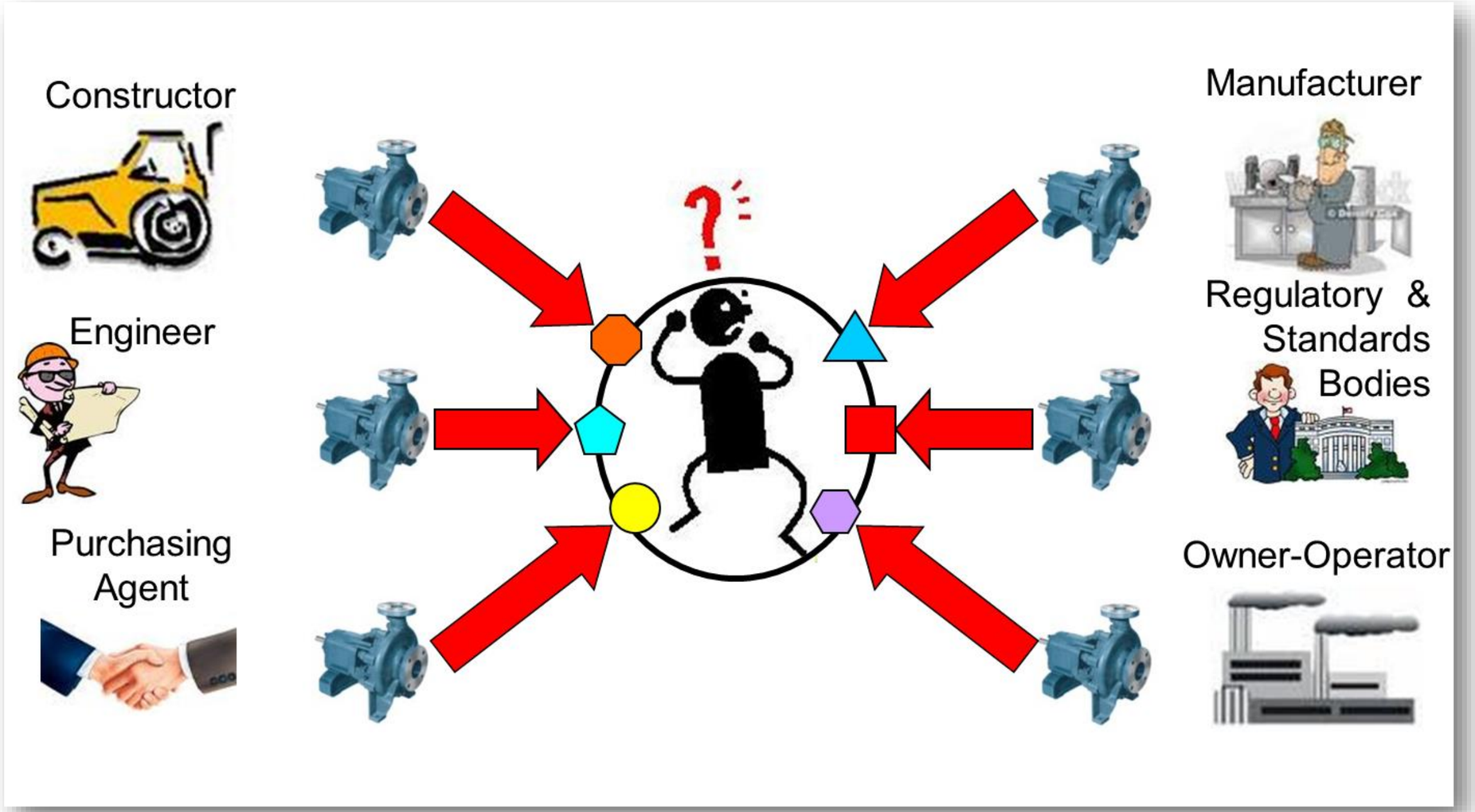
M	Sicherungsschraube	2	Stahl	
N	Mutter	2	Schmiedeeisen	} S. a. C
O				
P				

Lists

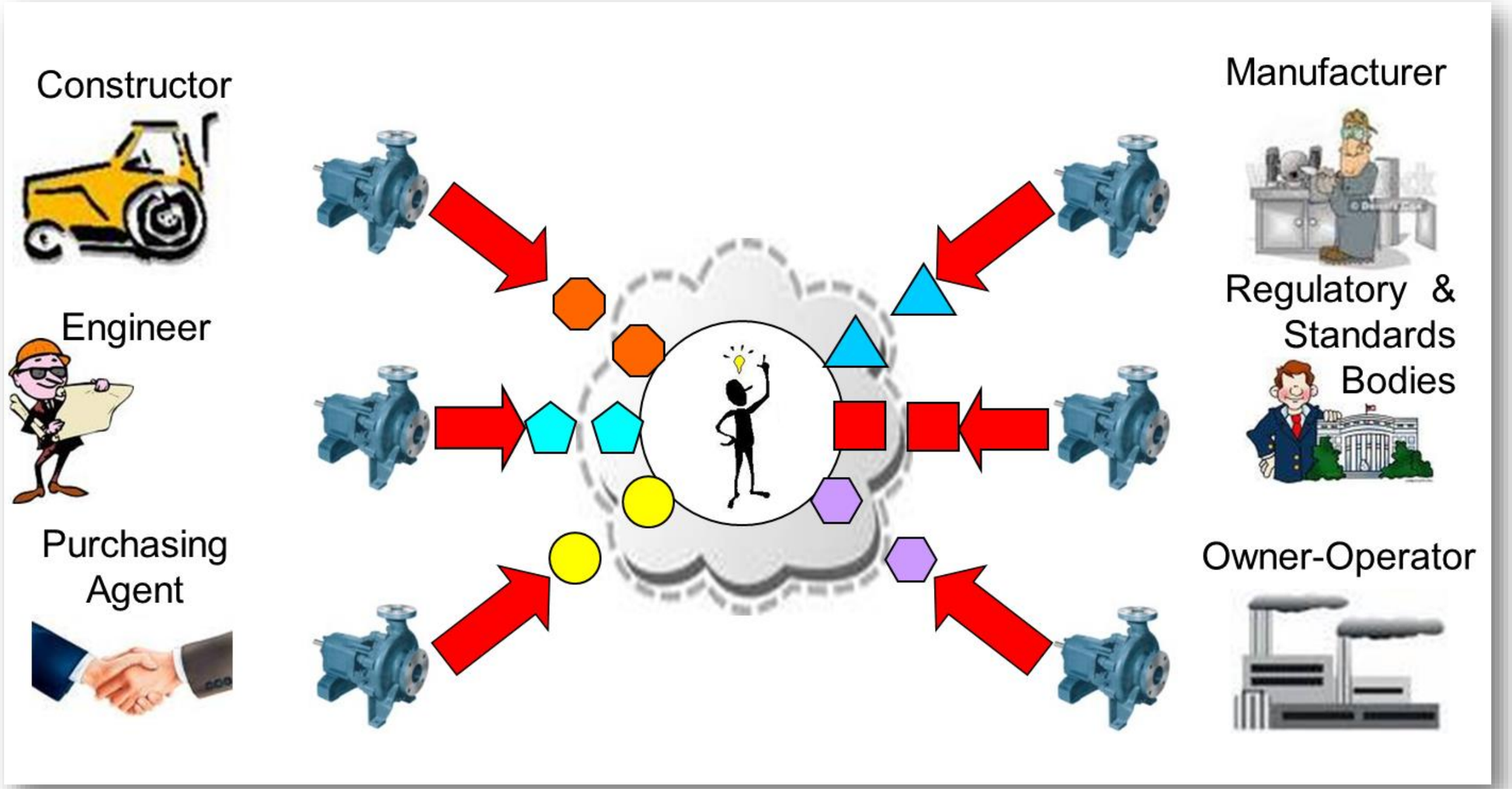


Structures

How Information Exchange Actually Works



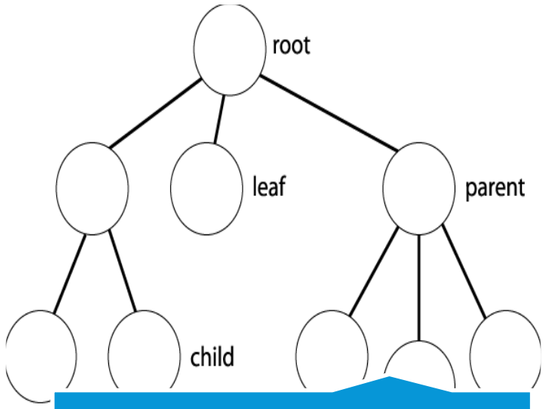
How ISO 15926 Handles Information Exchanges



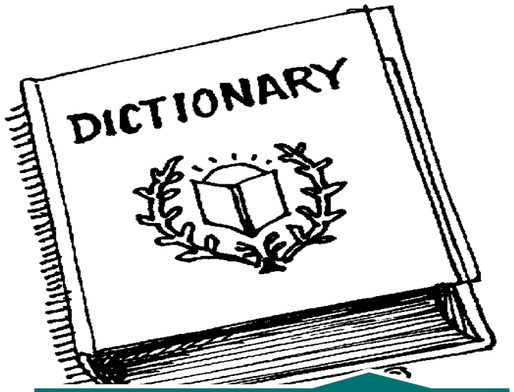
The Basic Concepts of ISO 15926

Describe the how not the what

Exchange data between machines



Knowledge about family



Centralized common dictionary (RDL)

The ISO 15926 framework

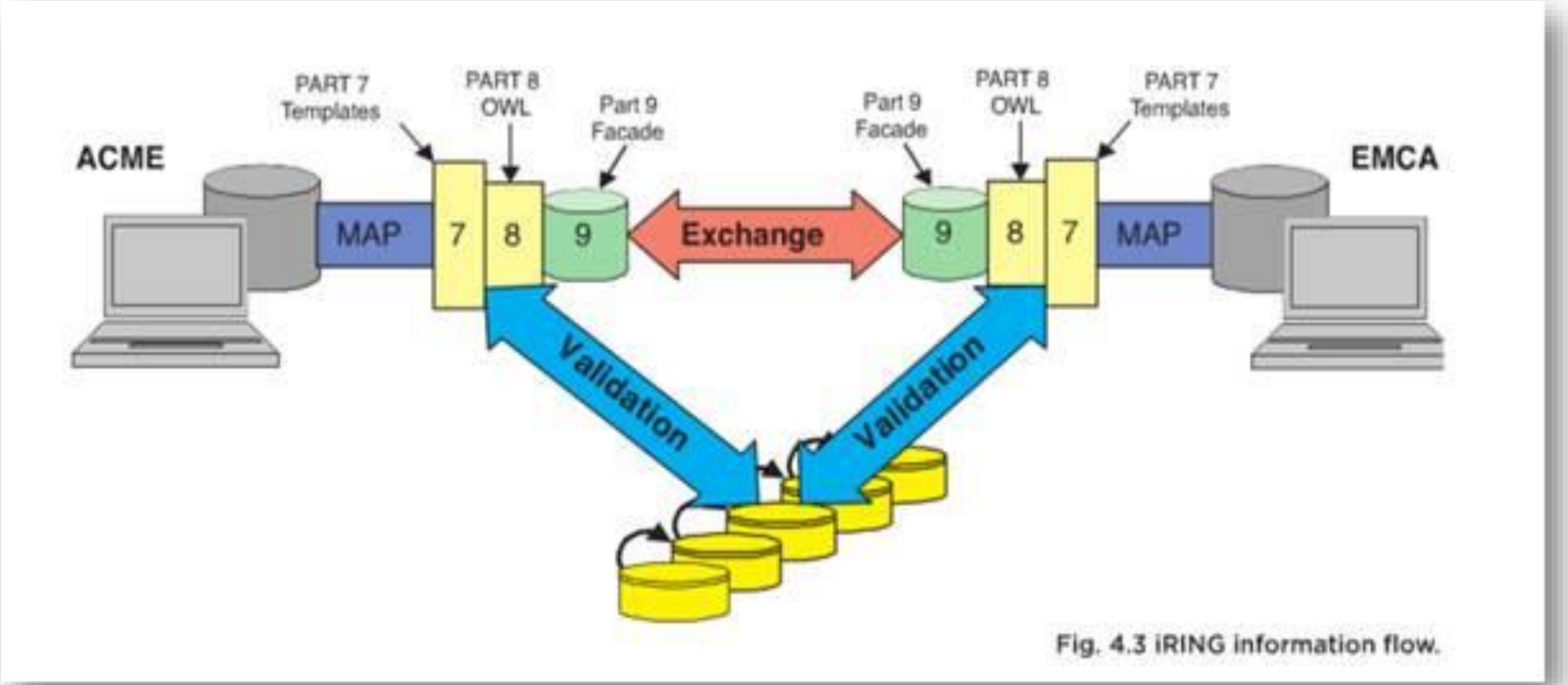


Fig. 4.3 iRING information flow.

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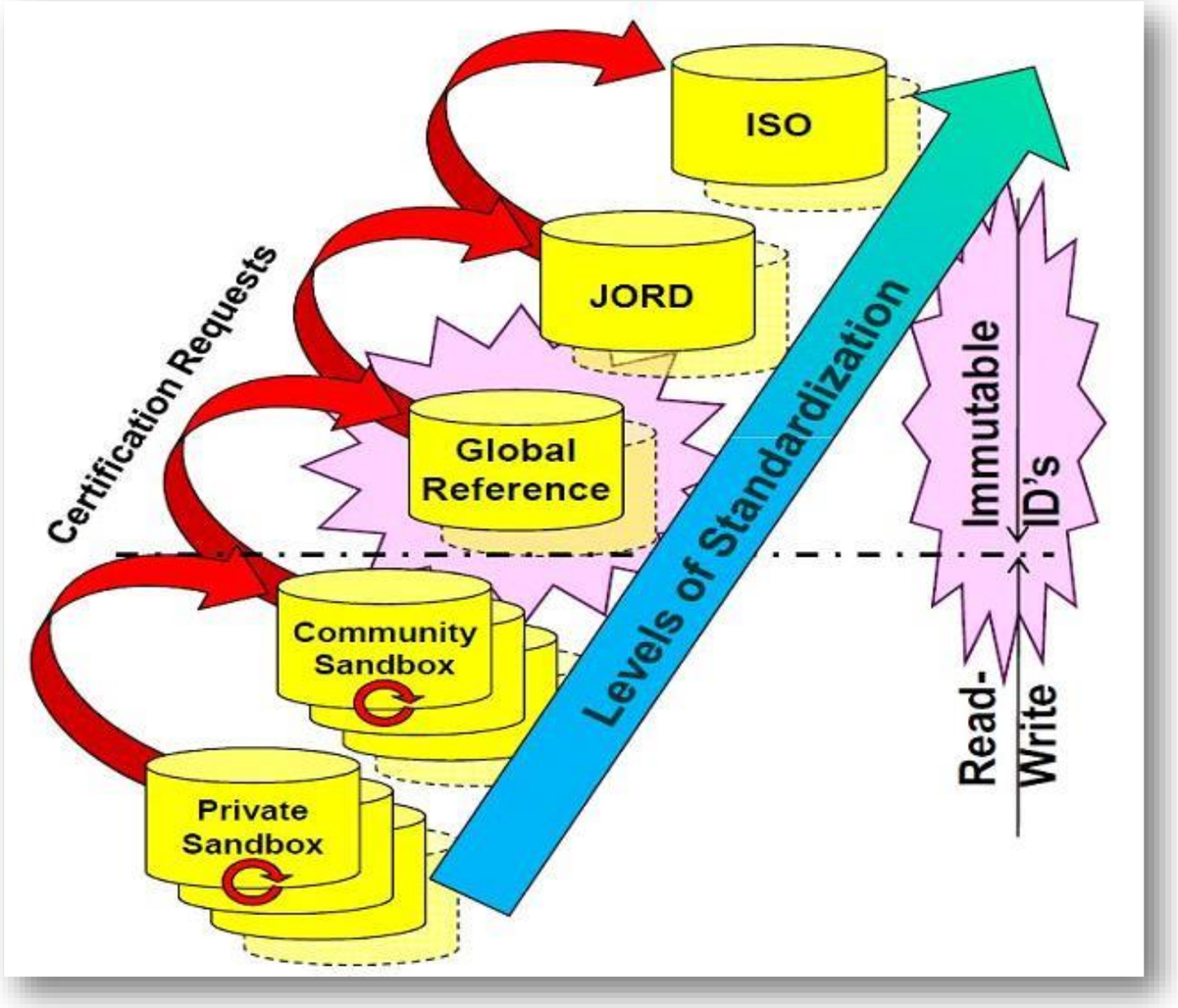
Standardization



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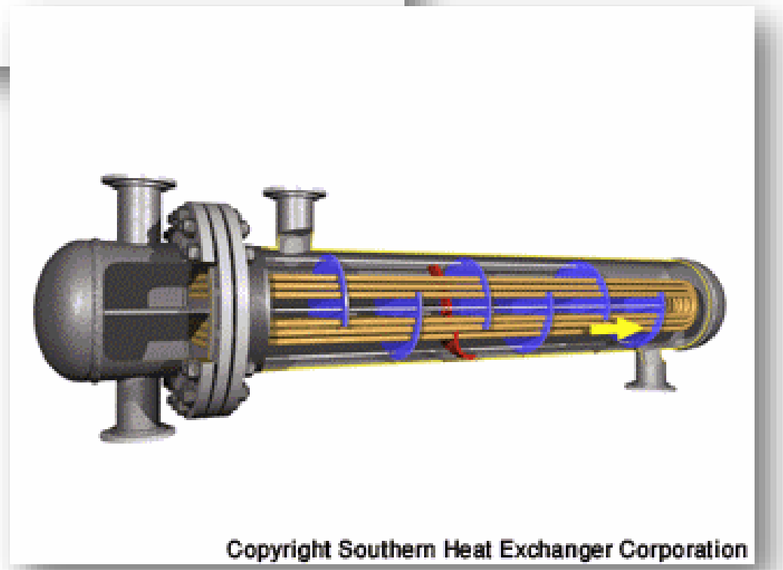
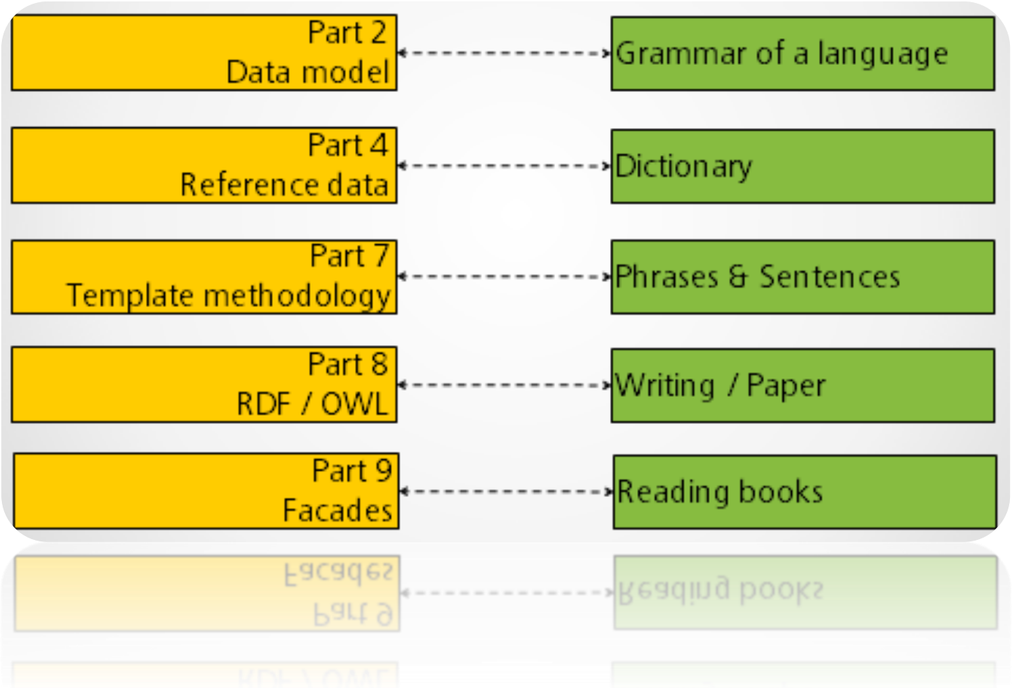
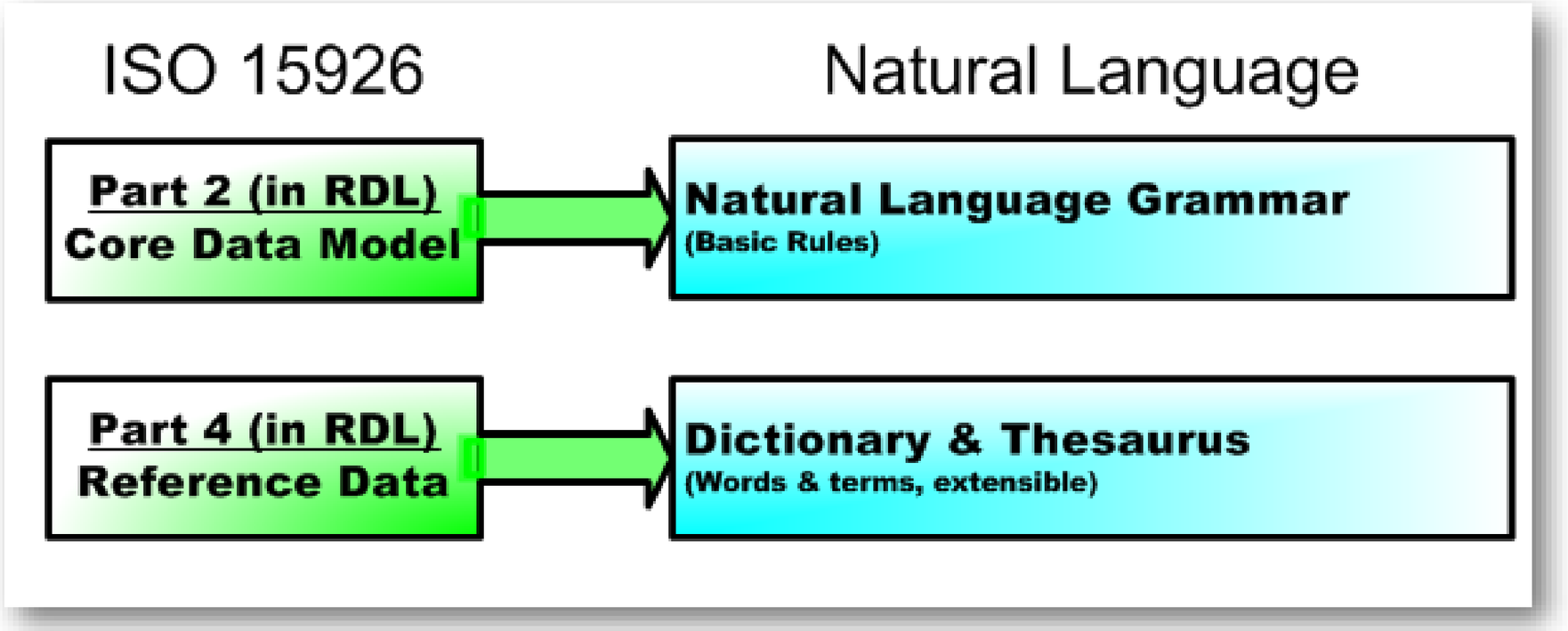
How ISO15926 works: Modelling a heat exchanger

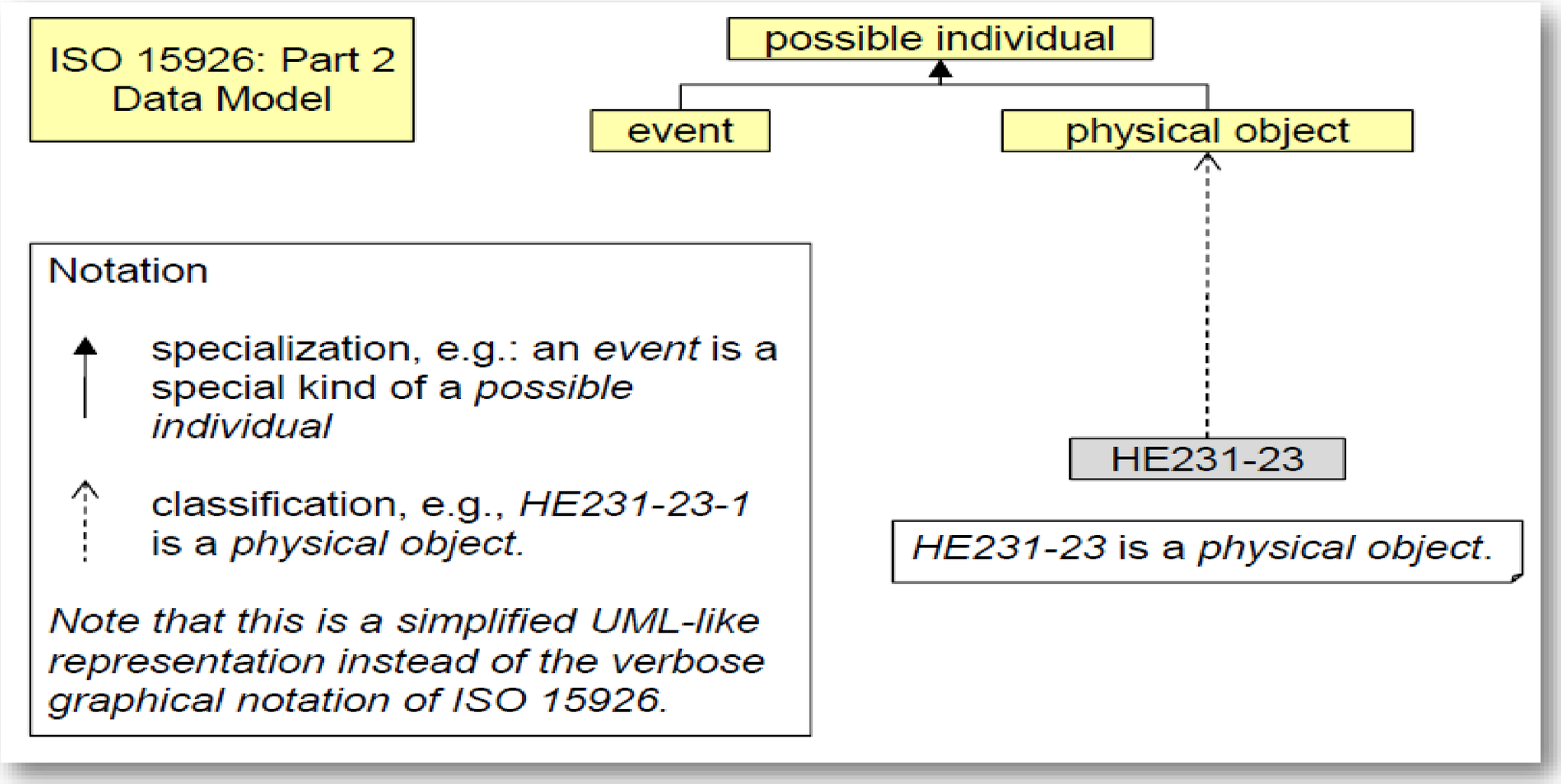




How ISO 15926 Works - Part 2 and Part 4



ISO 15926 – part 2



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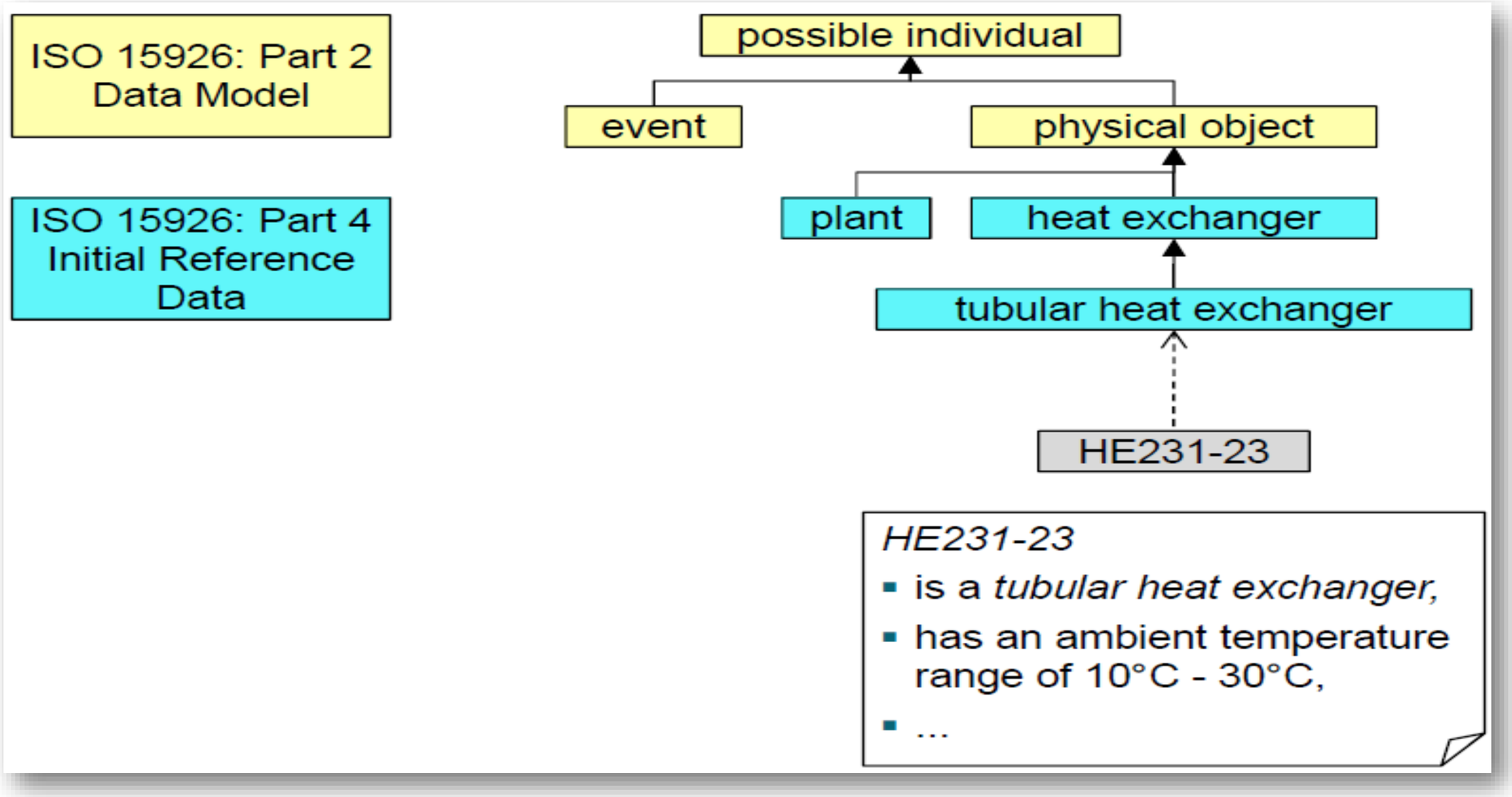
ISO 15926



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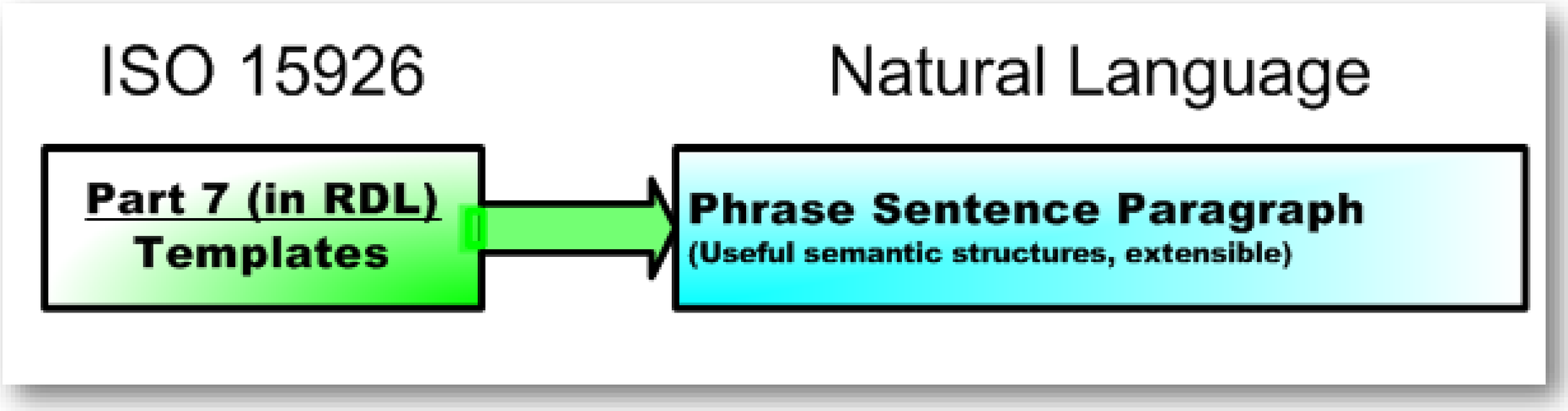
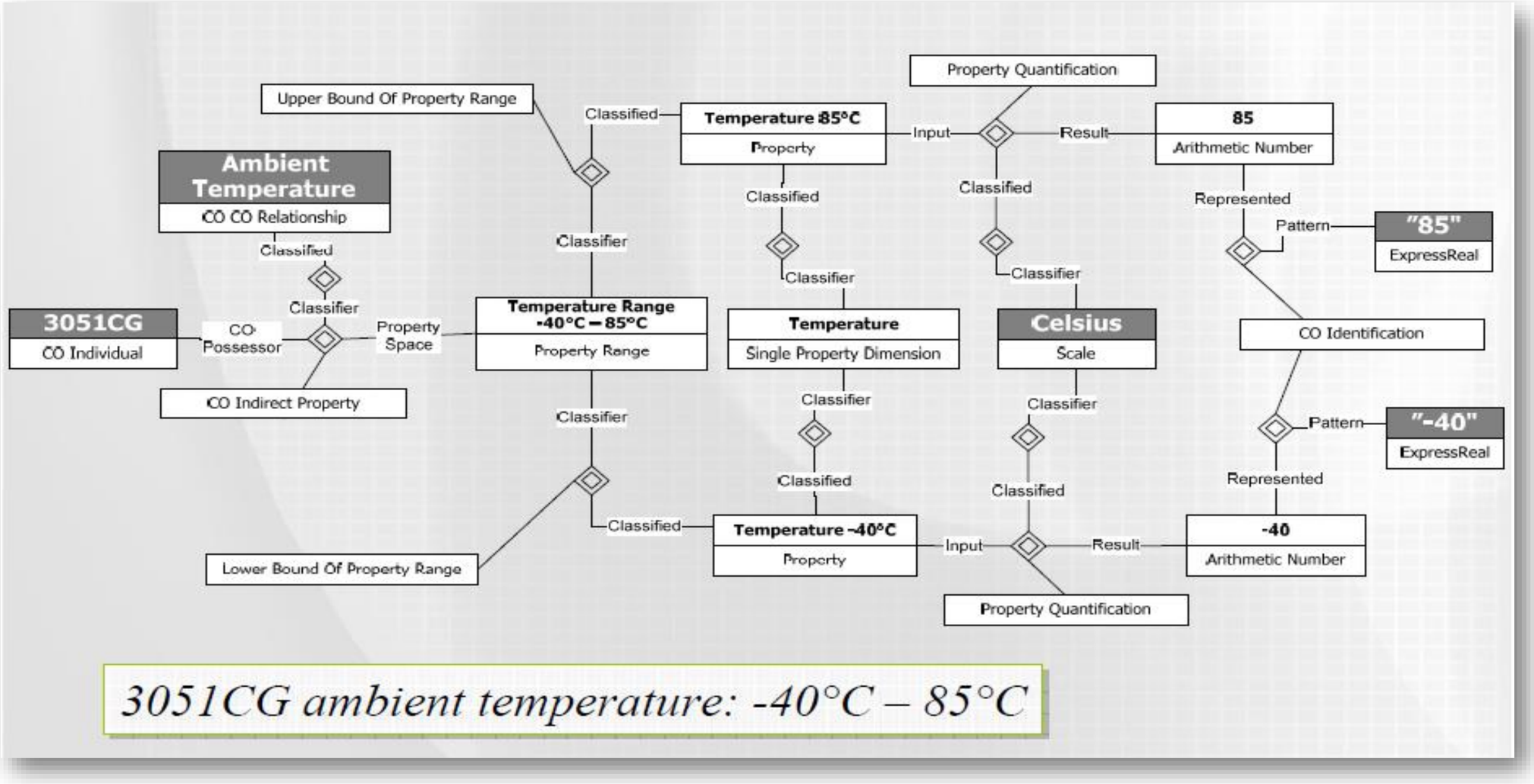
How ISO 15926 Works - Part 7



A *Simple* Example of a Data Record



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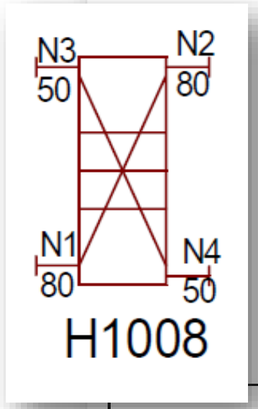
Heat Exchanger Modelling

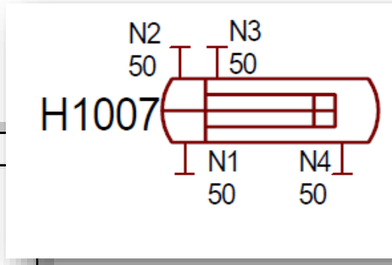


HeatExchanger
-TagNamePrefixAssignmentClass : string
-TagNameSequenceNumberAssignmentClass : string
-TagNameSuffixAssignmentClass : string
-FunctionalObjectDescriptionAssignmentClass : string
-DesignHeatFlowRate : power
-DesignHeatTransferArea : area

Specialization

PlateAndShellHeatExchanger
-MaterialOfConstructionCodeAssignmentClass : string
-PlateHeight : distance
-PlateWidth : distance

ShellAndTubeHeatExchanger
-NominalDiameter : distance



Decomposition

2

Chamber
-SubequipmentIdAssignmentClass : string
-UpperLimitDesignPressure : pressure
-LowerLimitDesignPressure : pressure
-UpperLimitDesignTemperature : temperature
-LowerLimitDesignTemperature : temperature
-NominalCapacityVolume : volume

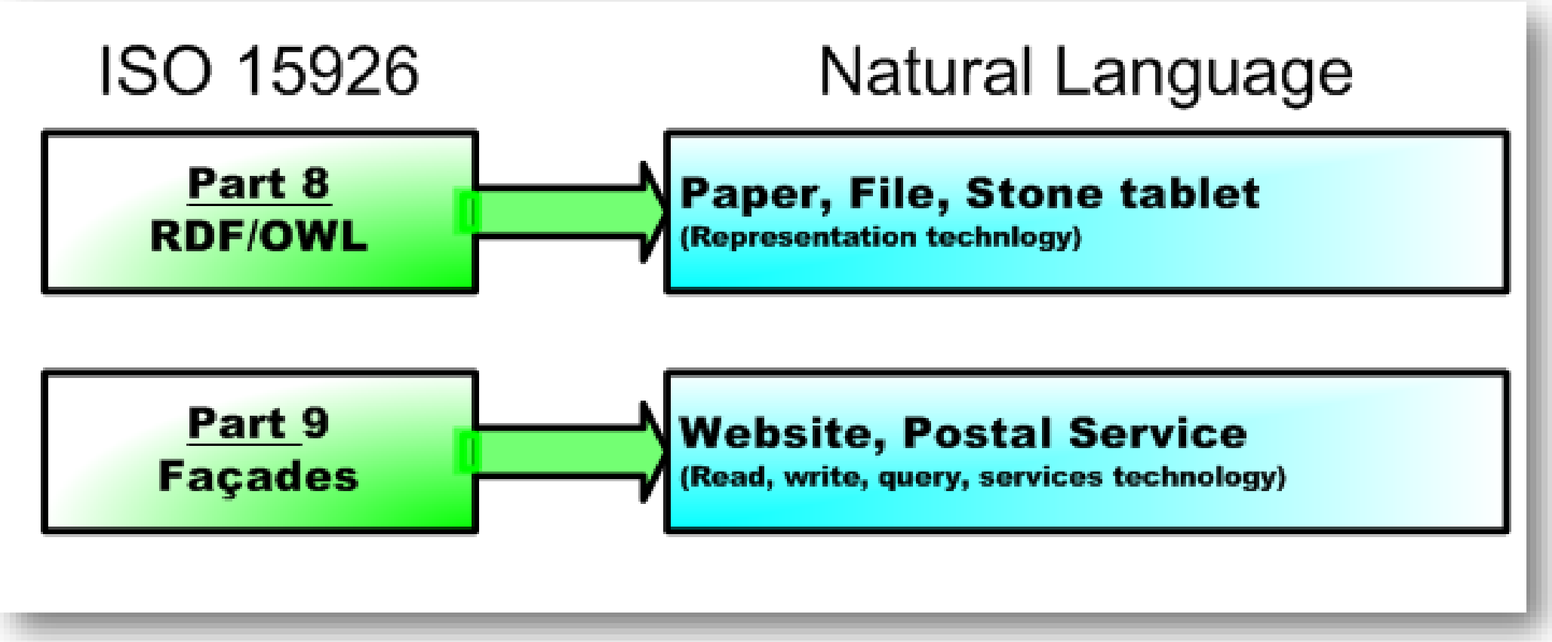
1

HeatExchangerShell
-SubequipmentIdAssignmentClass : string
-UpperLimitDesignPressure : pressure
-LowerLimitDesignPressure : pressure
-UpperLimitDesignTemperature : temperature
-LowerLimitDesignTemperature : temperature
-MaterialOfConstructionCodeAssignmentClass : string

1

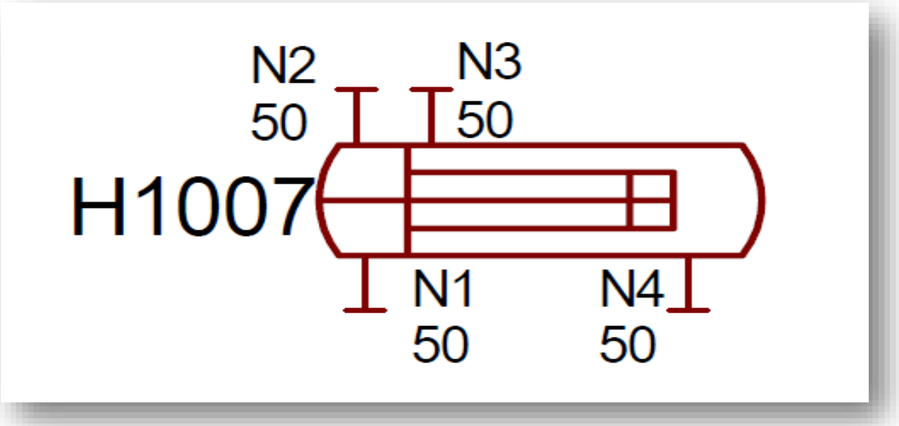
ShellAndTubeHeatExchangerTubeBundle
-SubequipmentIdAssignmentClass : string
-UpperLimitDesignPressure : pressure
-LowerLimitDesignPressure : pressure
-UpperLimitDesignTemperature : temperature
-LowerLimitDesignTemperature : temperature
-MaterialOfConstructionCodeAssignmentClass : string
-TubeLength : distance

How ISO 15926 Works - Part 8 and Part 9



Heat Exchanger in the Sample PID

Here:
Shell and Tube Heat Exchanger



Ident	H1007	
Design Press. min. Chamber 1 / 2	-1 barg	-1 barg
Design Press. max. Chamber 1 / 2	60 barg	30 barg
Design Temp. min. Chamber 1 / 2	-45 °C	-45 °C
Design Temp. max. Chamber 1 / 2	100 °C	100 °C
Design Duty / Design Heat Transfer Area	313 kW	46,8 m²
Nominal Diameter / Tube Length	DN 800	2200 mm
Material Tubes / Material Shell	1.4306	1.4308

Agenda

- Problem Statement
- Data – Information - Knowledge
- Data exchange in Process Plant
- IFC & BuildingSMART
- ISO15926
- DEXPI/ISO15926 Initiative
- Cooperation w/ Industry Groups
- Summary, Q&A

Anno 2011: Bayer asked us to join the initiative

Sent: Dienstag, 12. Juli 2011 13:29

Subject: Koordinationskreis Working Group "ISO 15926 und EQP-Liste" in Leverkusen

Sehr geehrte Herren,

Im Nachgang zum Jahrestreffen der Fachgemeinschaft "Prozess-, Apparate- und Anlagentechnik" (PAAT) im November 2010 in Magdeburg haben die Firmen Evonik Degussa, BASF und Bayer Technology Services eine Arbeitsgruppe zur Evaluierung der ISO 15926 gegründet.

Dabei spielt die Verzahnung der technischen Möglichkeiten der ISO 15926 mit Anforderungen aus Planung und Betrieb verfahrenstechnischer Anlagen eine wichtige Rolle. Bisheriger Fokus der Zusammenarbeit ist eine gemeinsame, firmenübergreifende Informationsmodellierung von Apparaten und Maschinen. Nächster Schritt ist eine Abbildung dieses gemeinsamen Verständnisses in eine ISO 15926-kompatible Darstellung.

Weiterhin möchten wir in dieser Fallstudie auch den Umgang aktueller CAE-Werkzeuge mit der ISO 15926 einbeziehen. Wir möchten Sie daher einladen, mit uns beim nächsten Termin unserer Arbeitsgruppe am **27.7.2011 in Leverkusen** mögliche Szenarien zu diskutieren.

Es wird angestrebt, erste Ergebnisse auf dem Jahrestreffen der PAAT 2011 in Fulda vorzustellen.

Auf Ihre Rückmeldung und eine Zusammenarbeit zum Thema ISO 15926 freuen wir uns.

Mit freundlichen Grüßen,

T. Kügerl
(Evonik Degussa GmbH)

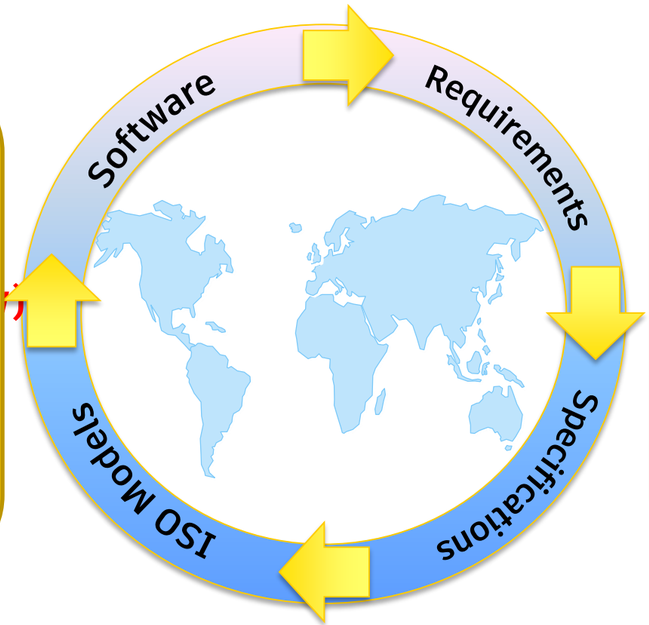
H. Mannsperger
(BASF SE)

J. Kussi
(Bayer Technology Services GmbH)

DEXPI Project

Coordination
Requirements

Implementation
Proteus know-how
ISO knowledge
Interface building
Graphic exchange



Conceptual model
Specifications
Validation / Verificator
DEXPI home page

Model support
Model extension

DEXPI Data Exchange in Process Industry

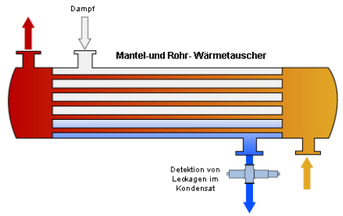
Three major O/O, two EPC's ***and*** the major CAE vendors in ***one*** working group.

Very pragmatic approach with an agile touch.

Operational working mode adapted when required.

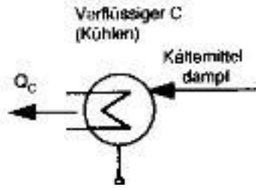
Life cycle

Specification of function in a conceptual phase as in process simulation (Versioning required)



Specification of equipment under a construction aspect as in shop drawings (Versioning required)

Functional requirements → **Functional design** → **Asset specification** → **Asset operational**



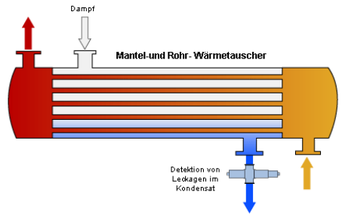
Specification of equipment from a detailed process aspect, e.g. using mathematical models (Versioning required)

Specification of a physical equipment as built and delivered

AUTODESK.

Life cycle

Specification of function in a conceptual phase as in process simulation (Versioning required)



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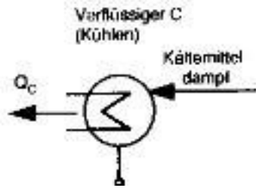
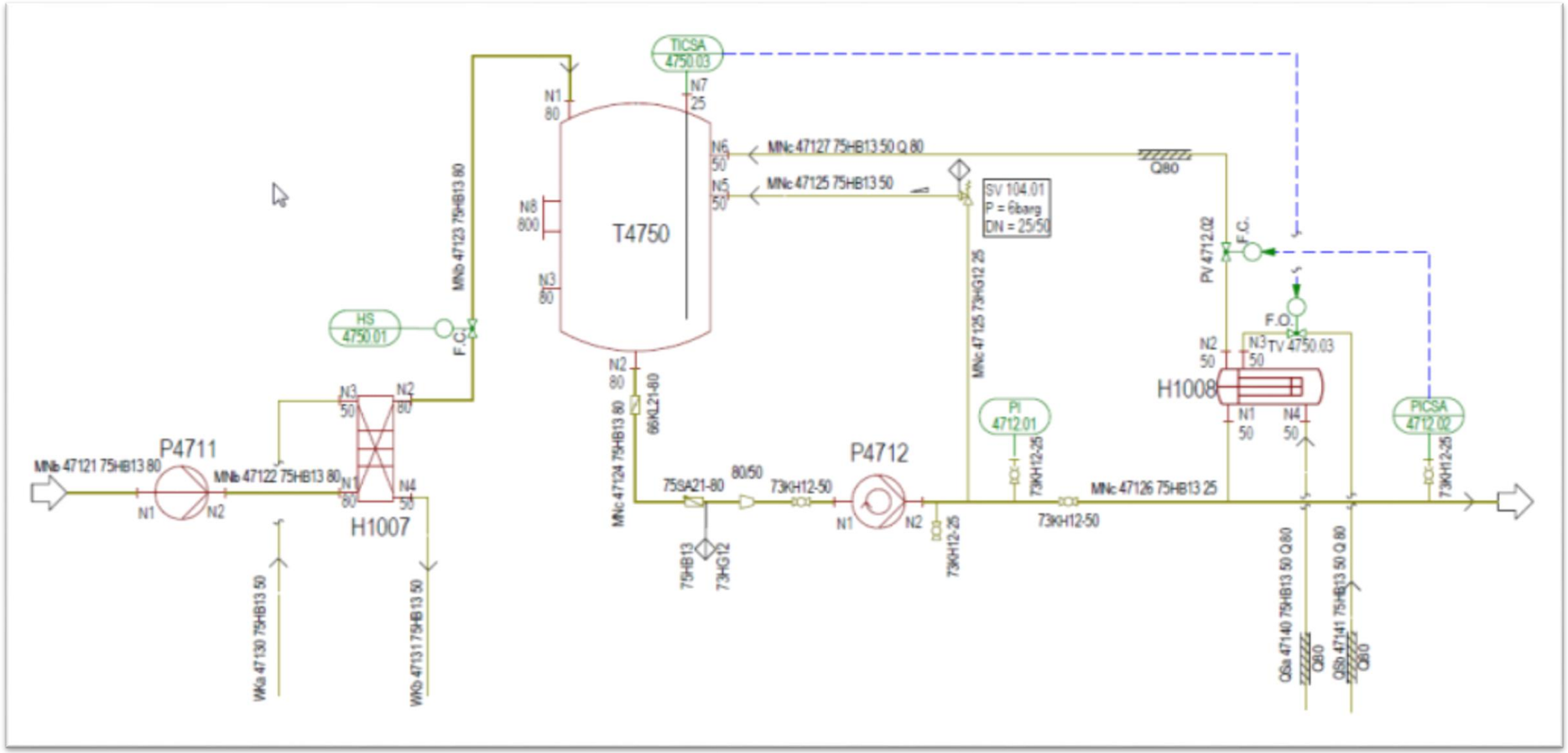


Specification of equipment from a detailed process aspect,
e.g. using mathematical models
(Versioning required)

Specification of a physical equipment as built and delivered

AUTODESK.

Scope for data exchange - P&ID fragment



AUTODESK.

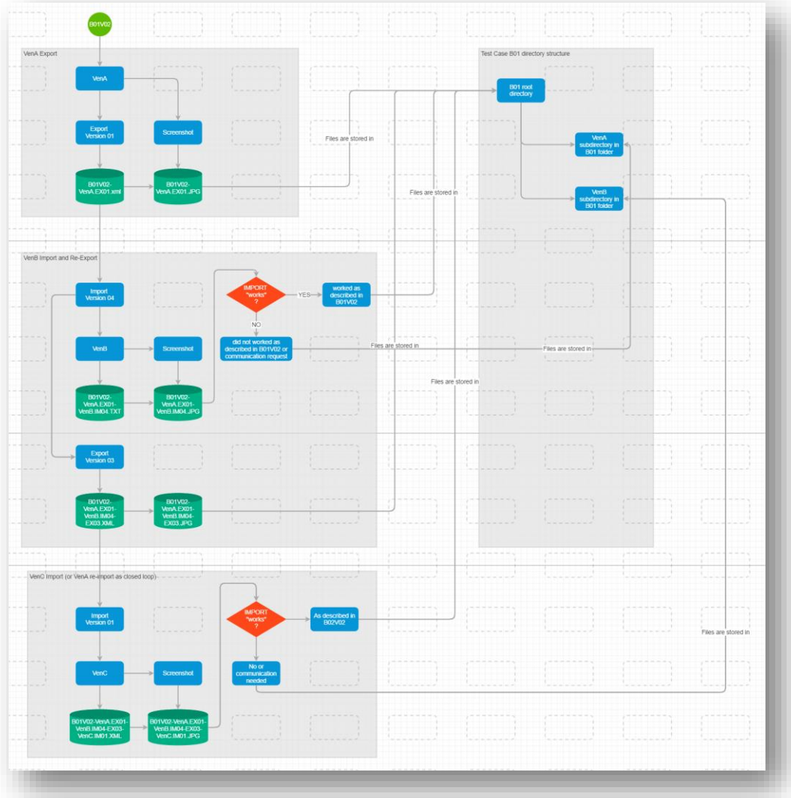
DEXPI approach

- Methodology: ISO 15926 + Proteus (XMpLant) scheme
- All main CAE software vendors involved
- Impact of DEXPI work to international standards
- Bottom up, pragmatic approach
- International coverage, not only local

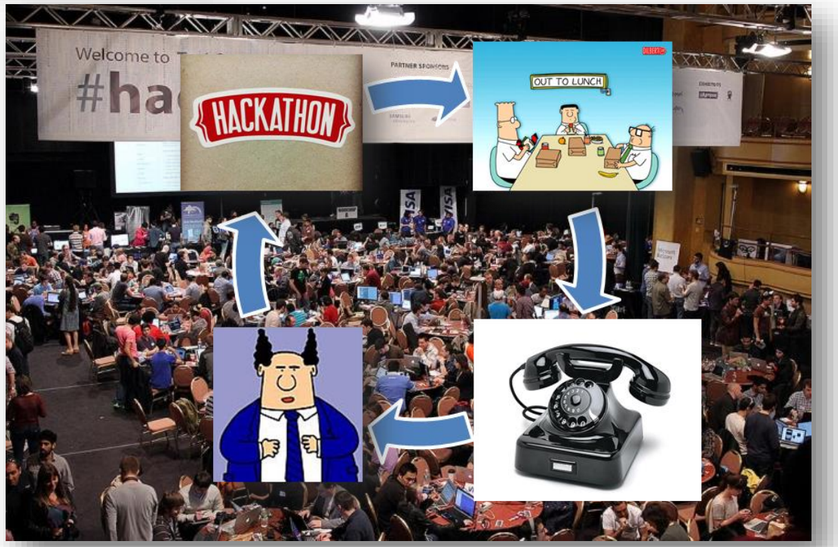
Test Cases as Collaboration Methodology

Exx	Pxx	Ixx	Dxx	Cxx
• Equipment	• Pipelines, • Inline Items, • OPC	• Instrumentation	• Drawing annotation, • title block	• Complete small loops • Combination

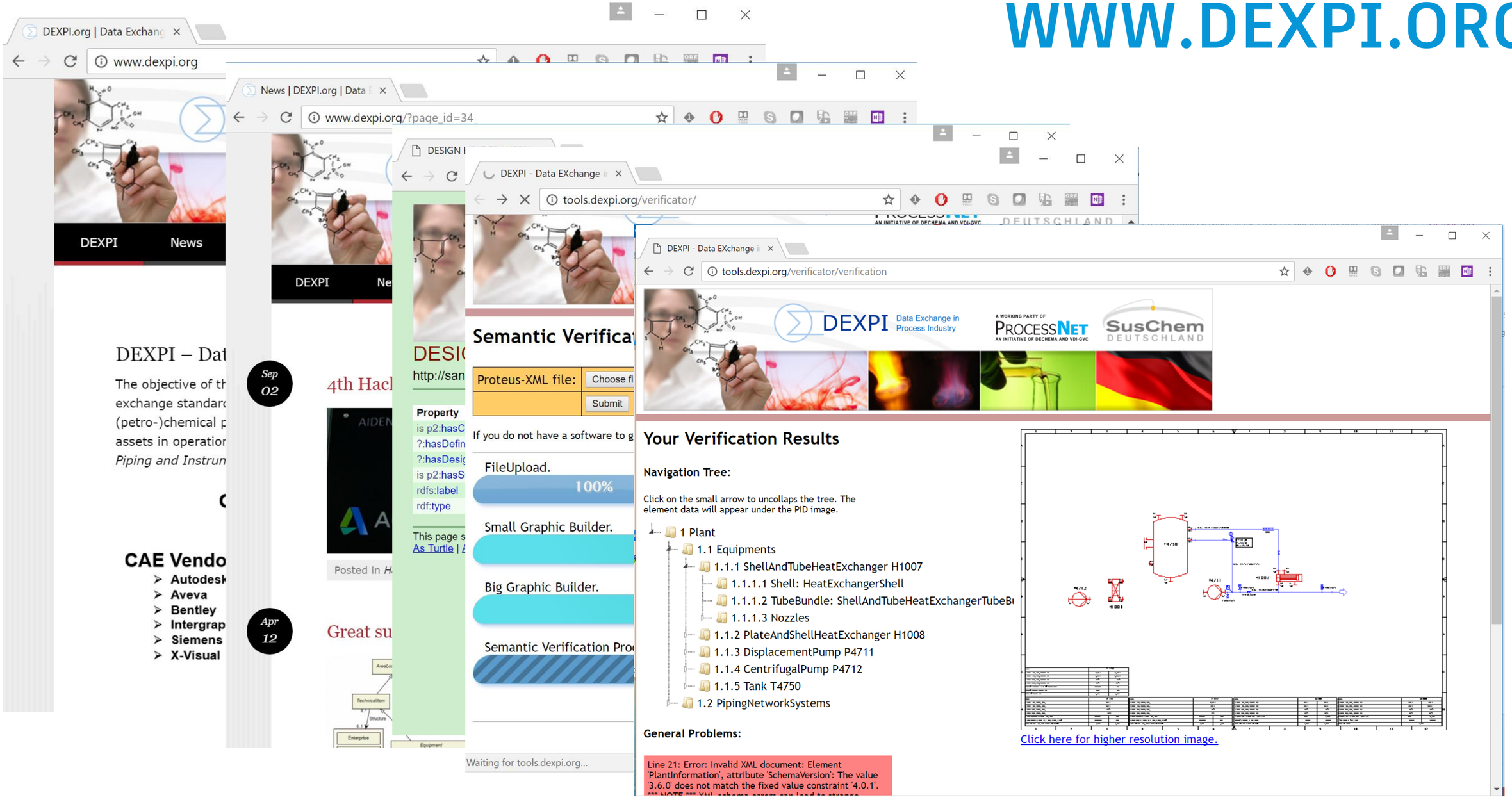
Proteus Scheme as bridge



Agile Approach implemented



WWW.DEXPI.ORG



Current State of AutoCAD P&ID DEXPI interface

Agenda

Problem Statement
Data – Information - Knowledge
Data exchange in Process Plant
IFC & BuildingSMART
ISO15926
DEXPI/ISO15926 Initiative
Cooperation w/ Industry Groups
Summary, Q&A

Influence and cooperation


Fiatech™
LEADERSHIP FORUM
DRIVING INDUSTRY
SOLUTIONS
SEPTEMBER 19 - 21, 2016 NEW ORLEANS, LA

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SusChem DEUTSCHLAND

DECHEMA VCI GDCh

Zum Datenaustausch zwischen P&ID-Systemen – Von der DEXPI-Spezifikation zur Implementierung

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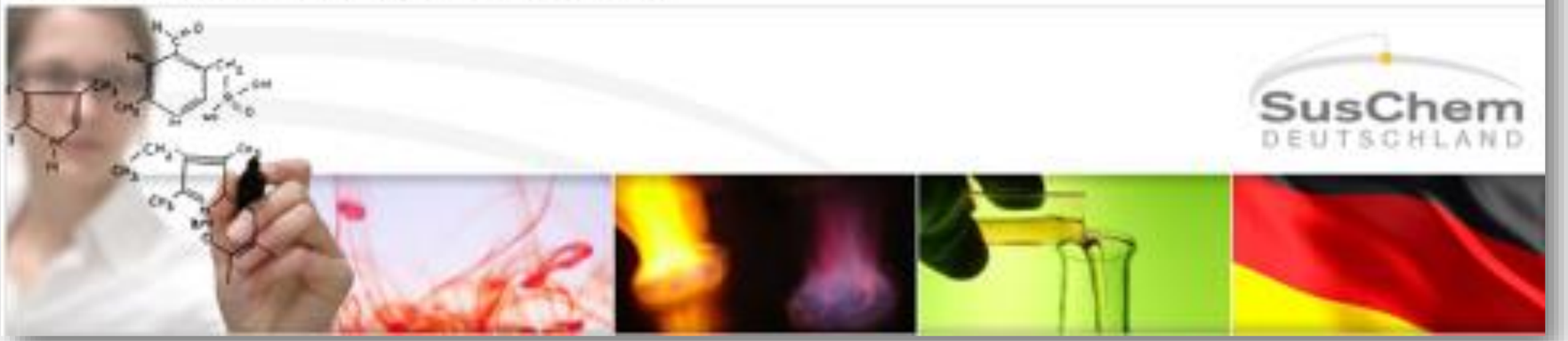
Thomas Lanzendorf, Air Liquide, Frankfurt/D;
Hannes Richert, Evonik Technology & Infrastructure GmbH, Hanau-Wolfgang/D;
Franz Schulze, AixCAPE e.V., Aachen/D;
Heiner Temmen, Evonik Technology & Infrastructure GmbH, Marl/D;
Manfred Theißen, AixCAPE e.V., Aachen/D;
Lars von Wedel, Bayer AG, Leverkusen/D;
Richard Welke, BASF SE, Ludwigshafen/D;
Michael Wiedau, RWTH Aachen, Aachen/D

ProcessNet – A joint initiative of DECHEMA and GVC/VDI



Beta-testing: assessment by O/O

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O/O EPC	Tool 1 (vendor)		Tool 2 (vendor)	Setup; Export DEXPI Example P&ID	Equipment; Piping; Symbols; OPC; Title block;	Instrumen-tation
Air Liquide	SP P&ID (Intergraph)	⇨	AutoCAD P&ID (Autodesk)	☺	In progress	In progress
BASF	COMOS P&ID (Siemens)	⇔	AutoCAD P&ID (Autodesk)	☺	In progress	In progress
Evonik	SP P&ID (Intergraph)	⇨	COMOS P&ID (Siemens)	☺	☺	In progress
				Proof of concept	Investment projects	

Implementation: current status vendor self-assessment

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Vendor	Import (Imp) Export (Exp)	Piping	Equip-ment	Symbols and labels	Instrumen-tation	OPC title blocks
AVEVA	Imp+Exp	😐	☹	☹	🛠	🛠
Autodesk	Imp+Exp	😐	☹	😐	🛠	🛠
Intergraph	Exp	😐	☹	☹	🛠	🛠
Siemens	Imp+Exp	☹	😐	☹	🛠	🛠
X-Visual	Imp[1]	😐	☹	😐	🛠	🛠
Bentley[2]	–	–	–	–	–	–

[1]Export development started
[2]Bentley does not support Proteus XML

☺	≥ 85%
😐	≥ 75%
🛠	< 75%

Success factors: DEXPI based on standards

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

P&ID standard
ISO 10628

Instrumentation
IEC 62424
ANSI 5.1
DIN 19227
IEC 61987

Data exchange
ISO 15926
Proteus (formerly XMPlant)

Agenda

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Summary

Data Handover is a business issue

Autodesk supports open Standards

If there is no standard, we help to develop

DEXPI PID interface for AutoCAD PID is in Beta state

Autodesk continues investment in PP Industry

Thank you

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- Give feedback after each session.
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Q&A - Comments

Section/chapter title slide