Systems thinking for the twin transition. Cross-sectoral interoperability and digital twins

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The digital transition
of society consists all processes at all levels in society producing and applying infrastructure, services, applications and human behavior that depend on digital representation of knowledge and computer power.
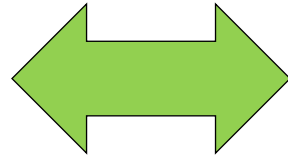
The green transition
of society is about reducing greenhouse gas emissions, preserving and restoring nature, reversing environmental degradation and ensuring that the energy of the future comes from renewable sources.

The twin transition
is about how the dynamics and strength of the digital transition affects the green transition of society, and how these two transitions mutually influence each other and should be combined in the coming years.

The energy transition will blend the process, energy and construction disciplines
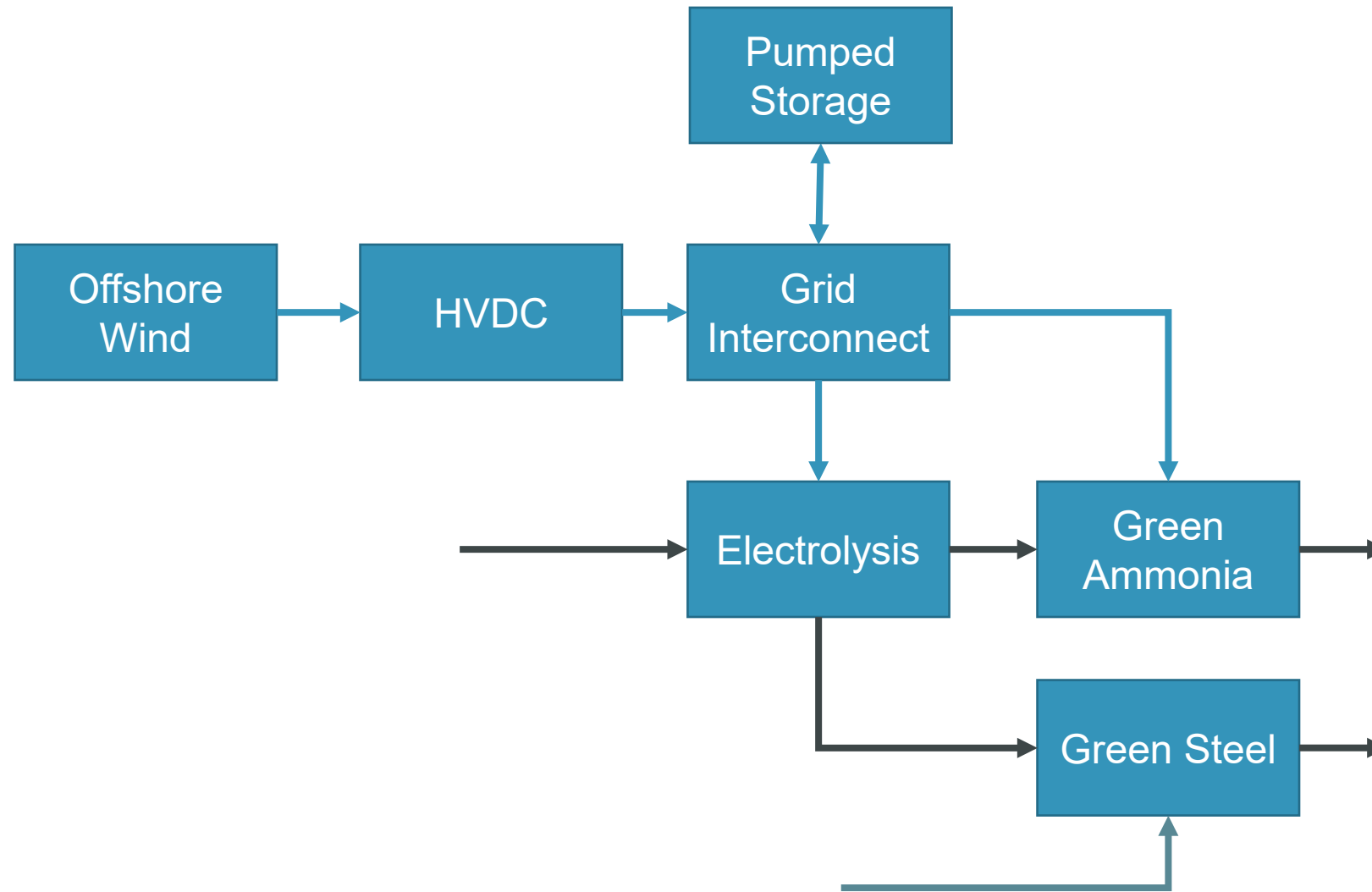
Information about capital assets is segregated

Process	Electrical Energy	Construction

- Chemical and automation engineering
- Electrical and automation engineering
- Civil and environmental engineering

- ISO15926
- ISO81346-10
- BIM

- CFIHOS
- CIM
- IFC

- DEXPI

Our future energy systems will require this information to be interoperable

Information loss along the project life cycle

Project knowledge

Intelligent maintenance

Operational phase

Construction

Detail engineering

Design specifications

Operating solution

Platform technology

Reservoir Complexity

Requirement

Information

Requirement

Information

Requirement

Information

Requirement

Information

Requirement

Information

DG0   DG1   DG2   DG3   DG4
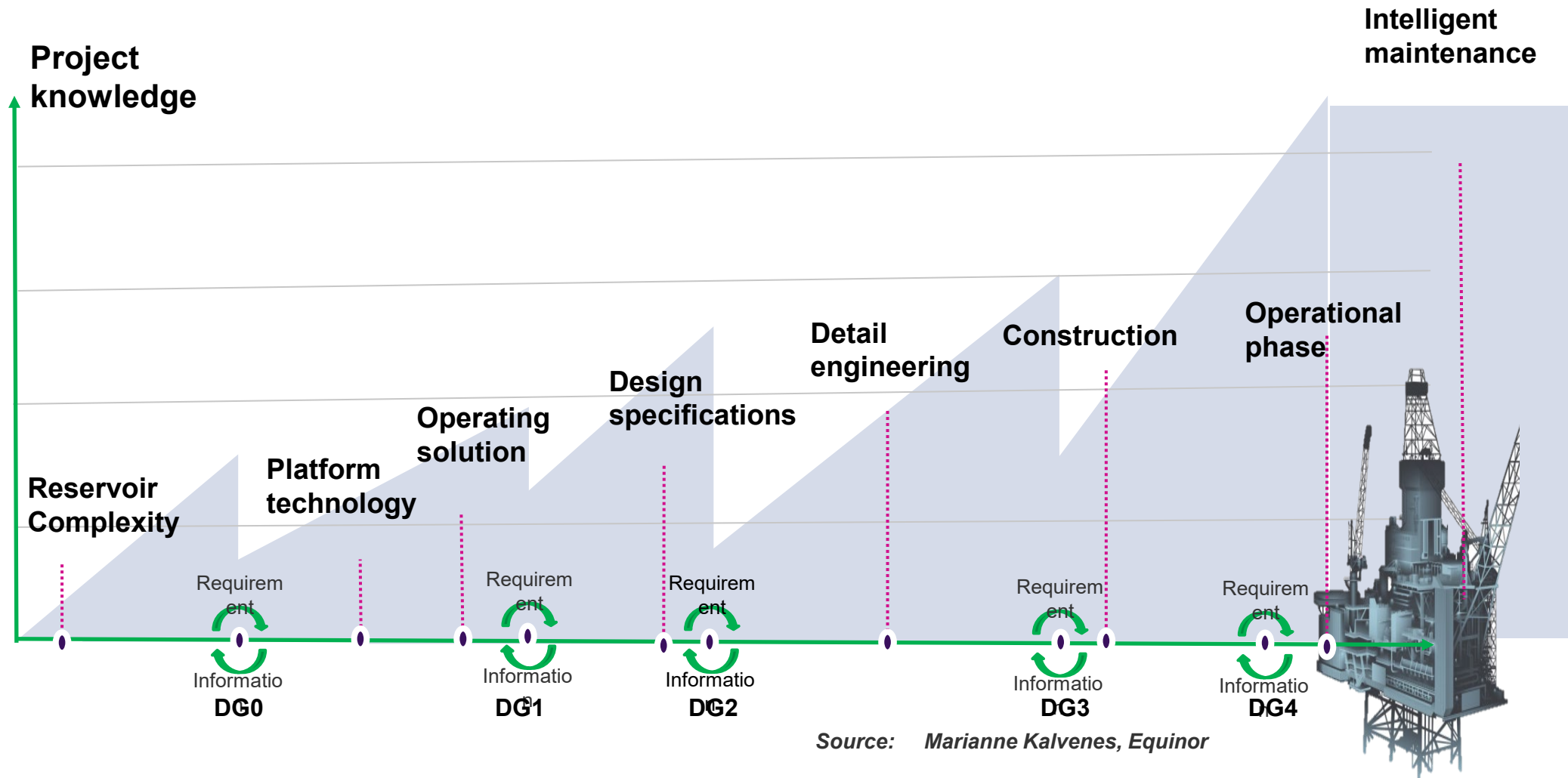
Source: Marianne Kalvenes, Equinor

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Digital Twins:
a pattern for using IT to make good decisions
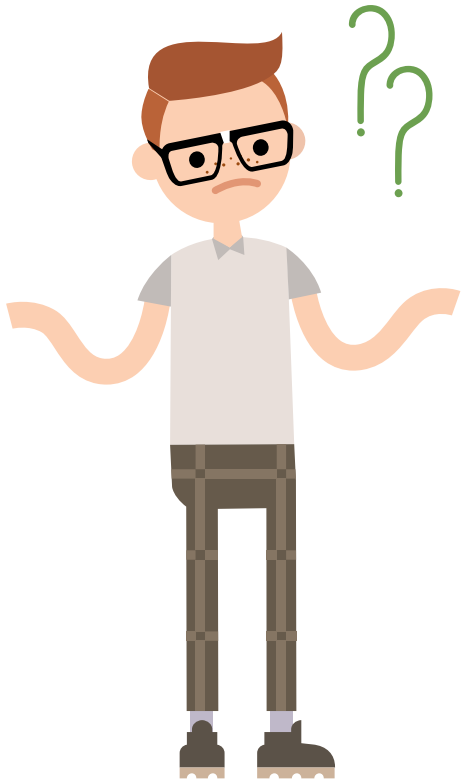
Optimal Performance
(Reliable, Safe,
Profitable, Sustainable)

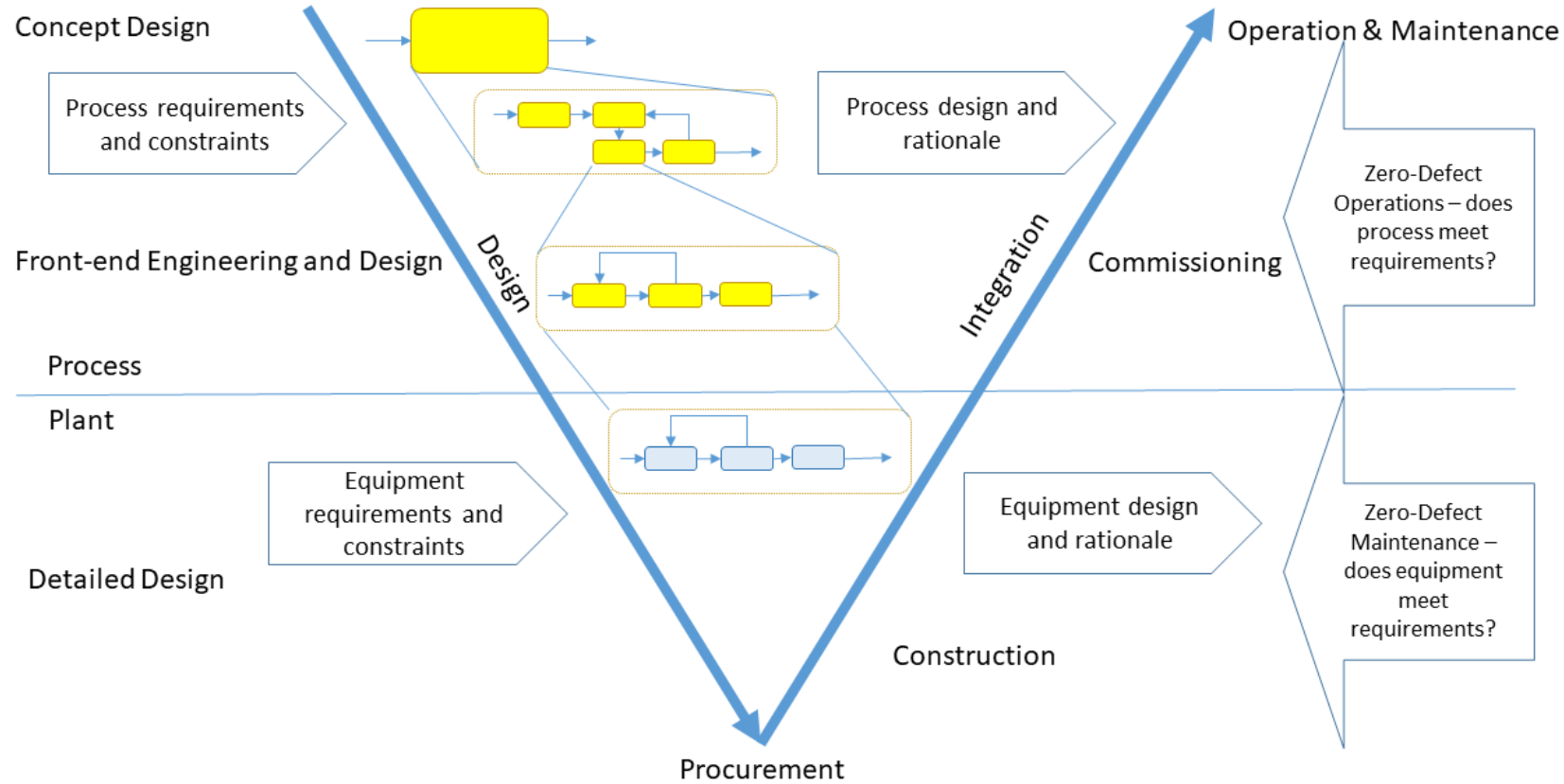Analysis, reasoning and decision support
i.e. Artificial Intelligence

The system's design and configuration

Measurements

Simulation and analysis

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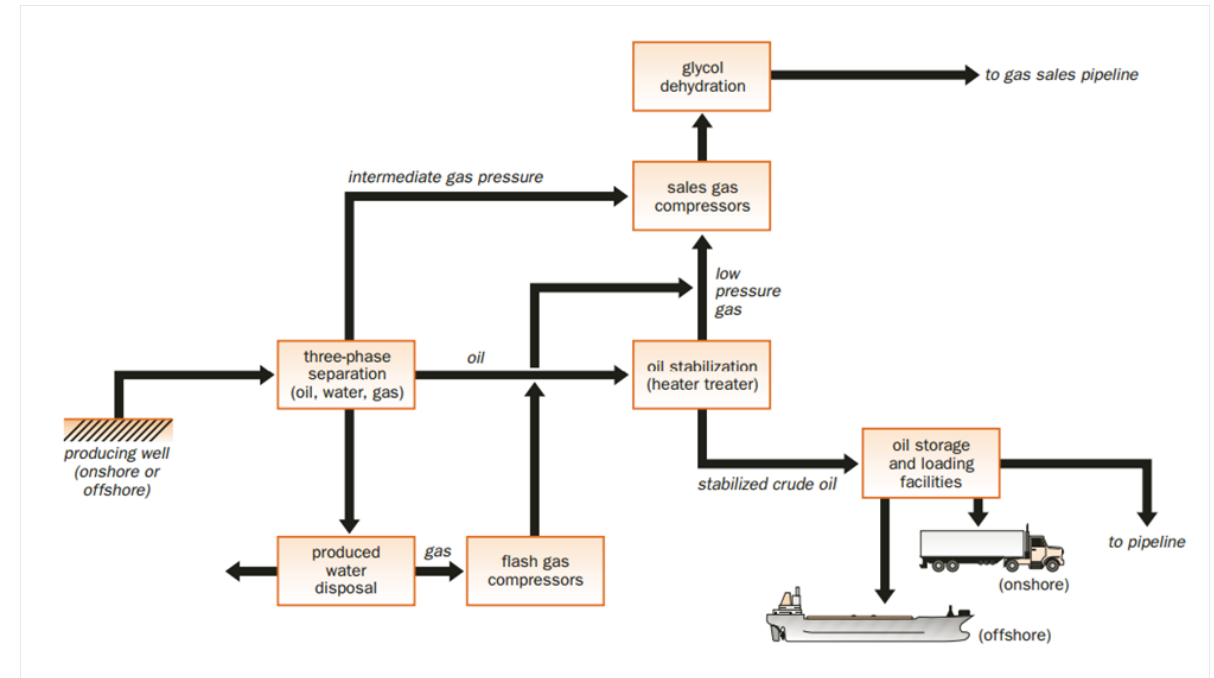
Process and Plant

Conceptual Model of an Asset Information System

The core to the solution: systems thinking
But there are two ways of looking at systems

Assembly of physical things

https://www.oil-gasportal.com/upstream/petroleum-production-phase/

Way of analyzing (desired) reality

Elisabeth Sahl Jonny Engelsvoll Equinor, Grane Platform

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We need to think about systems in different ways

Aspect modelling

What it does
Function aspect

Where it is
Location aspect

What it is
Equipment / Product aspect

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We need to think about systems in different ways

Discipline modelling

Process
Flow of gas

Materials
Corrosion and strength
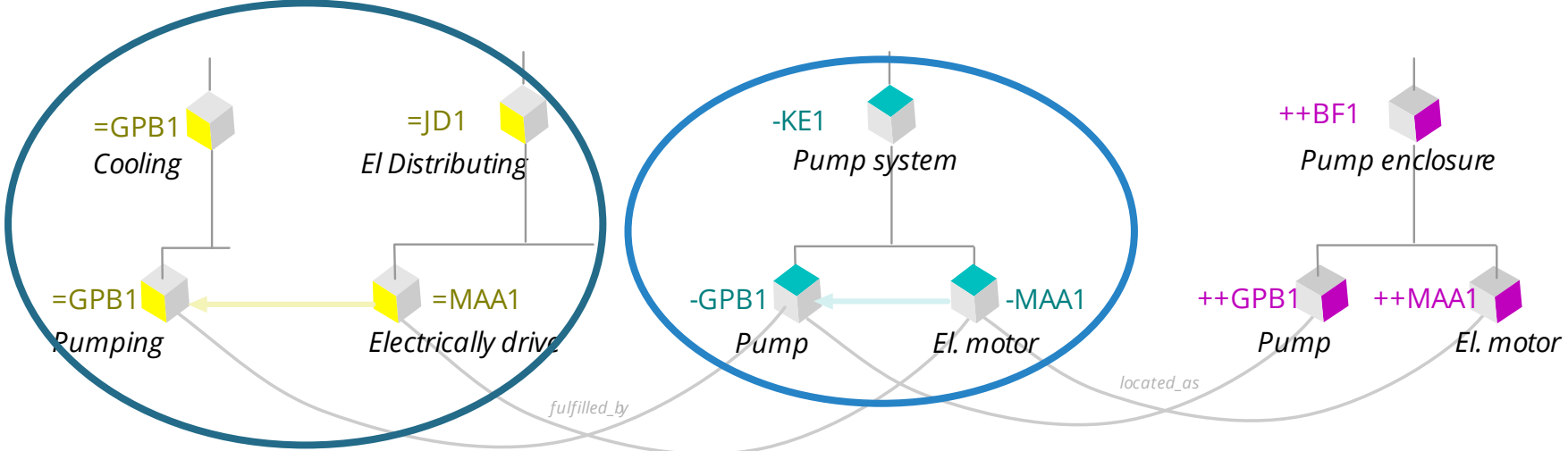
Piping

Electrical
Power use and supply

Automation
Control and instruments

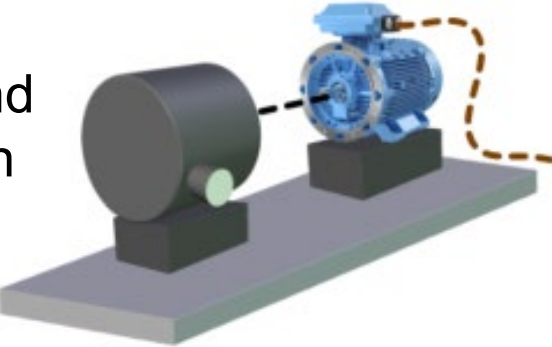**Mechanical**
Rotating equipment

Structural

Layout

10/9/2023

10

IMF uses aspects to separate function from equipment: for example a pump

ISO15926-4/IDO **Artefacts** cover the product aspect

=GPB1
Cooling

=JD1
El Distributing

=GPB1
Pumping

=MAA1
Electrically drive

-KE1
Pump system

-GPB1
Pump

-MAA1
El. motor

++BF1
Pump enclosure

++GPB1
Pump

++MAA1
El. motor

fulfilled_by

located_as

IMF gives agreed functional systems and break-down structures. Typed by **Activities**

Requirements e.g.	Specifications e.g.	Req's and spec 's e.g.
- Shaft power req'd	- Motor power input	- Dimensional spec's
- Start torque req'd	- Motor power output	- Positional spec's
- Speed req's	- Rated speed	
- Voltage & Hz req'd	- Rated voltage	plus part of area req's
	- Enclosure type	- Noise limitation
	- Insulation class	- Ingress protection
		- Explosion protection

FUNCTION

PRODUCT

LOCATION

(credit: Arild Waaler, Erlend Fjøsna and IMF team)

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DEXPI and the ENPRO lifecycle model

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

Functional Requirements → Functional Design → Plant Specification → Plant in Operation

Process Structure

Plant Structure

Plant Structure
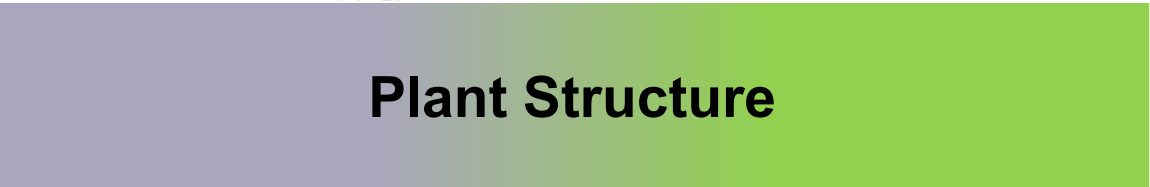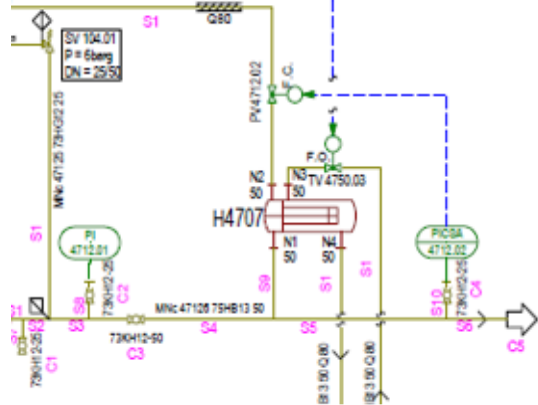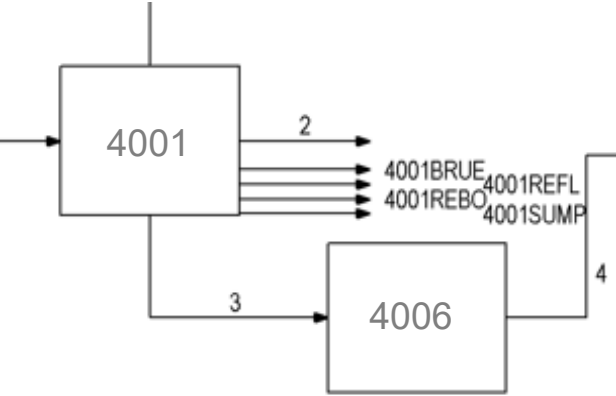
FEED, Detailed Engineering, Procurement & Construction

Process Steps realized by Plant Items and delivered as Installed Plant Items
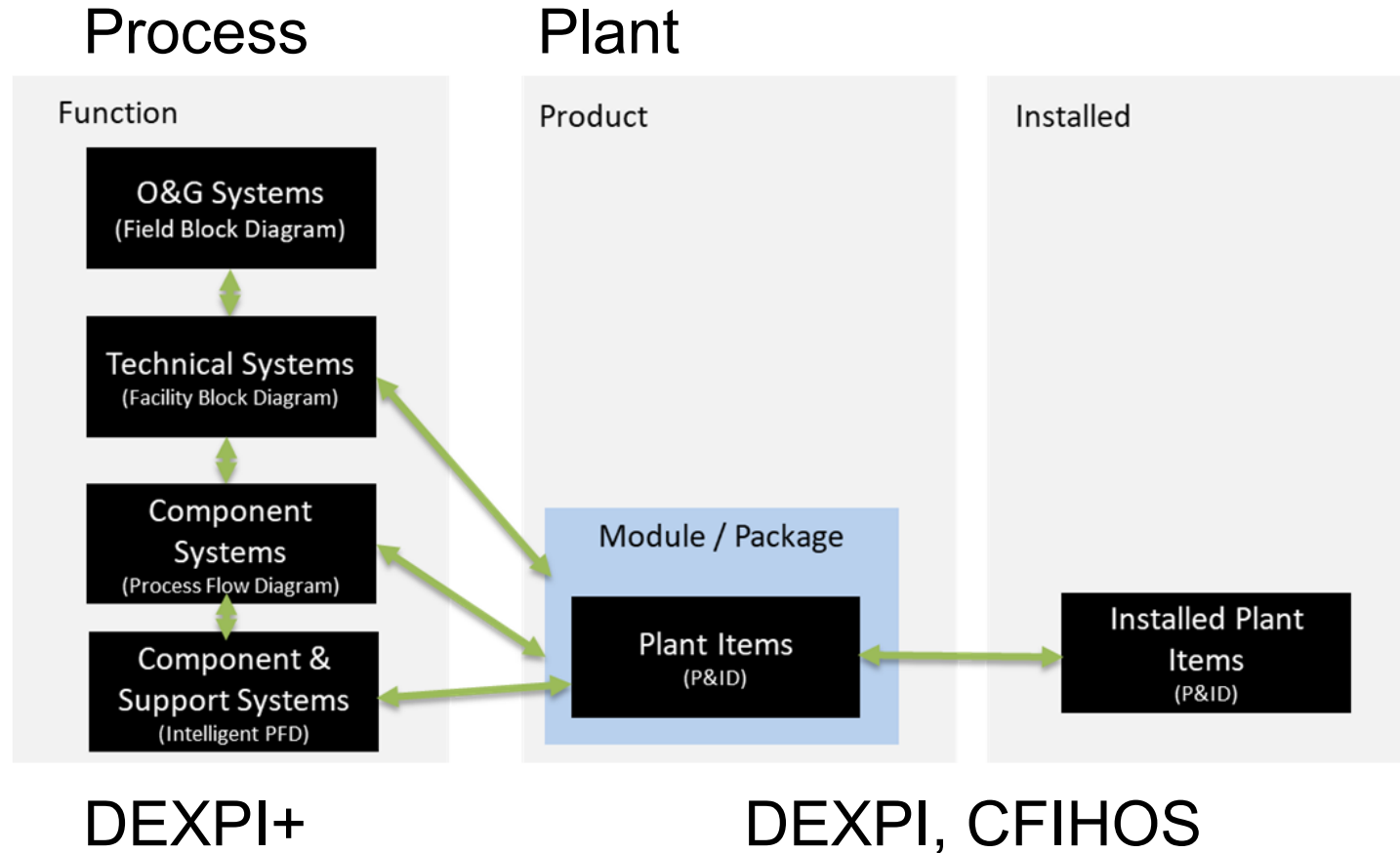
Conclusion

IMF as an opportunity to tie things together

- BIM, CIM, DEXPI, CFIHOS, ISO/IEC81346-10 and ISO/IEC81347-10 product classes
  - Product objects in IMF.

- BIM, ISO/IEC81346-2 Spaces
  - Location objects in IMF

- We need standard functional modelling blocks:
  - Functional objects in IMF.
  - DEXPI Process addresses this for the process discipline
  - ISO/IEC81346-12 for civil discipline.
  - ISO/IEC81346-10 for electrical energy

We can use our IMF objects to transform our engineering work practices

Thank You!

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