

DTC Q3 Virtual Members Meeting

Open-Source Workshop: EcolCafé in Industrie 4.0



Eric Truffet

Professor Digitization of information flows & Solution Owner AKKA Technologie

- Responsible for the establishment of the common list of scenarios between the Alliance Industrie du Futur and the Plattform Industrie 4.0
- Member of the joint ISO/IEC working group for the definition of future reference architecture models for industry
- Member of the AFNOR Data and Model Engineering for Industry standardization commission
- Former manager of Easy-MES, editor and integrator of MES software

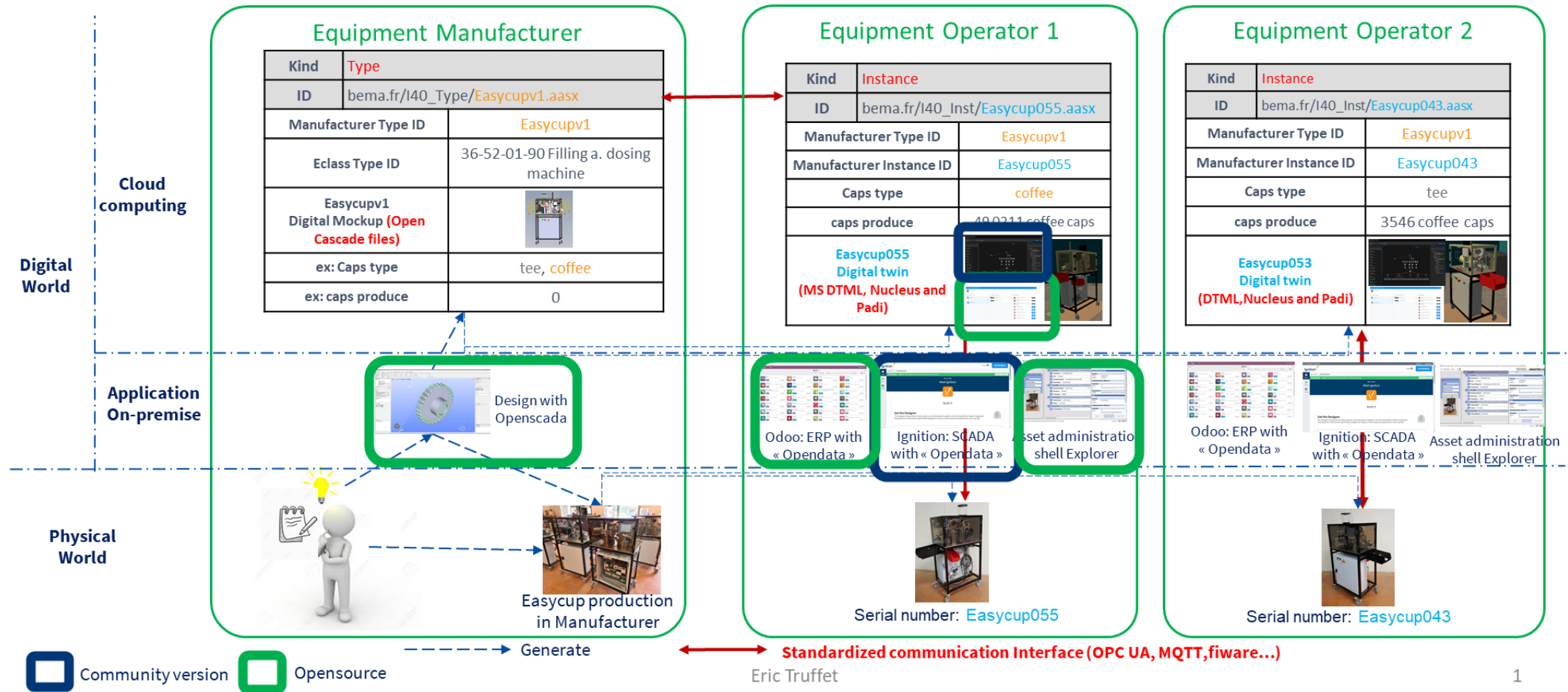
EcolCafé presentation

What is EcolCafé ?



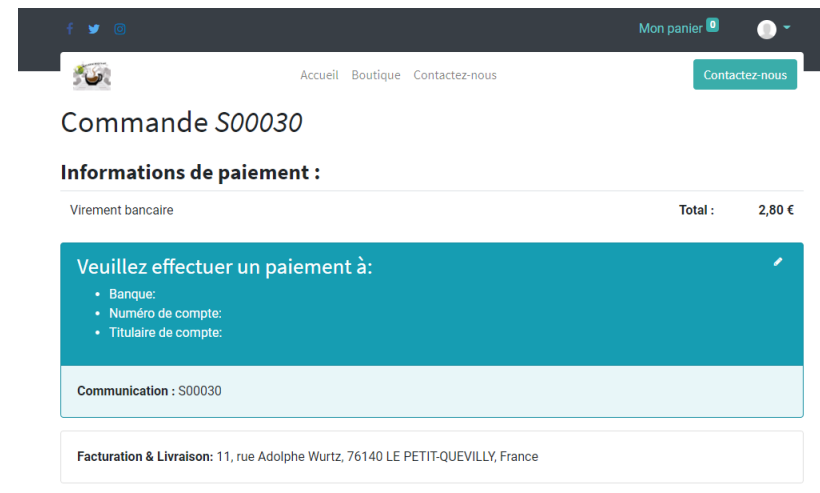
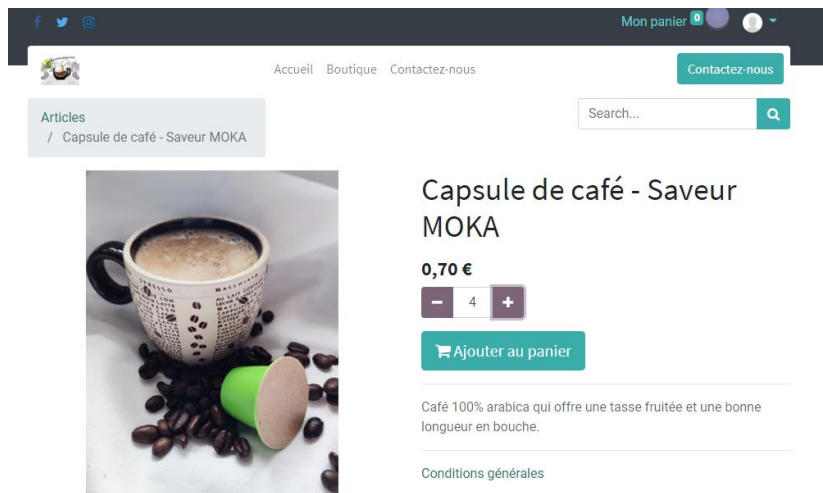
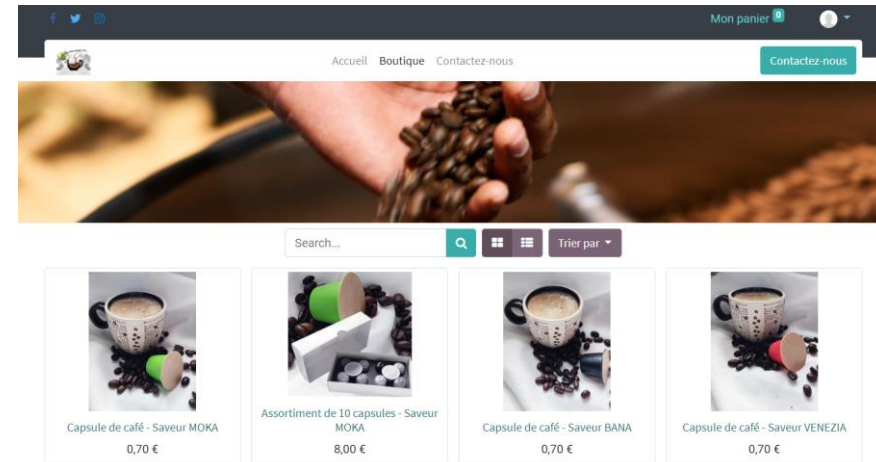
EcolCafé presentation

What is EcolCafé ?



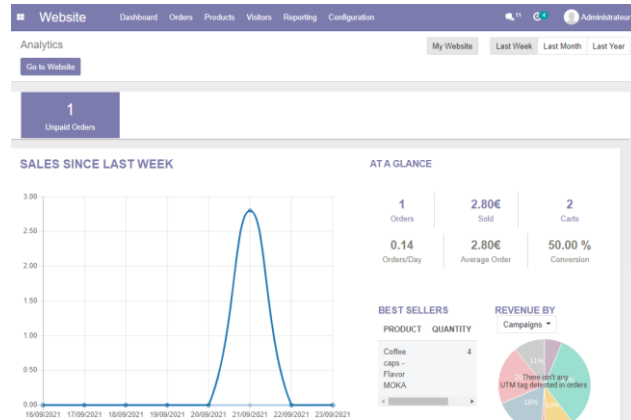
EcolCafé presentation

ERP Odoo and Database opensource – Front office - Website module



EcolCafé presentation

ERP Odoo and Database opensource – Front office - Sale module



The order form for S00030 shows customer details and a table of order lines. The customer is 'Administrateur' at '11, rue Adolphe Wurtz, 76140 LE PETIT-QUEVILLY, France'. The order line includes 'Coffee caps - Flav...' with a quantity of 4.00 and a subtotal of 2.80€.

Product	Description	Quantity	Uo...	Package	Unit Price	Tax...	Subtotal
[PR-CAUNCAMO] Coffee caps - Flav...	[PR-CAUNCAMO] Capsule de café - Saveur MOKA Café 100% arabica qui offre une tasse fruitée et une bonne longueur en bouche.	4.00	Units		0.70		2.80 €



This is a duplicate of the order form for S00030, showing the same customer details and order line.

This version of the order form for S00030 includes a 'Create Invoice' button in the top navigation bar, indicating the next step in the sales process.

EcolCafé presentation

ERP Odoo and Database opensource – Manufacturing Module

Manufacturing

Operations Planning Products Reporting Configuration

Manufacturing Orders

Create

Filters Group By Favourites 1-1/1

ID	Reference	Scheduled Date	Product	Unit of Measure...	Source	Material Availability...	Quantity	State
76	WH/MO/000...	Today	[PR-CAUNCAMO] Coffe...	Units	S00030	Waiting	4.00	Confirmed

4.00



Manufacturing

Operations Planning Products Reporting Configuration

Manufacturing Orders / WH/MO/00073

Edit Create Print Action

Mark as Done Plan Check availability Scrap Unlock Cancel

Draft Confirmed In Progress Done

☆ WH/MO/00073

Product [PR-CAUNCAMO] Coffee caps - Flavor MOKA

Quantity 0.00 / 4.00 Units To Produce

Bill of Material BOM-PRCAUNMO: [PR-CAUNCAMO] Coffee caps - Flavor MOKA

Scheduled Date 23/09/2021 18:01:13

Responsible Administrateur

Components Work Orders By-Products Miscellaneous

Operation Type Warehouse 1 Vinay: Production

Source S00030

Components Location WH1V/Stock

Finished Products Location WH1V/Stock



Manufacturing

Operations Planning Products Reporting Configuration

Manufacturing Orders / WH/MO/00073

Edit Create Print Action

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Draft Confirmed In Progress Done

☆ WH/MO/00073

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Quantity 0.00 / 4.00 Units To Produce

Bill of Material BOM-PRCAUNMO: [PR-CAUNCAMO] Coffee caps - Flavor MOKA

Scheduled Date 23/09/2021 18:01:13

Responsible Administrateur

Components Work Orders By-Products Miscellaneous

Product	To Consume	Reserved	Consumed	Unit of Measure
[RM-EMPCAGR] Empty caps (Verte-Mok)	0.00 / To Consume	Available	0.00	Units
[RM-COBEMO] Roasted coffee beans (Moka)	0.00 / 22.00	Available	0.00	g
[RM-LIPASTBR] Bande pour opercule	0.00 / 22.00	Available	0.00	cm

Manufacturing

Operations Planning Products Reporting Configuration

Manufacturing Orders / WH/MO/00073

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Draft Confirmed In Progress Done

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Bill of Material BOM-PRCAUNMO: [PR-CAUNCAMO] Coffee caps - Flavor MOKA

Scheduled Date 23/09/2021 18:01:13

Responsible Administrateur

Components Work Orders By-Products Miscellaneous

Operation	Work Center	Scheduled Start Date	Expected Duration	Real Duration	Status
Encapsulage Moka	Encapsulage		00:28	00:00	Ready

EcolCafé presentation

ERP Odoo and Database opensource – Manufacturing Module

Manufacturing

Operations Planning Products Reporting Configuration

Manufacturing Orders

Create

Filters Group By Favourites 1-1/1

ID	Reference	Scheduled Date	Product	Unit of Measure...	Source	Material Availability...	Quantity	State
76	WH/MO/000...	Today	[PR-CAUNCAMO] Coffe...	Units	S00030	Waiting	4.00	Confirmed

4.00



Manufacturing

Operations Planning Products Reporting Configuration

Manufacturing Orders / WH/MO/00073

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Quantity 0.00 / 4.00 Units To Produce

Bill of Material BOM-PRCAUNMO: [PR-CAUNCAMO] Coffee caps - Flavor MOKA

Scheduled Date 23/09/2021 18:01:13

Responsible Administrateur

Components Work Orders By-Products Miscellaneous

Operation Type Warehouse 1 Vinay: Production

Source S00030

Components WH1V/Stock

Finished Products WH1V/Stock



Manufacturing

Operations Planning Products Reporting Configuration

Manufacturing Orders / WH/MO/00073

Edit Create Print Action

Mark as Done Plan Check availability Scrap Unlock Cancel

Draft Confirmed In Progress Done

☆ WH/MO/00073

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Scheduled Date 23/09/2021 18:01:13

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[RM-LIPASTBR] Bande pour opercule	0.00 / 22.00	Available	0.00	cm

Manufacturing

Operations Planning Products Reporting Configuration

Manufacturing Orders / WH/MO/00073

Edit Create Print Action

Mark as Done Plan Check availability Scrap Unlock Cancel

Draft Confirmed In Progress Done

☆ WH/MO/00073

Product [PR-CAUNCAMO] Coffee caps - Flavor MOKA

Quantity 0.00 / 4.00 Units To Produce

Bill of Material BOM-PRCAUNMO: [PR-CAUNCAMO] Coffee caps - Flavor MOKA

Scheduled Date 23/09/2021 18:01:13

Responsible Administrateur

Components Work Orders By-Products Miscellaneous

Operation	Work Center	Scheduled Start Date	Expected Duration	Real Duration	Status
Encapsulage Moka	Encapsulage		00:28	00:00	Ready Start Block

EcolCafé presentation

SCADA Ignition by Inductive automation demonstration and Project opensource

Manufacturing Operations Planning Products Reporting Configuration 11 4 Administrateur

Manufacturing Orders / WH/MO/00073

Edit Create Print Action 1 / 1 < >

Mark as Done Unplan Check availability Scrap Unlock Cancel Draft Confirmed In Progress Done

Product Moves

☆ WH/MO/00073

Product [PR-CAUNCAMO] Coffee caps - Flavor MOKA Scheduled Date 23/09/2021 18:01:13
Quantity 0.00 / 4.00 Units To Produce Responsible Administrateur
Bill of Material BOM-PRCAUNMO [PR-CAUNCAMO] Coffee caps
- Flavor MOKA

Components Work Orders By-Products Miscellaneous

Operation	Work Center	Scheduled Start Date	Expected Duration	Real Duration	Status
Encapsulage Moka	Encapsulage	23/09/2021 18:06:00	00:28	00:05	In Progress Pause Done Block



Poste de charge ASFW-ENCAP01 Encapsulage

Gestion des ordres de production à réaliser

Ordre de production	Article	Opération	Quantité prévue	Quantité produite	Temps requis min	Temps réalisé min
WH/MO/00073	PR-CAUNCAMO	Encapsulage Moka	4	0	0.47	0

Créer ordre de production
Charger les paramètres
Lancer la production
Arrêt

Ordre de production en cours

Désignation	Valeurs requises	Valeurs réelles
Article PR-CAUNCAMO PR-CAUNCAMO		
Ordre Prod WH/MO/00073 WH/MO/00066		
Quantité 4 10		

Gestion des composants à réserver

Type de composant	Quantité à réserver
[RM-EMPCAGR] Capsule vide (Verte-Mok)	4.0 Units
[RM-COBEMO] Grain de Café torréfié (Moka)	22.0 g
[RM-LIPASTBR] Bande pour opercule	0.22 cm

Gestion des consignes de production

Equipement	Paramètre	Valeur requise	Valeur réelle
1 ASEW-ENCAP01	Contrôle dosage	1	0
1 ASEW-ENCAP01	Dosage max cafe pourcentage	55	55
1 ASEW-ENCAP01	Dosage min cafe pourcentage	15	15
1 ASEW-ENCAP01	Numero recette	0	0



Poste de charge ASFW-ENCAP01 Encapsulage

Gestion des ordres de production à réaliser

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Poste de charge ASFW-ENCAP01 Encapsulage

Gestion des ordres de production à réaliser

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Charger les paramètres
Lancer la production
Arrêt

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Ordre Prod WH/MO/00073 WH/MO/00066		
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1 ASEW-ENCAP01	Numero recette	0	0

EcolCafé presentation

SCADA Ignition by Inductive automation demonstration and Project opensource

Poste de charge: ASFW-ENCAP01 | Encapsulage

Gestion des ordres de production à réaliser

Créer ordre de production

Charger les paramètres

Lancer la production

Arrêt

Ordre de production en cours

Désignation	Valeurs requises	Valeurs réelles
Article	PR-CAUNCAMO	PR-CAUNCAMO
Ordre Prod	WH/MO/00073	WH/MO/00066
Quantité	4	10

Gestion des composants à réserver

Type de composant	Quantité à réserver
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Manufacturing

Operations Planning Products Reporting Configuration

Manufacturing Orders / WH/MO/00073

Edit Create Print Action

Mark as Done Plan Check availability Scrap Unlock Cancel

Draft Confirmed In Progress To Close Done

☆ WH/MO/00073

Product [PR-CAUNCAMO] Coffee caps - Flavor MOKA

Quantity 4.00 / 4.00 Units To Produce

Scheduled Date 23/09/2021 18:06:00

Responsible Administrateur

Bill of Material BOM-PRCAUNMO: [PR-CAUNCAMO] Coffee caps - Flavor MOKA

Components Work Orders By-Products Miscellaneous

Operation	Work Center	Scheduled Start Date	Expected Duration	Real Duration	Status
Encapsulage Moka	Encapsulage	23/09/2021 18:06:00	00:28	04:19	Finished Block

Send message Log note Schedule activity

0 Following 1

Manufacturing

Operations Planning Products Reporting Configuration

Manufacturing Orders

Create

Filters Group By Favourites 1-1/1

ID	Reference	Scheduled Date	Product	Unit of Measure	Source	Material Availability	Quantity	State
76	WHMO00073	Today	[PR-CAUNCAMO] Coffee caps - Flavor MOKA	Units	S00130	Waiting	4.00	To Close

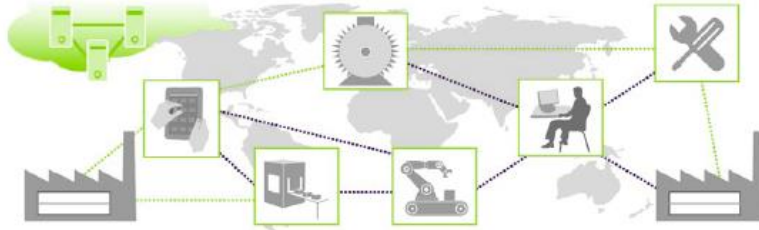
4.00

localhost8069/web#

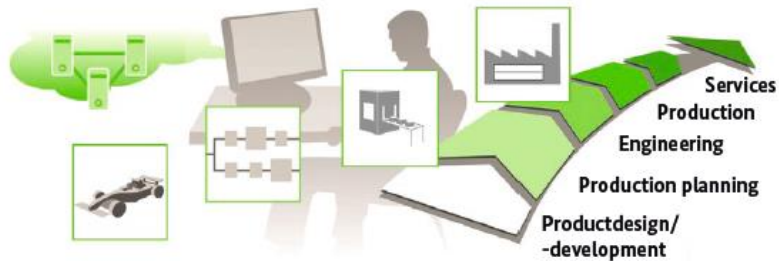
Industry 4.0 objectives

Four pillars of Industry 4.0

Horizontal integration via value-added networks

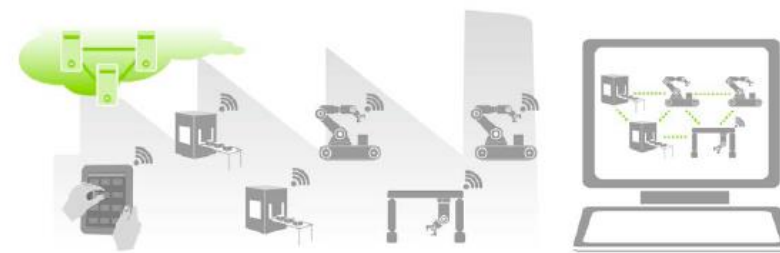


Digital consistency for the engineering throughout the whole value-added chain



Source: Siemens AG/Festo AG&Co KG

Vertical (integration and networked production system)



The human being as a conductor for added value



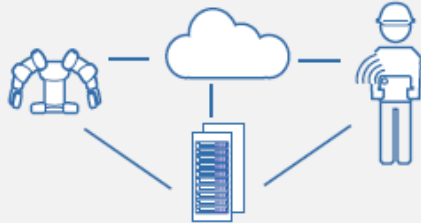
Source: Trilateral Presentation Structure of the Administration Shell” on Tri-lateral on Steering Committee in Hannover fair 2018

Industrie 4.0 concepts Presentation

What's new in Industry 4.0

That's already possible today

- ▶ The cloud
- ▶ The network
- ▶ Automation devices with Internet access
- ▶ Internet-based services



Industrie 4.0: New Ingredients

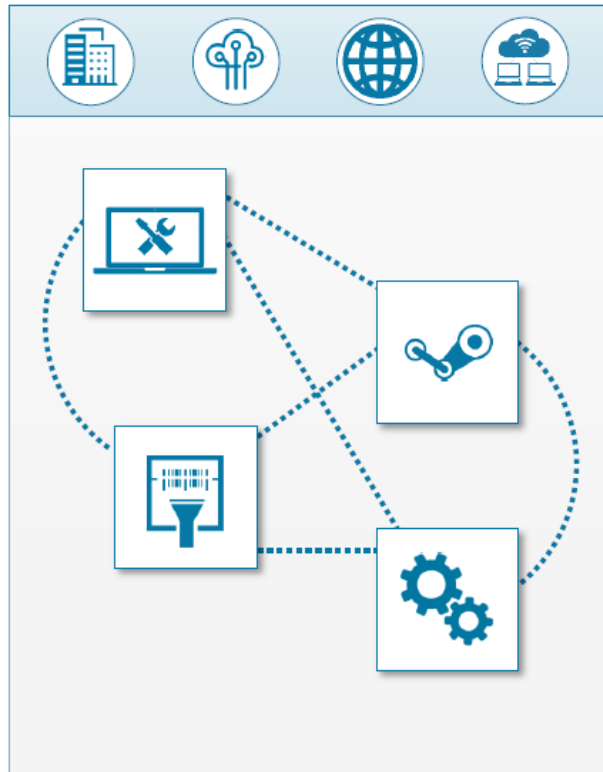
- ▶ **Added value** by exchanging information between value chain partners
- ▶ From **Intranet** to **Internet**
- ▶ **Neutral and common standards** for communication, services and semantics across companies and sectors



A large number of new **applications** and **business models** will emerge.

Industrie 4.0 concepts Presentation

What do the devices need to communicate with each other?

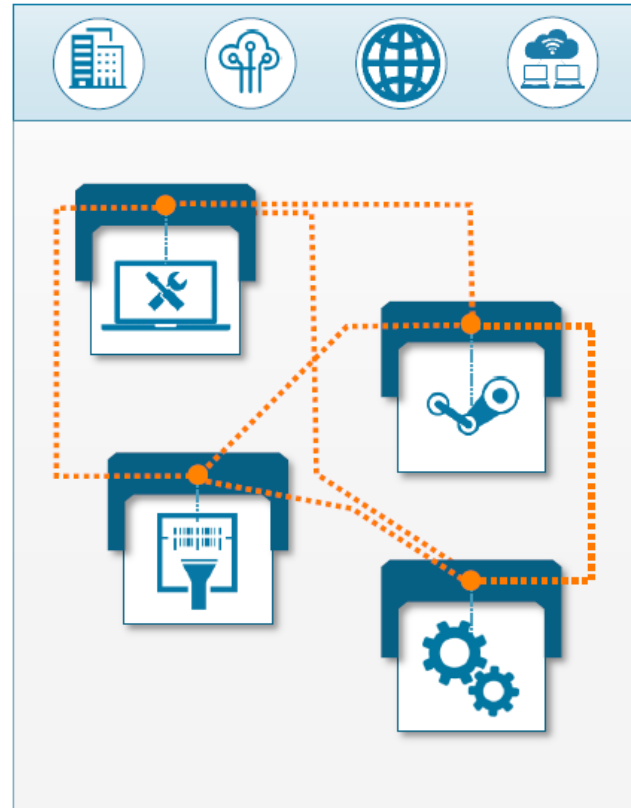


Graphics © Anna Salari, designed by freepik

- ...standardized and global communication
- plug and play installation and operation
- ...a standardized language for information exchange

Industrie 4.0 concepts Presentation

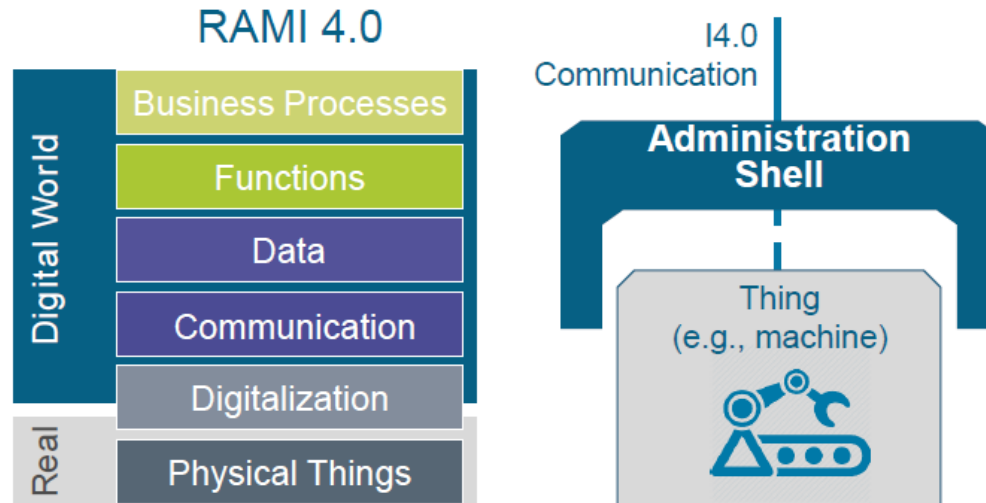
Who provides these services? It is the "Administration shell"...



- ... is the interface connecting Industry 4.0 to physical assets
- ... stores all the data concerning the physical assets
- ... provides a standardized communication interface to the network
- ... is able to manage passive devices (know-how, mechanical parts, etc...)

Industrie 4.0 concepts Presentation

Details of the shell administration



- Connections are made through Industry 4.0 communication
- The shell administration defines the digital part (property, operations, events) of the physical asset
- The asset (everything that is valuable to a company) defines the real part

Each object needs to be managed and represented by at least one shell administration to be Industry 4.0 compatible

Industrie 4.0 concepts Presentation

Asset administration Explorer Open Source on Github example

The screenshot displays the Asset Administration Explorer (AAE) software interface, which is based on the specifications of Platform Industrie 4.0. The interface is divided into several panes:

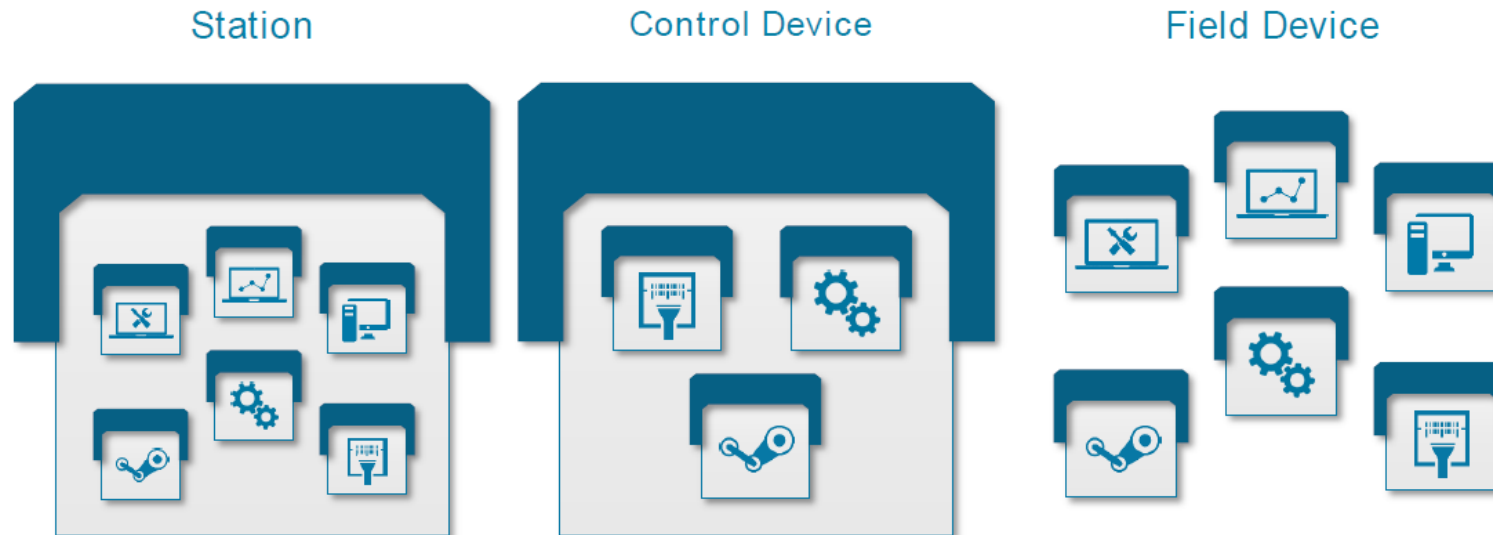
- Left Pane:** Contains a URL bar with the address `http://customer.com/aas/9175_7013_7091_9168` and a list of submodel elements. Below this is a thumbnail image of a motor assembly on a cart.
- Central Tree View:** Shows a hierarchical structure of the asset data:
 - AAS "ExampleMotor"** [IRI, `http://customer.com/aas/9175_7013_7091_9168`] of [IRI, ...]
 - SM "Identification"** [IRI, `http://i40.customer.com/type/1/1/F13E8576F6488342`]
 - Prop "Manufacturer"** = CUSTOMER GmbH
 - Prop "GLN"** = 10101010
 - Prop "ProductDesignation"** = I40 Capable Servo Motor (EN)
 - Prop "SerialNumber"** = P12345678I40
 - SM "TechnicalData"** [IRI, `http://i40.customer.com/type/1/1/7A7104BDAB57E1E`]
 - Prop "MaxRotationSpeed"** = 5000 [1/min]
 - Prop "MaxTorque"** = 200 [Nm]
 - Prop "CoolingType"** = BAB657
 - SM "OperationalData"** [IRI, `http://i40.customer.com/instance/1/1/AC69B1CB4`]
 - Prop "RotationSpeed"** = 4370 [1/min]
 - Prop "Torque"** = 117.4 [Nm]
 - SM "Documentation"** [IRI, `http://i40.customer.com/type/1/1/1A7B62B529F191`]
 - SMC "OperatingManual"** (9 elements)
- Right Pane:** Displays detailed information for the selected asset, organized into sections:
 - Asset Administration Shell**
 - Referable:**
 - idShort:** ExampleMotor
 - category:** CONSTANT
 - HasDataSpecification (Reference):**
 - Identifiable:**
 - idType:** IRI
 - id:** `http://customer.com/aas/9175_7013_7091_9168`
 - Asset Reference**
 - assetRef:** (Asset) (local) [IRI] `http://customer.com/assets/KH`
 - Asset**
 - Referable:**
 - idShort:** ServoDCMotor
 - category:**
 - HasDataSpecification (Reference):**
 - Identifiable:**
 - idType:** IRI
 - id:** `http://customer.com/assets/KHBVZJSQKIY`

At the bottom of the right pane, there are three buttons: "Reload", "Drag from here!", and "Show Content".

Industrie 4.0 concepts Presentation

Combination of Asset Administration Shell

- Each device has its own shell administration
- Several devices can form a complete device with a common shell administration

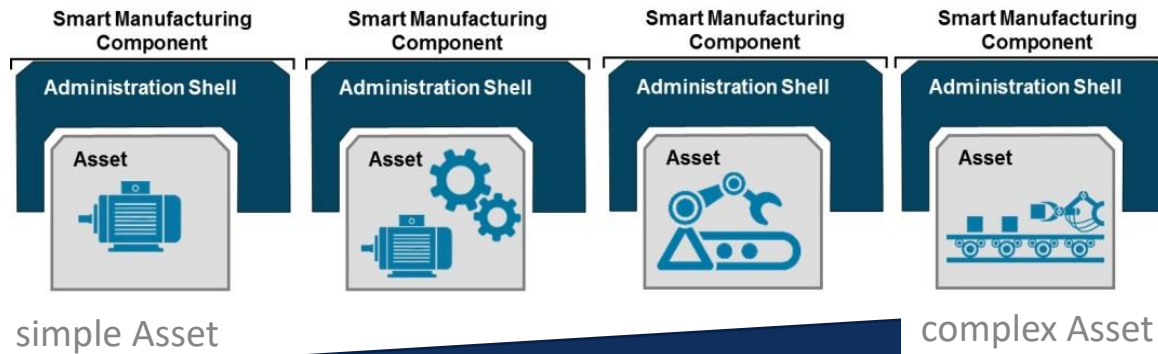


Graphics © Plattform Industrie 4.0, Administration Shell © ZVEI SG Modelle und Standards

Industrie 4.0 concepts Presentation

A provider of information and functions for Smart Manufacturing

As a flexible framework able to address all assets ...



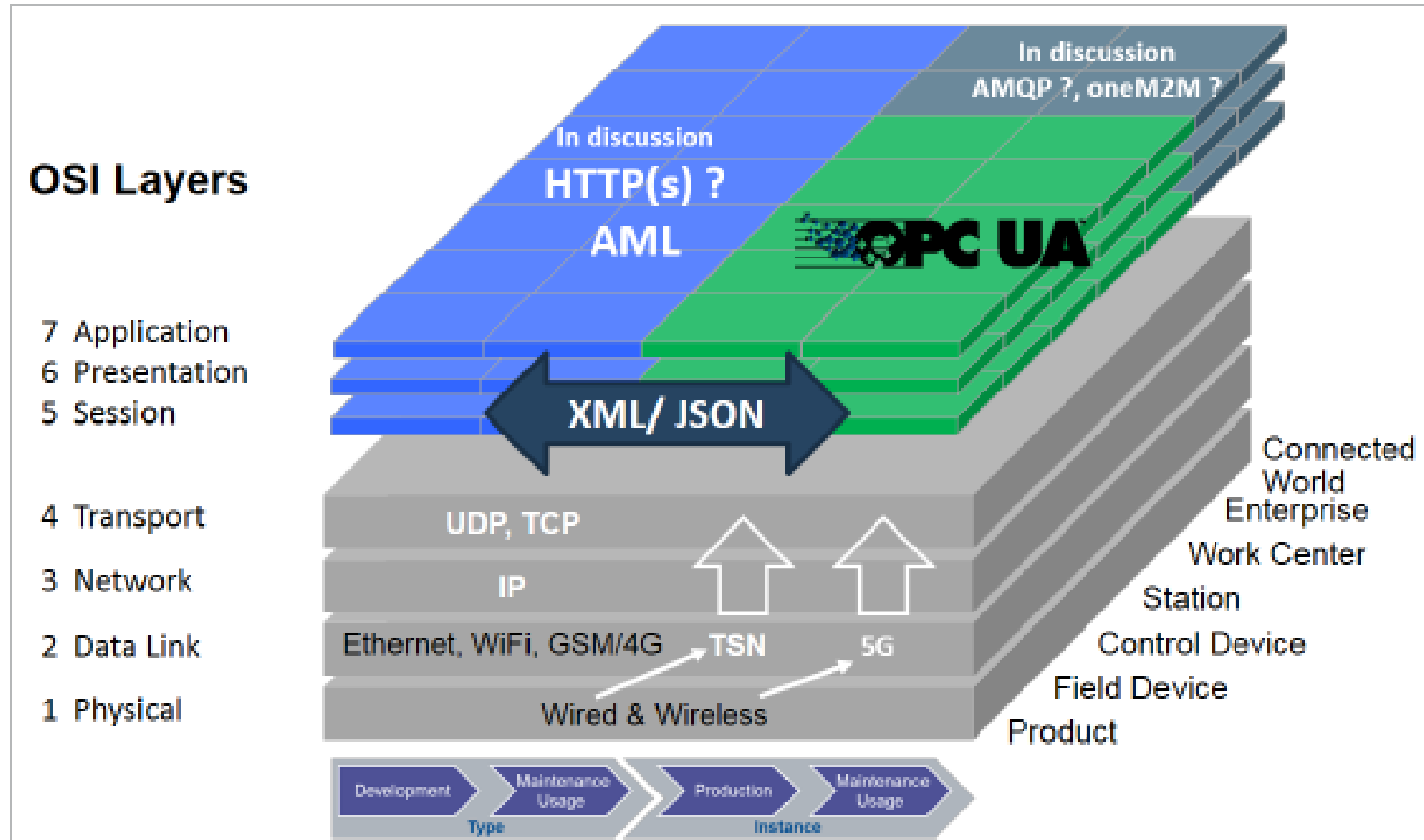
... able to consider a vendor independent complexity, as a composition of Assets...



Source: Trilateral Presentation Structure of the Administration Shell” on Tri-lateral on Steering Committee in Hannover fair 2018

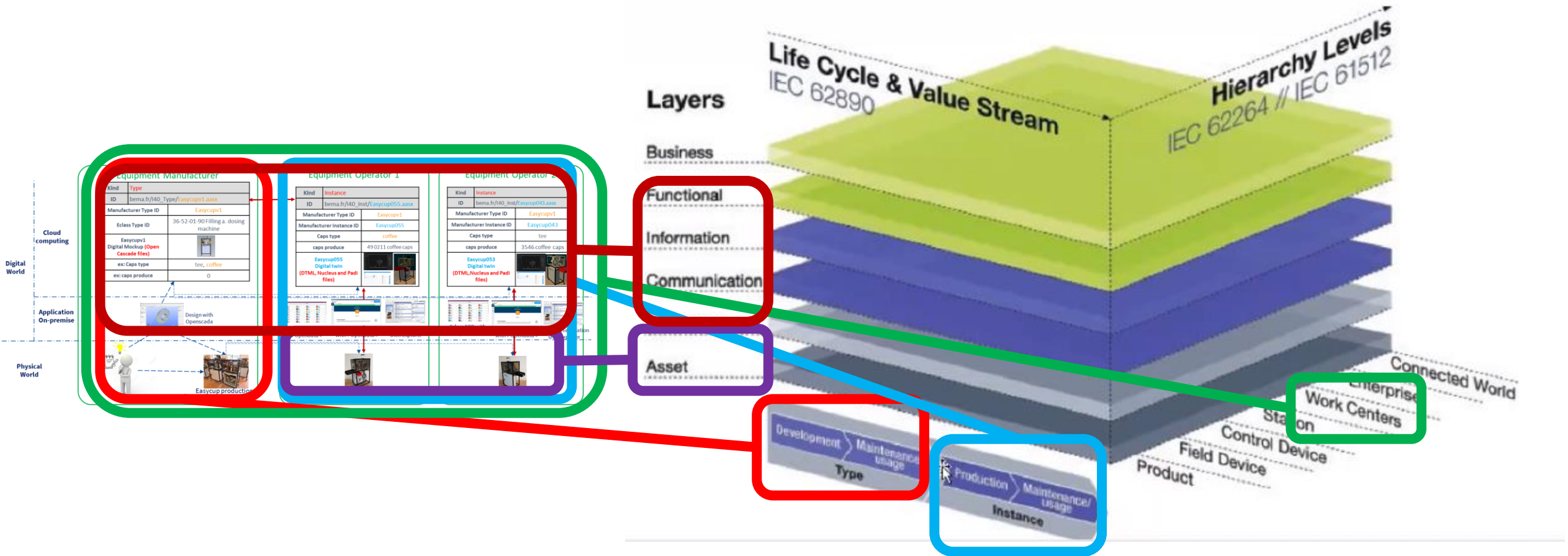
Industrie 4.0 concepts Presentation

Detail of the reference architecture for Industry 4.0



Industrie 4.0 concepts Presentation

Detail of the reference architecture for Industry 4.0



Presentation of Digital Twin concepts

Digital Twin definition from DTC

A digital twin is a **virtual representation** of **real-world entities** and **processes, synchronized** at a specified **frequency** and **fidelity**.

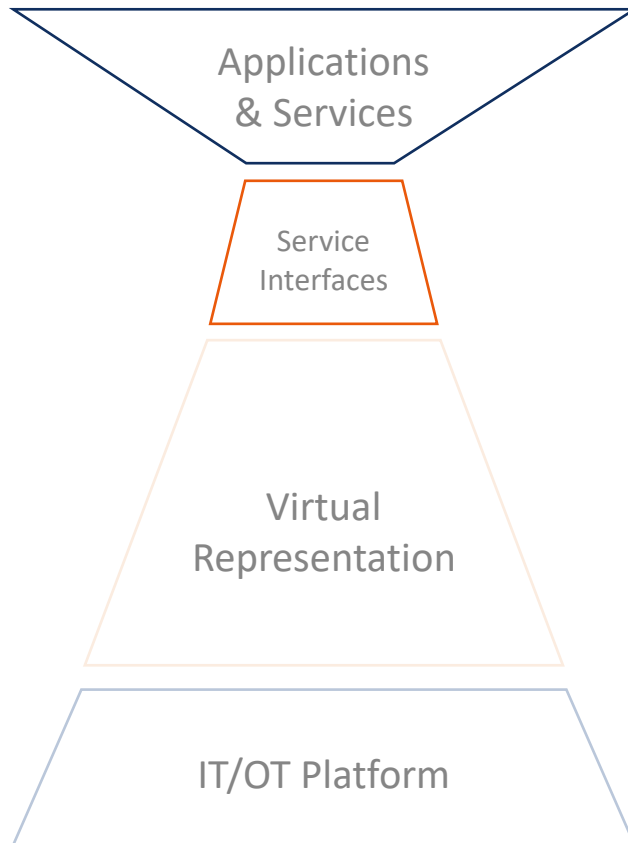
Digital twin systems transform business by accelerating holistic understanding, optimal decision-making, and effective action.

Digital twins use real-time and historical **data** to represent the past and present and **simulate** predicted futures.

Digital twins are motivated by outcomes, tailored to use cases, powered by integration, built on data, guided by domain knowledge, and implemented in **IT/OT systems**.

Presentation of Digital Twin concepts

Abstract Stack



Run on IT/OT Platforms

The **Virtual Representation** is the core

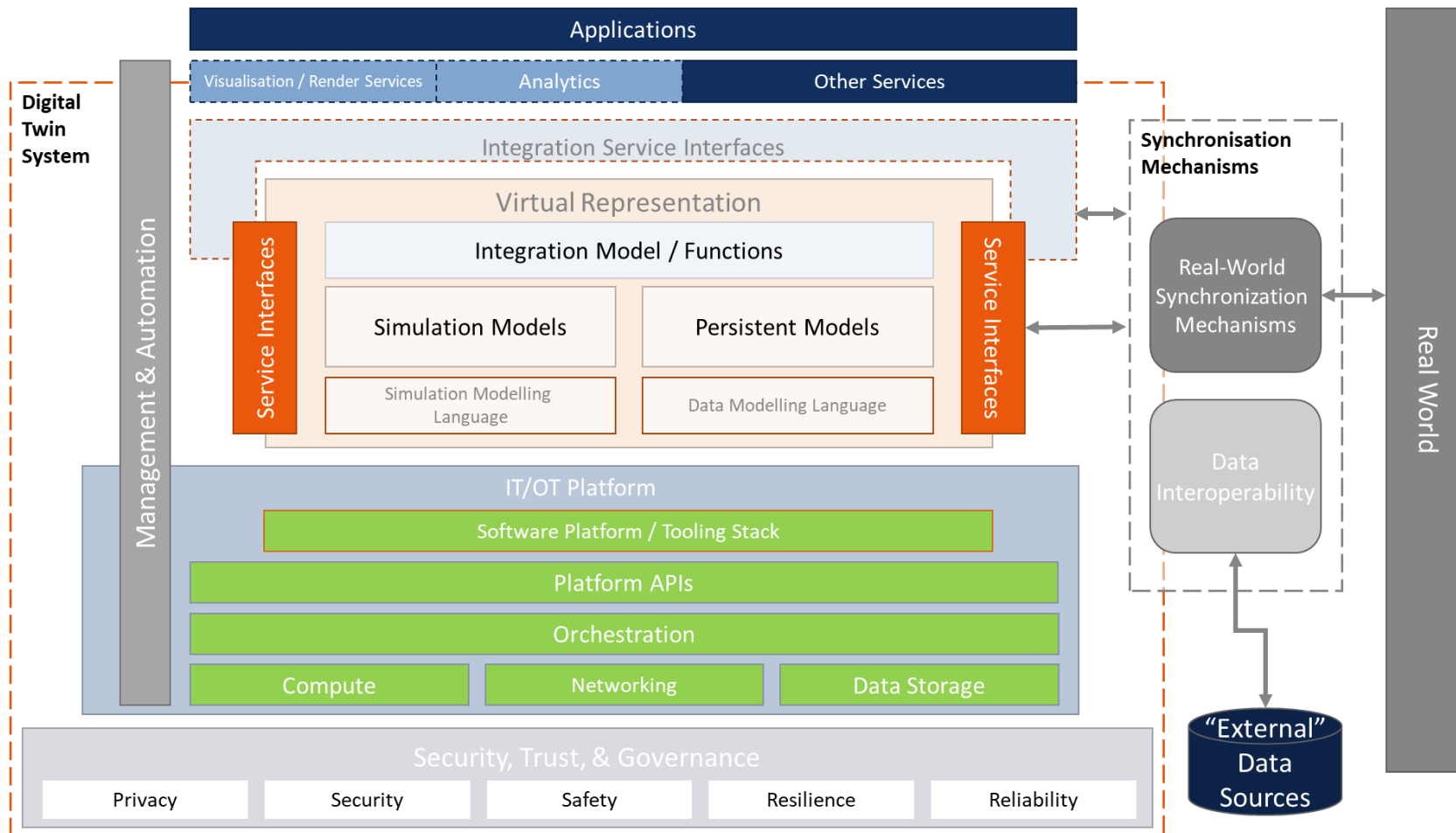
Have Service Interfaces for integration & interoperability

Includes elements of synchronisation

Applications & Services to realise the **value** to all & different stakeholders

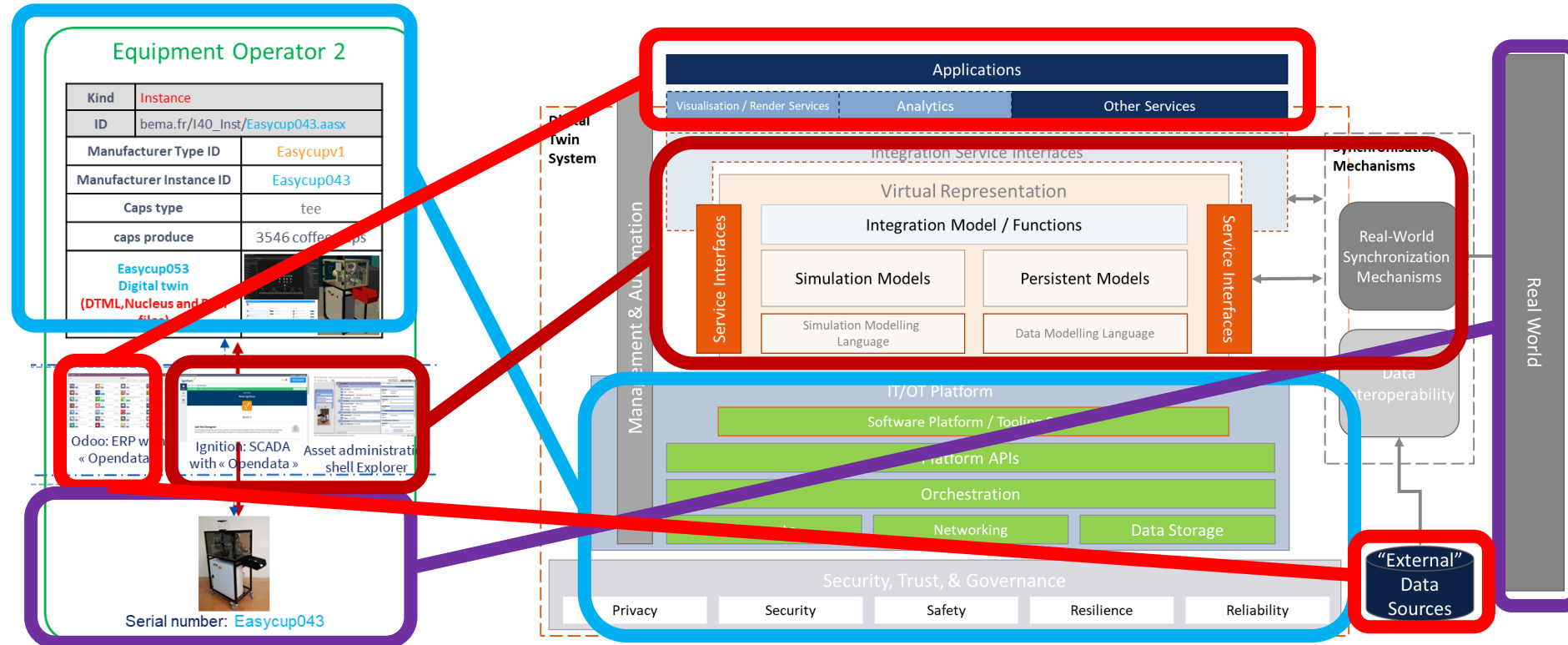
Presentation of Digital Twin concepts

Platform Stack



Presentation of Digital Twin concepts

Plattform Stack



Systems engineering motivations

System definition

A system is a set of resources interacting with each other according to certain principles or rules. A system is determined by its:

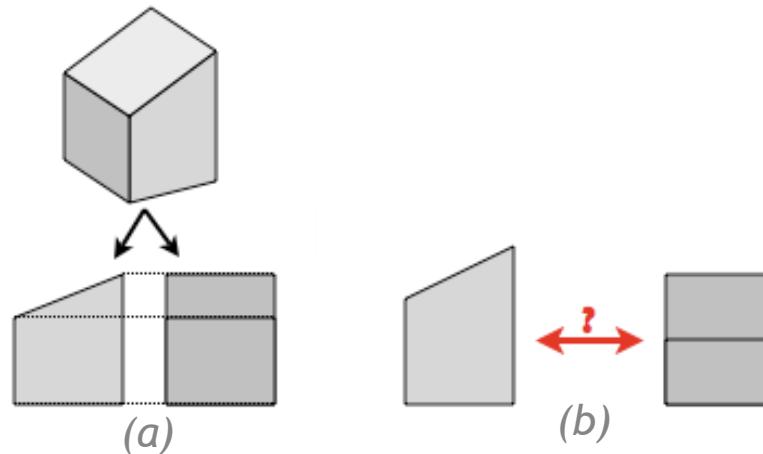
- **Boundary**, that is to say the criterion of belonging to the system (determining whether an entity belongs to the system or is part of its environment)
- **Missions** (its requirements and purpose)
- **Interactions** between internal resources and system external entities
- **Functions** of system
- **Resources entities** with their own properties (human, natural, software, material, immaterial,...)

A subsystem is a system participating in a higher-ranking system.

SysML language definition

SysML (Systems Modeling Language) definition

These benefits are analogous to those obtained in mechanical design by the automatic generation of 2D views from a 3D digital model made in a CAD software (Figure 3a) compared to direct drawing, even if it is computer-assisted, a set of 2D views separated from each other (Figure 3b).



*Figure 3 : (a) A model whose consistent views are extracted
(b) a set of views drawn independently, and therefore likely to contradict each other*

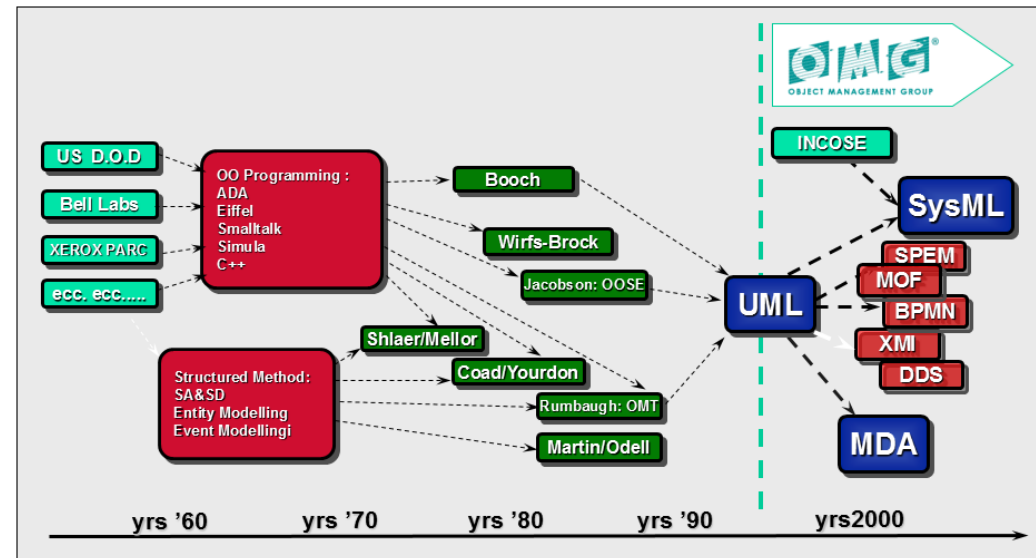
Source: ENS Cachan – Lionel Gendre

SysML language definition

SysML (Systems Modeling Language) definition

Systems Modeling Language (SysML) is a modeling language specific to the field of system engineering. It allows the **specification, analysis, design, verification and validation of broad complex systems and systems-of-systems**.

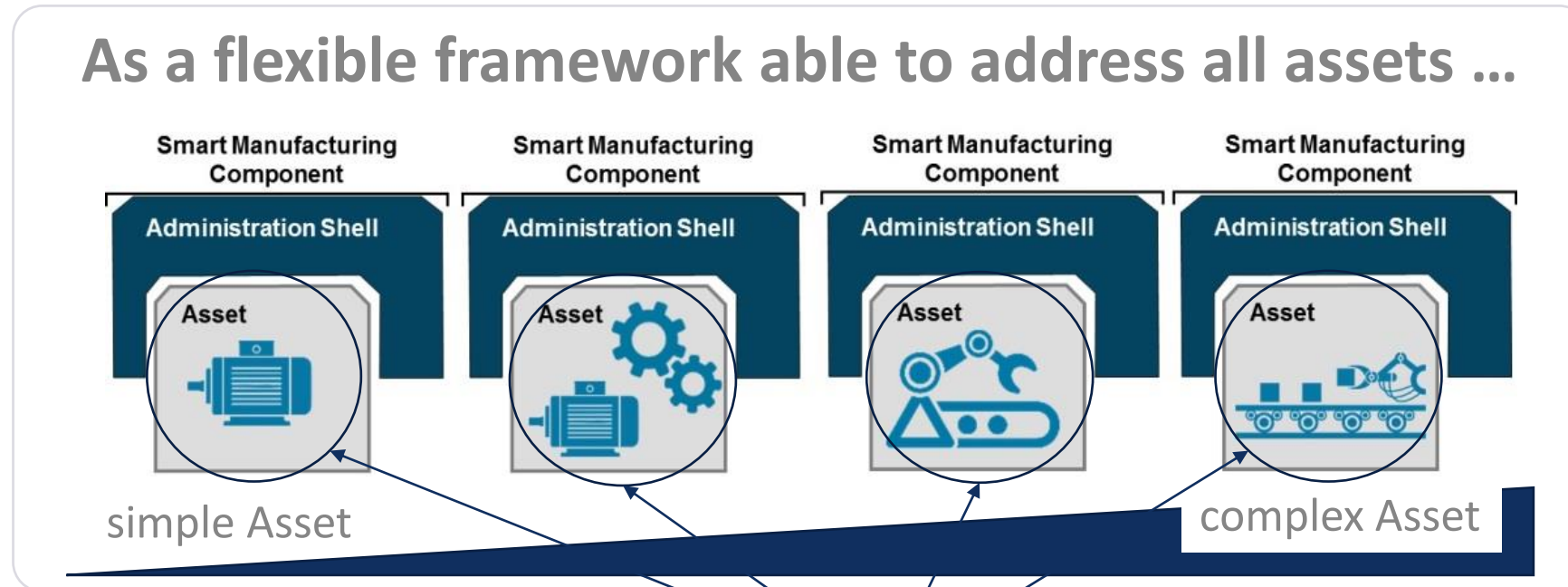
SysML is defined as an extension of a **subset of Unified Modeling Language (UML)** using the UML-defined profile mechanism, who is commonly used in software development and object-oriented design.



SysML background from OMG

Systems engineering motivations

Administration shell examples system limits



Differents levels of system of interest

SysML language definition

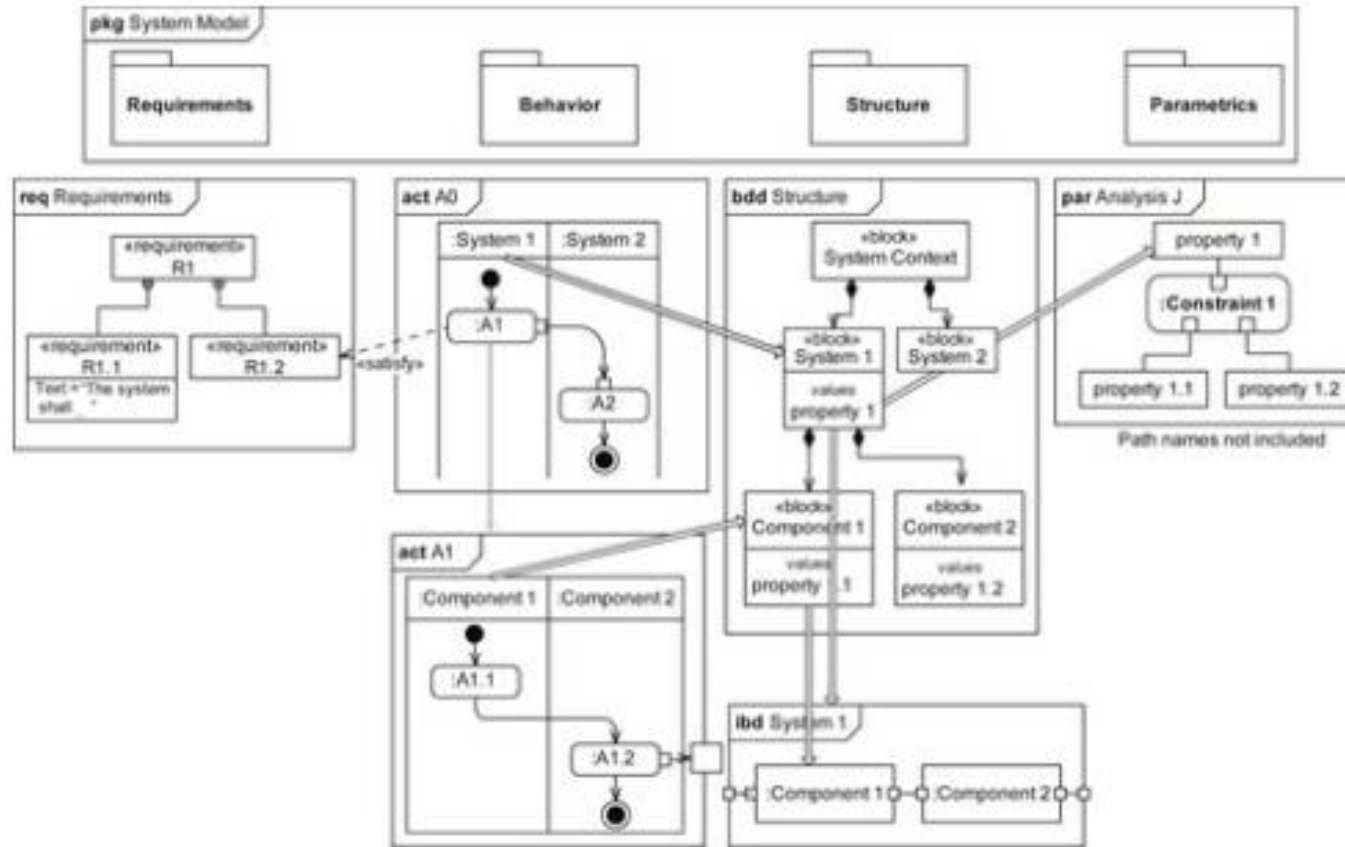
Three pillars of SysML language

Systems modeling has two main objectives: to **simulate behavior** and to **communicate descriptions** of a system. In engineering sciences, it can be carried out according to three major complementary points of view:

1. The **Goal view**, which is to describe the actions required performed by the system to answer the question «What is it for?»
2. The **structural view**, consists of describing the components of the system, its environment and relationships between these components, to answer the questions «How is it organized? »
3. The **behavioral view**, which consists of modeling system within a theory in order to answer, through simulation, the question "What are its performances? ".

SysML language definition

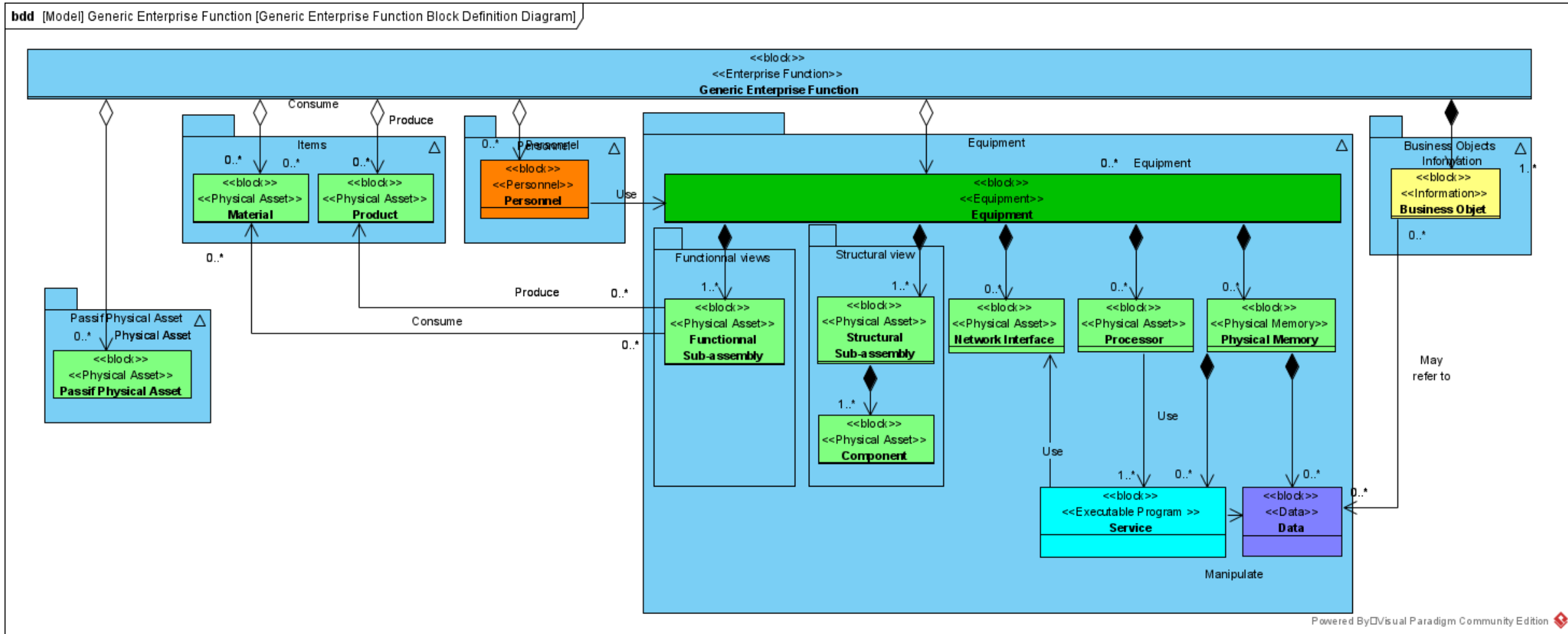
Simplify overview of SysML language elements



Source: Friedenthal, Sanford. A Practical Guide to SysML (The MK/OMG Press)

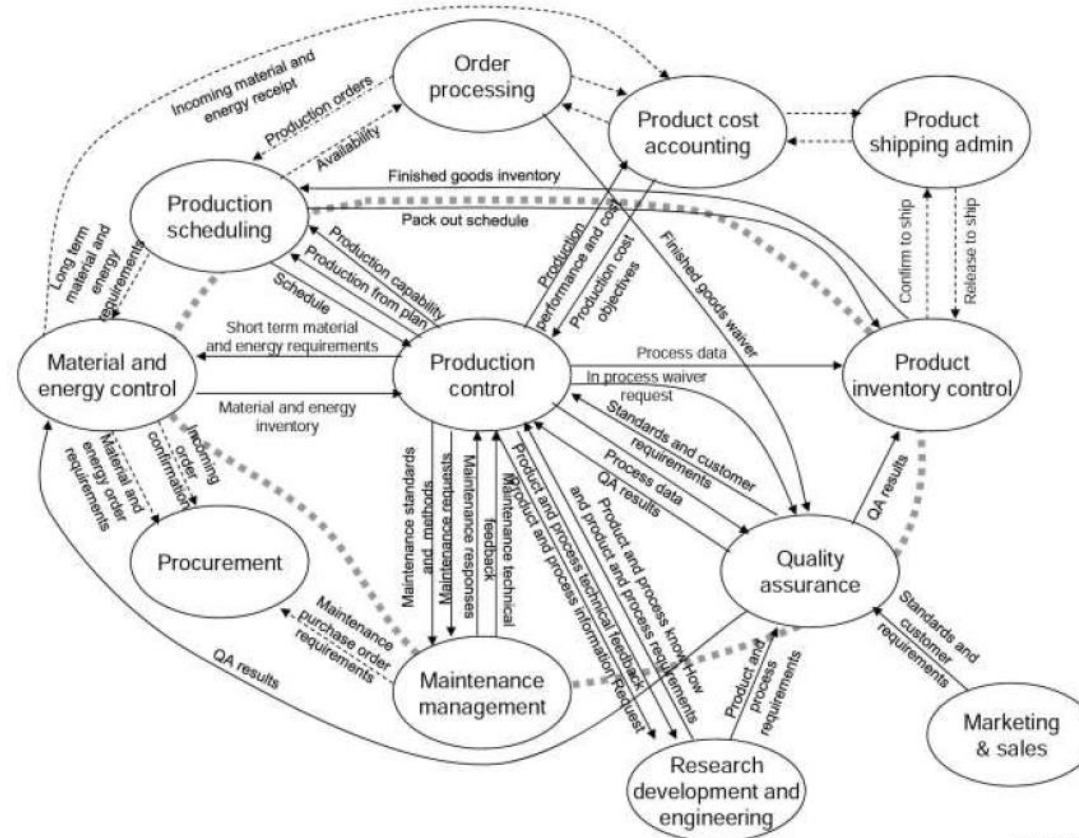
ISA 95 Presentation in SysML

Basic Manufacturing System in SysML



ISA 95 Presentation

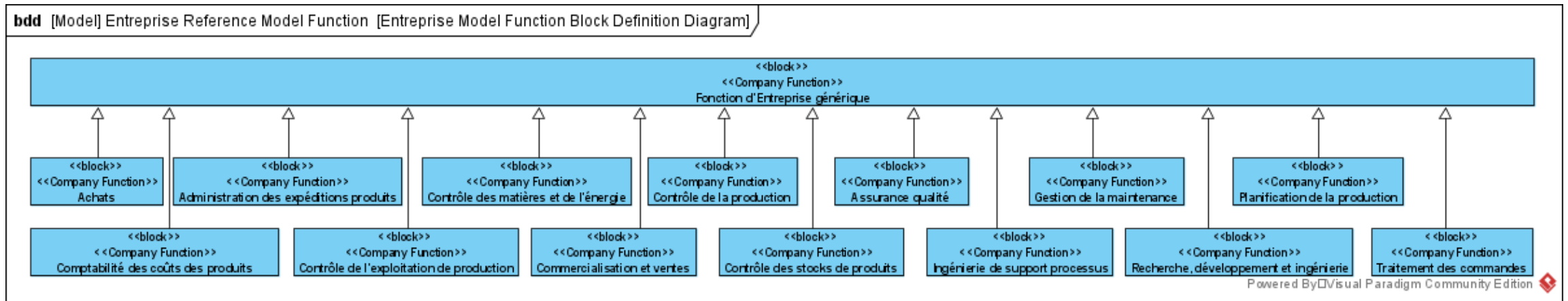
Functionnal Model



IEC 647/13

ISA 95 Presentation in SysML

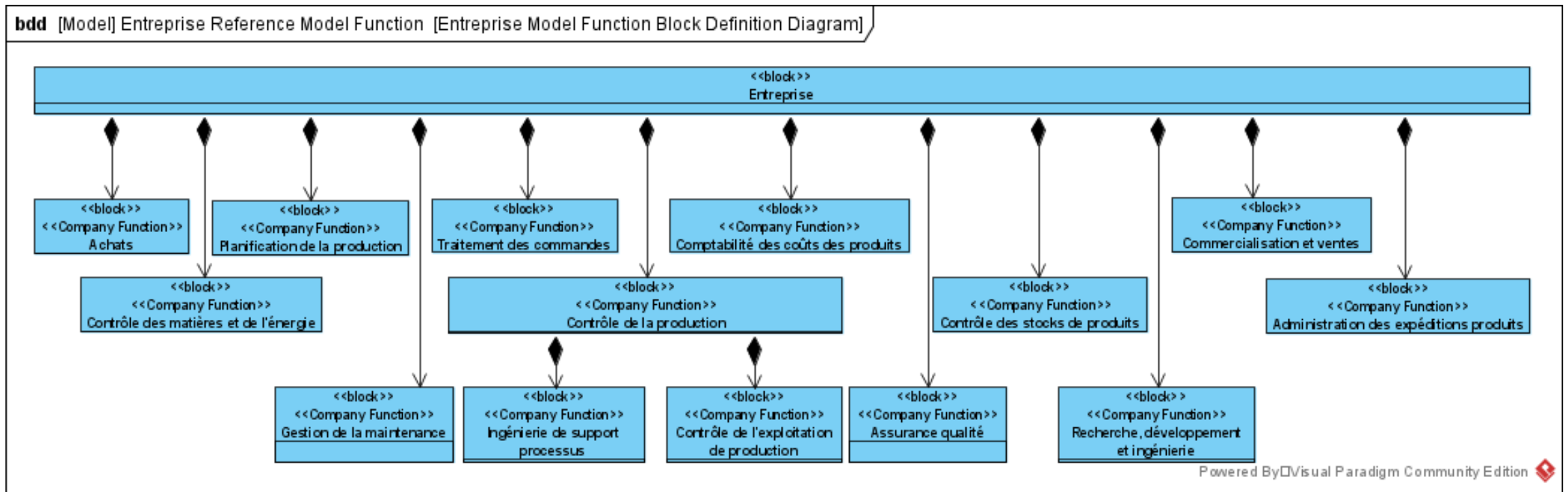
Functionnal Model in SysML



Source: Norme IEC/NE 62264-1

ISA 95 Presentation in SysML

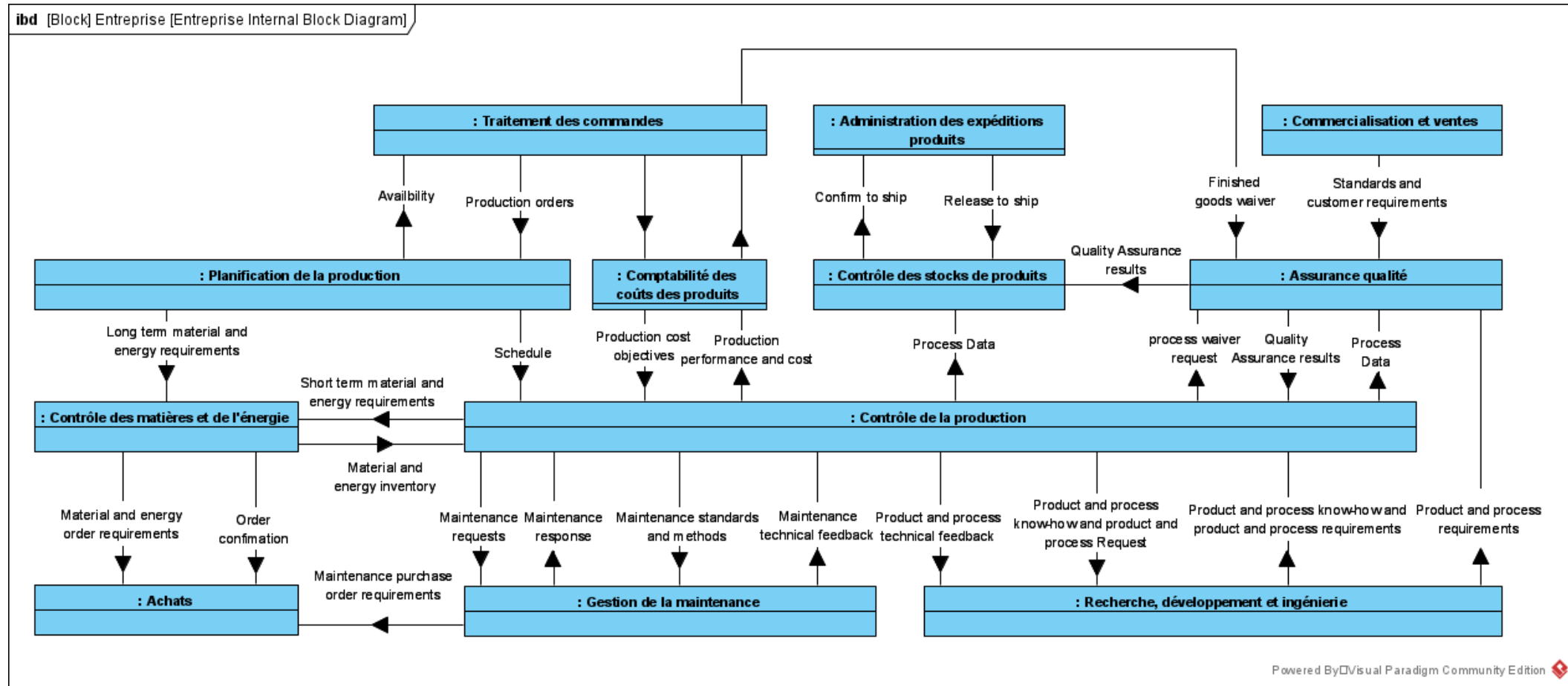
Functionnal Model in SysML



Source: Norme IEC/NE 62264-1

ISA 95 Presentation in SysML

Functionnal Model in SysML



Source: Norme IEC/NE 62264-1

Thanks for attention

eric.truffet@ecam-strasbourg.eu
+33 (0) 6 82 39 33 90