ECAM LASALLE SCHOOL OF ENGINEERING
Strasbourg - Europe

DTC Q3 Virtual Members Meeting

Open-Source Workshop: EcolCafé in Industrie 4.0

ÉCOLE D'INGÉNIEURS
Strasbourg - Europe

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

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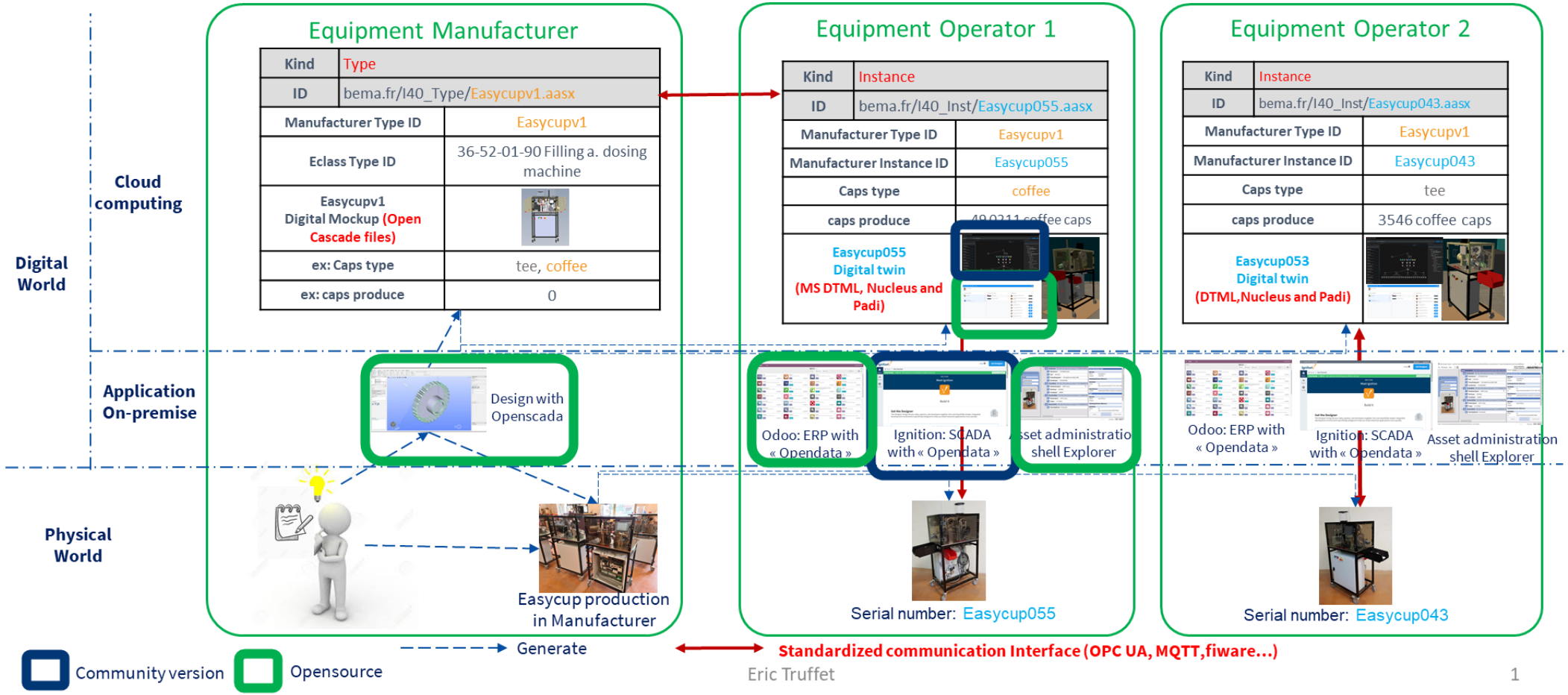
EcolCafé presentation

What is EcolCafé ?

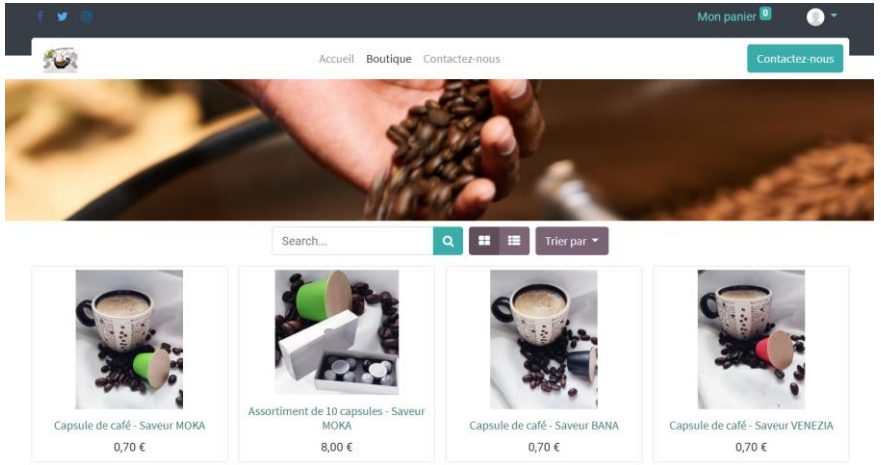
EcolCafé presentation

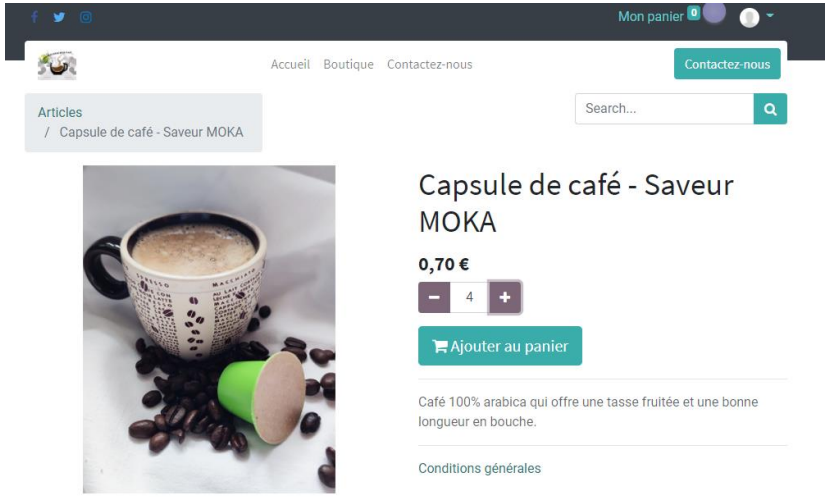
What is EcolCafé ?

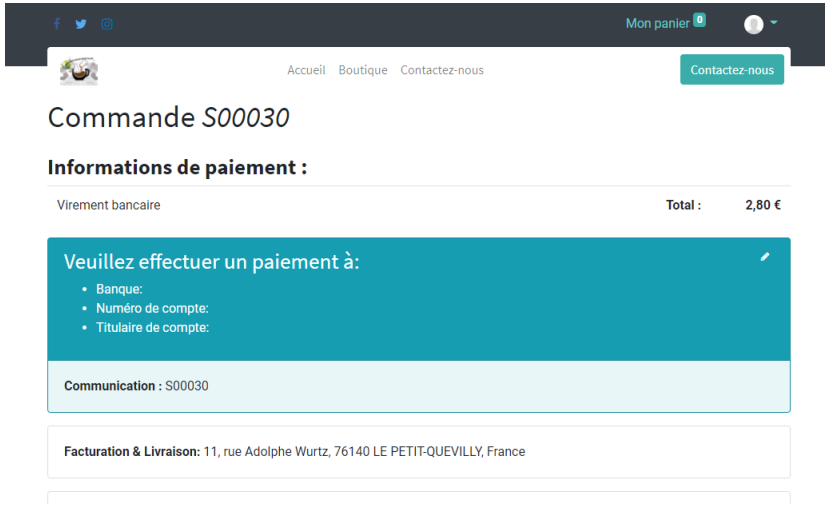


EcolCafé presentation

ERP Odoo and Database opensource – Front office - Website module







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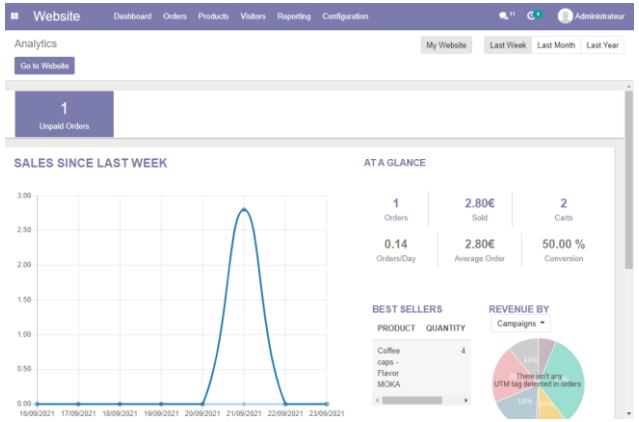
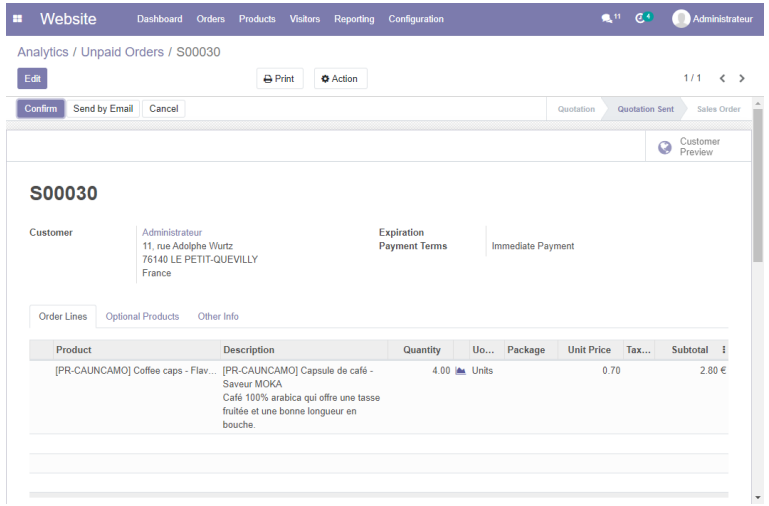
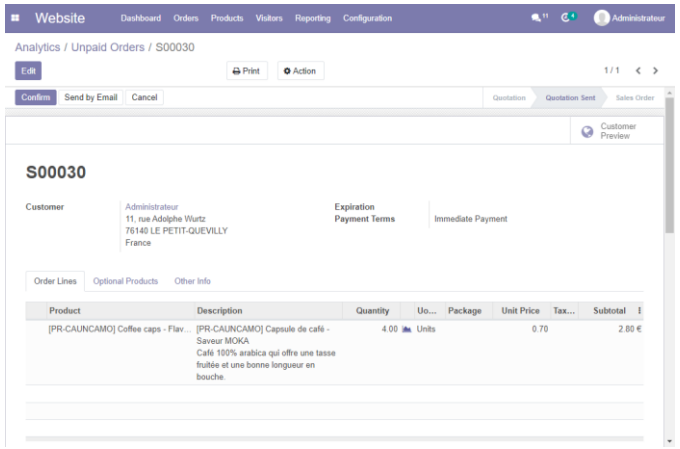
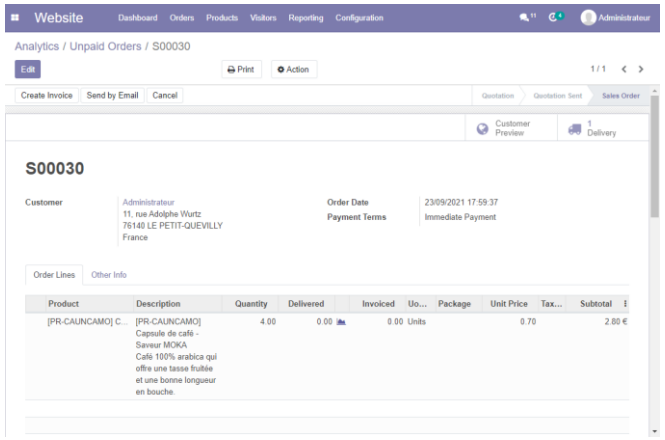
ERP Odoo and Database opensource – Front office - Sale module









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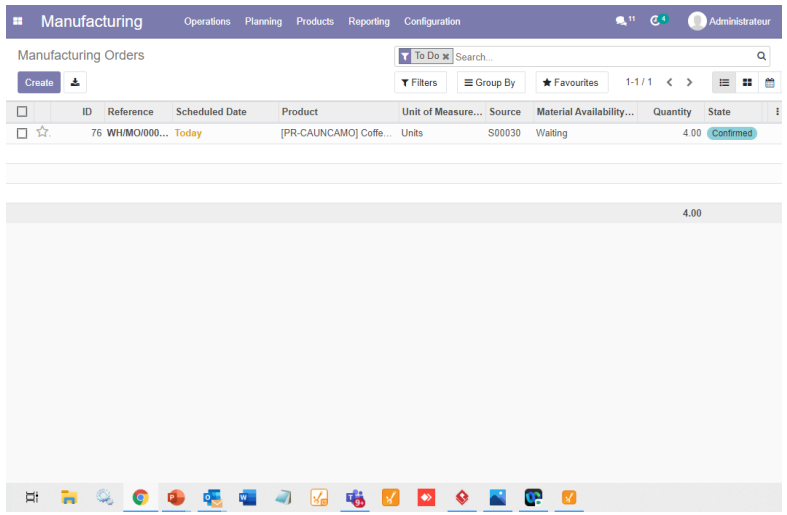
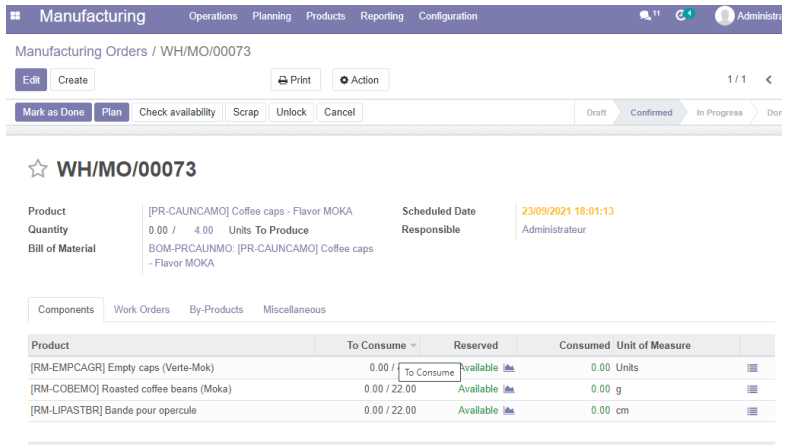
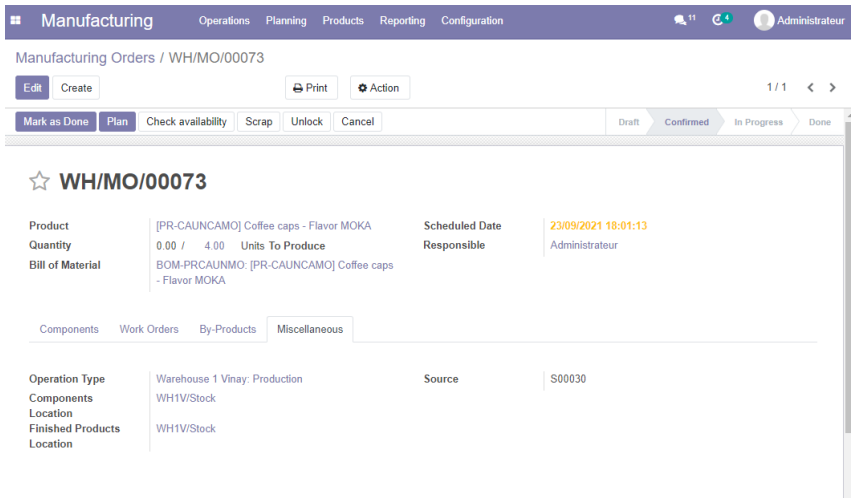
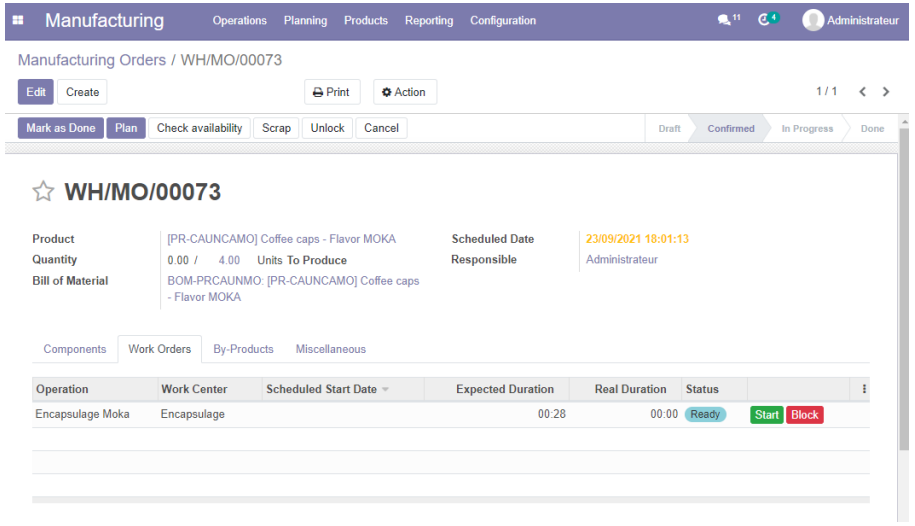
ERP Odoo and Database opensource – Manufacturing Module









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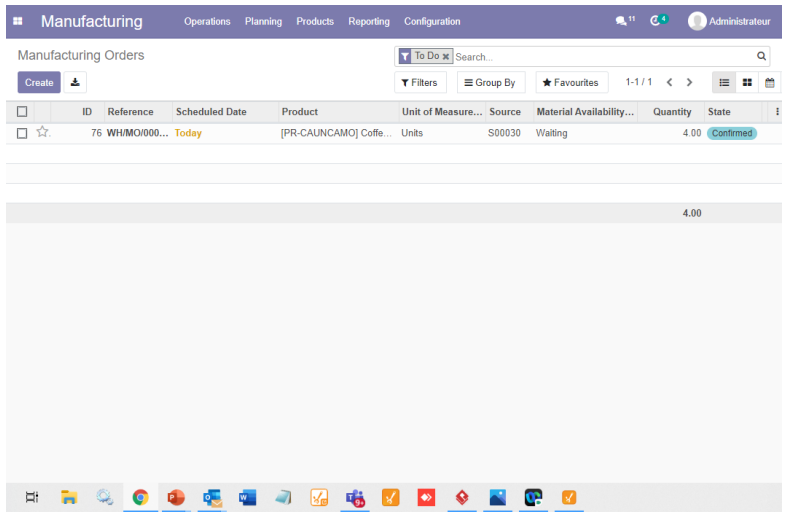
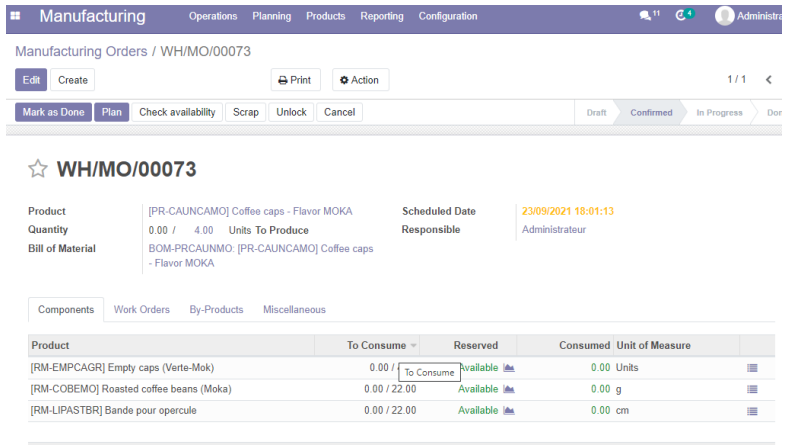
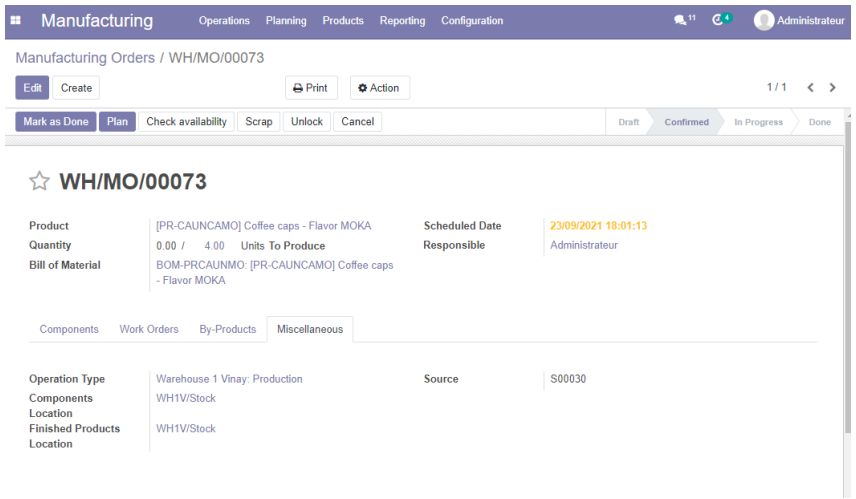
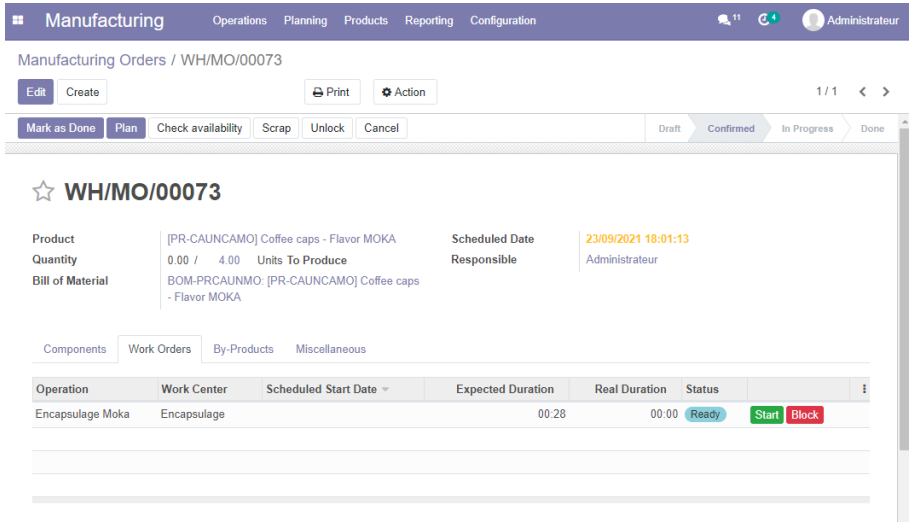
ERP Odoo and Database opensource – Manufacturing Module



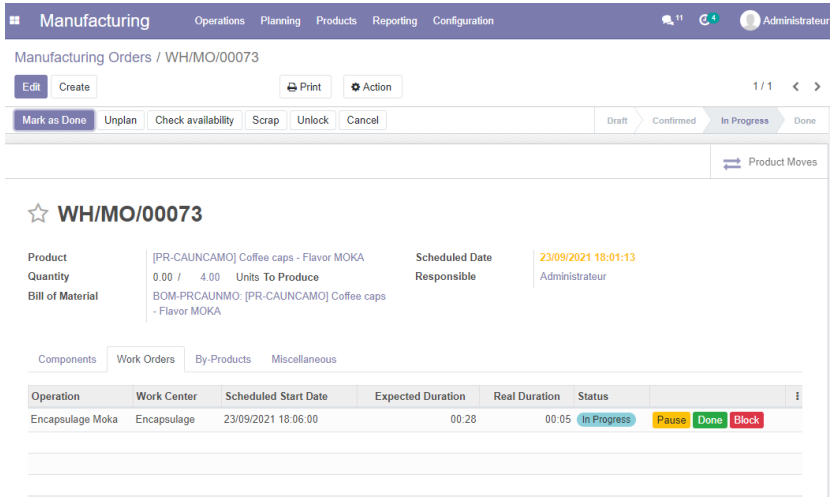


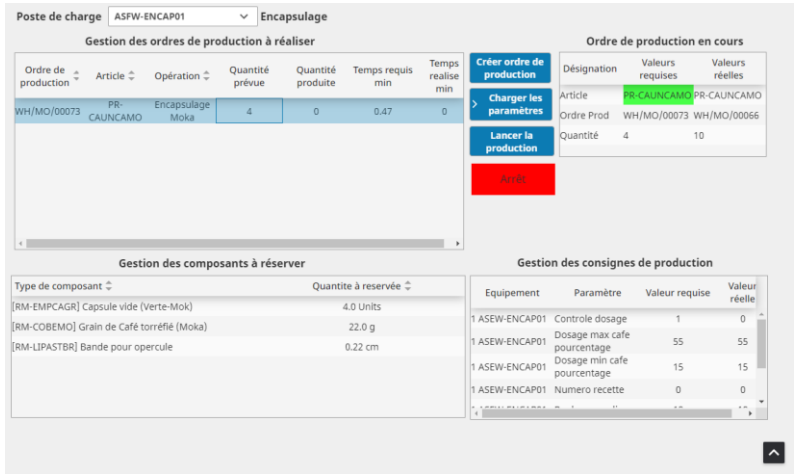


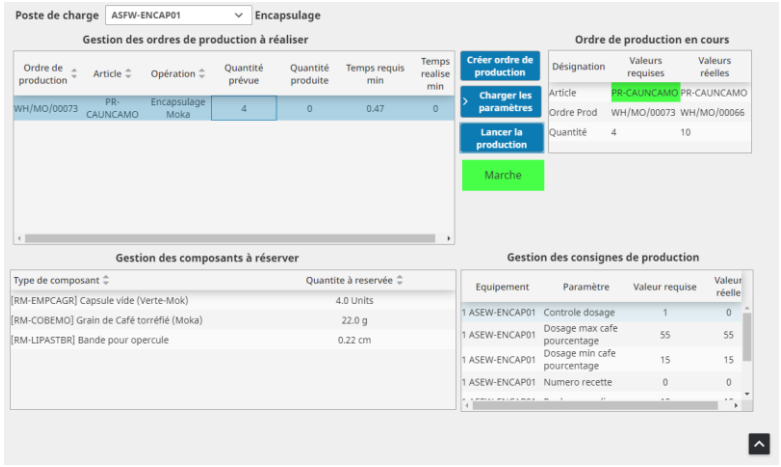


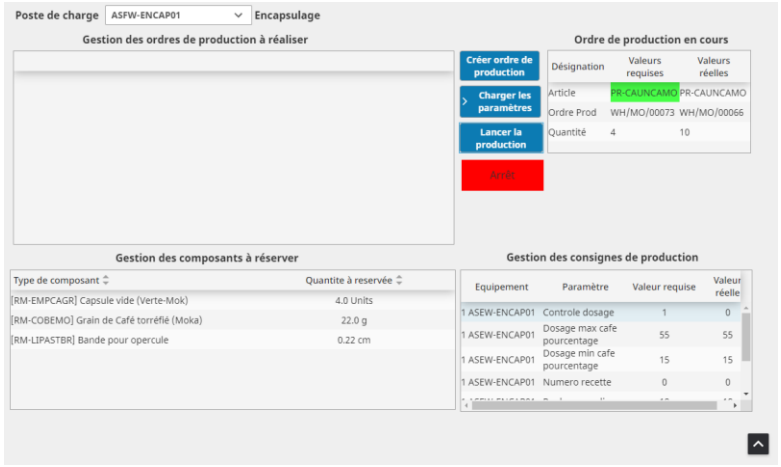
EcolCafé presentation

SCADA Ignition by Inductive automation demonstration and Project opensource









EcolCafé presentation

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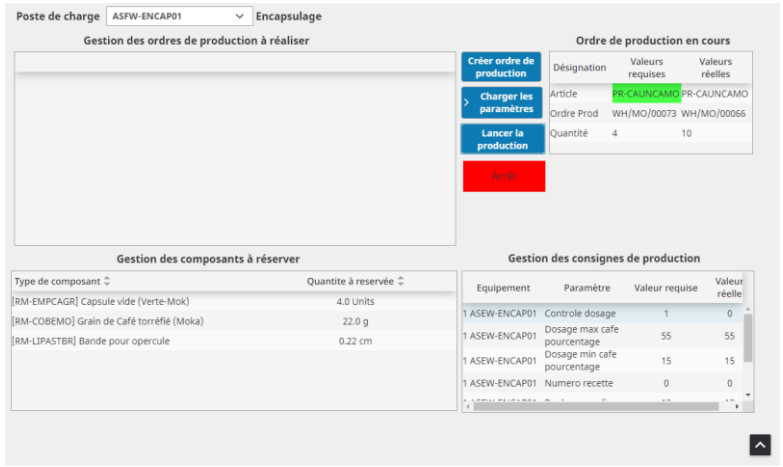
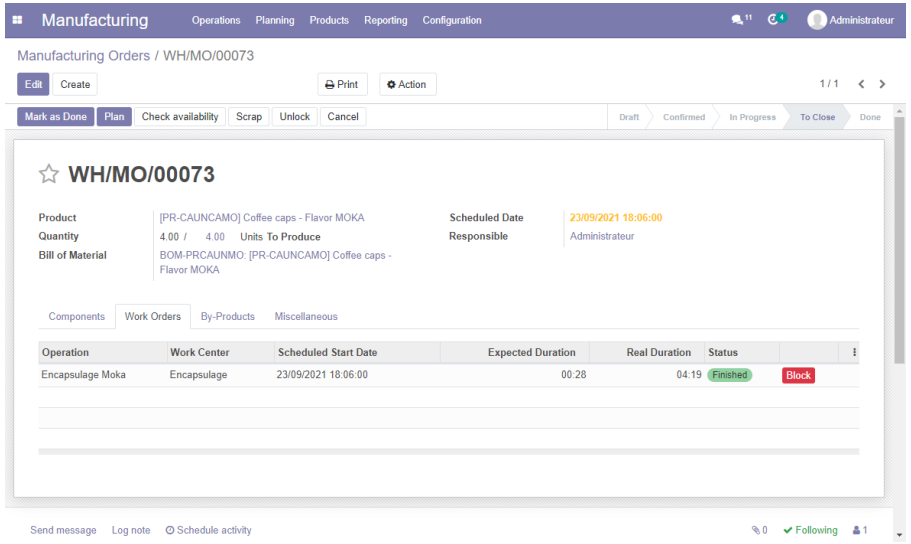
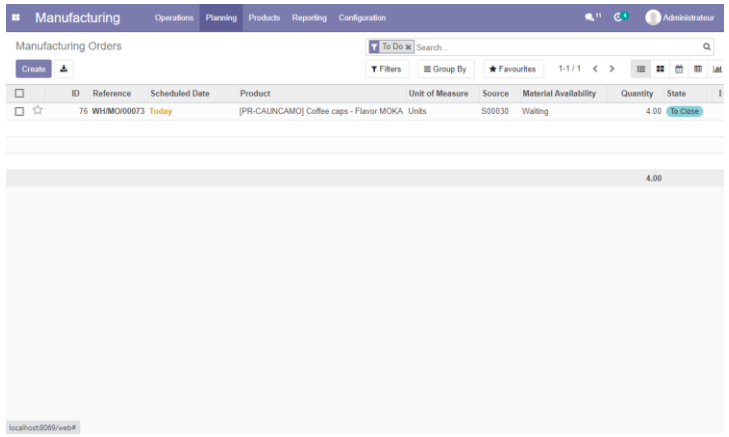


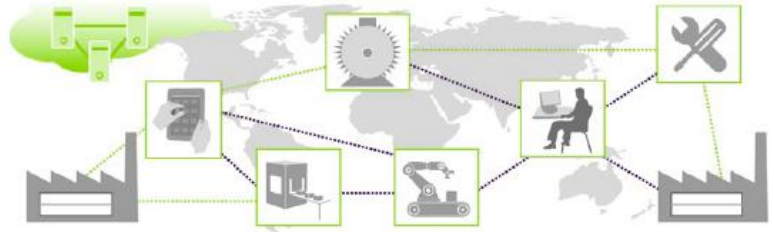




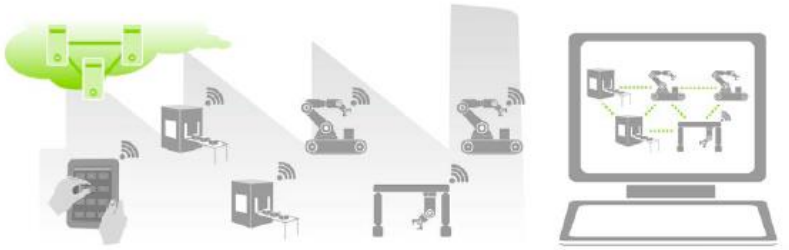
Industry 4.0 objectives

Four pillars of Industry 4.0

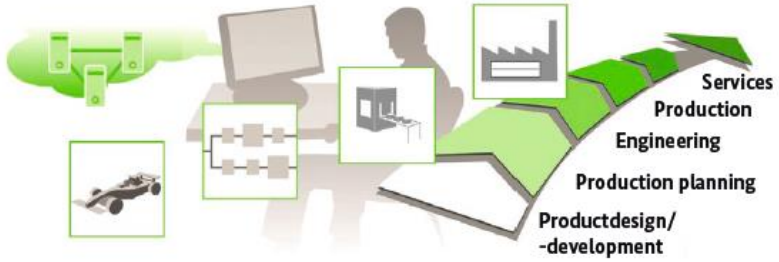
Horizontal integration via value-added networks



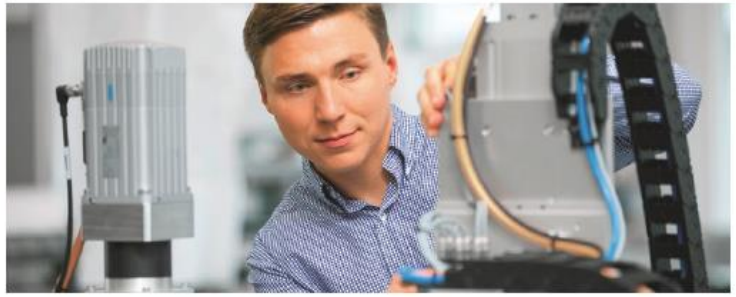
Vertical (integration and networked production system)



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



The human being as a conductor for aded value



Source: Siemens AG/Festo AG&Co KG

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

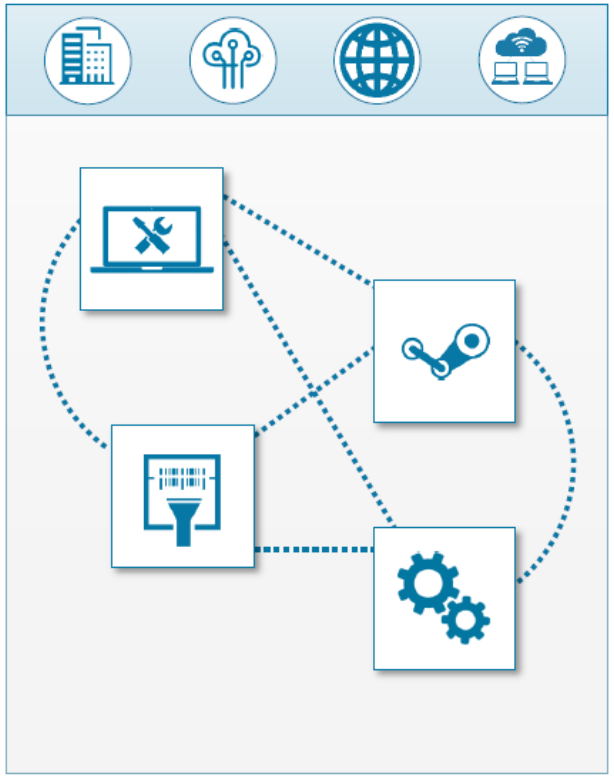
Industrie 4.0: New Ingredients

- **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?

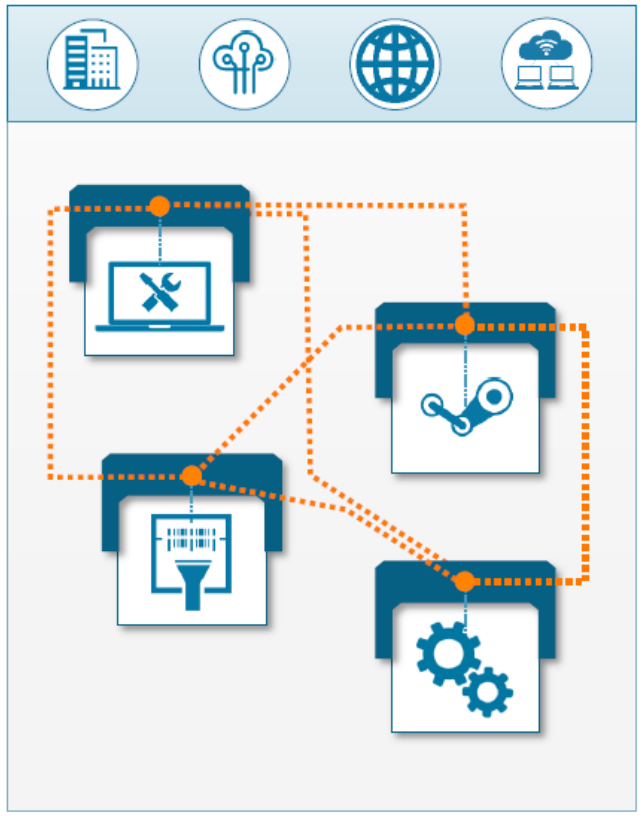


Graphics © Anna Salari, designed by freepik

- ...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"...



Grafik © Plattform Industrie 4.0, Modell Verwaltungsschale © ZVEI SG Modelle un

- … 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...)

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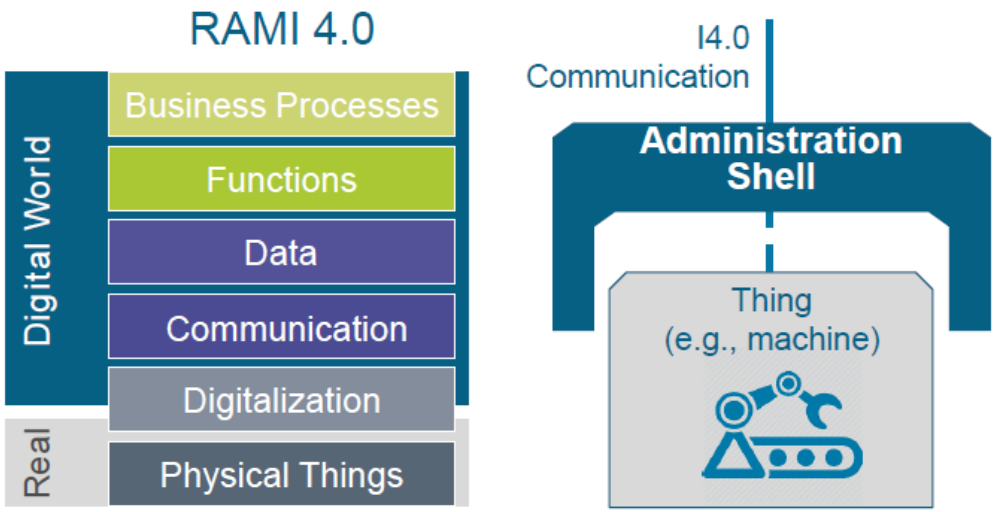
Industrie 4.0 concepts Presentation

Details of the shell administration

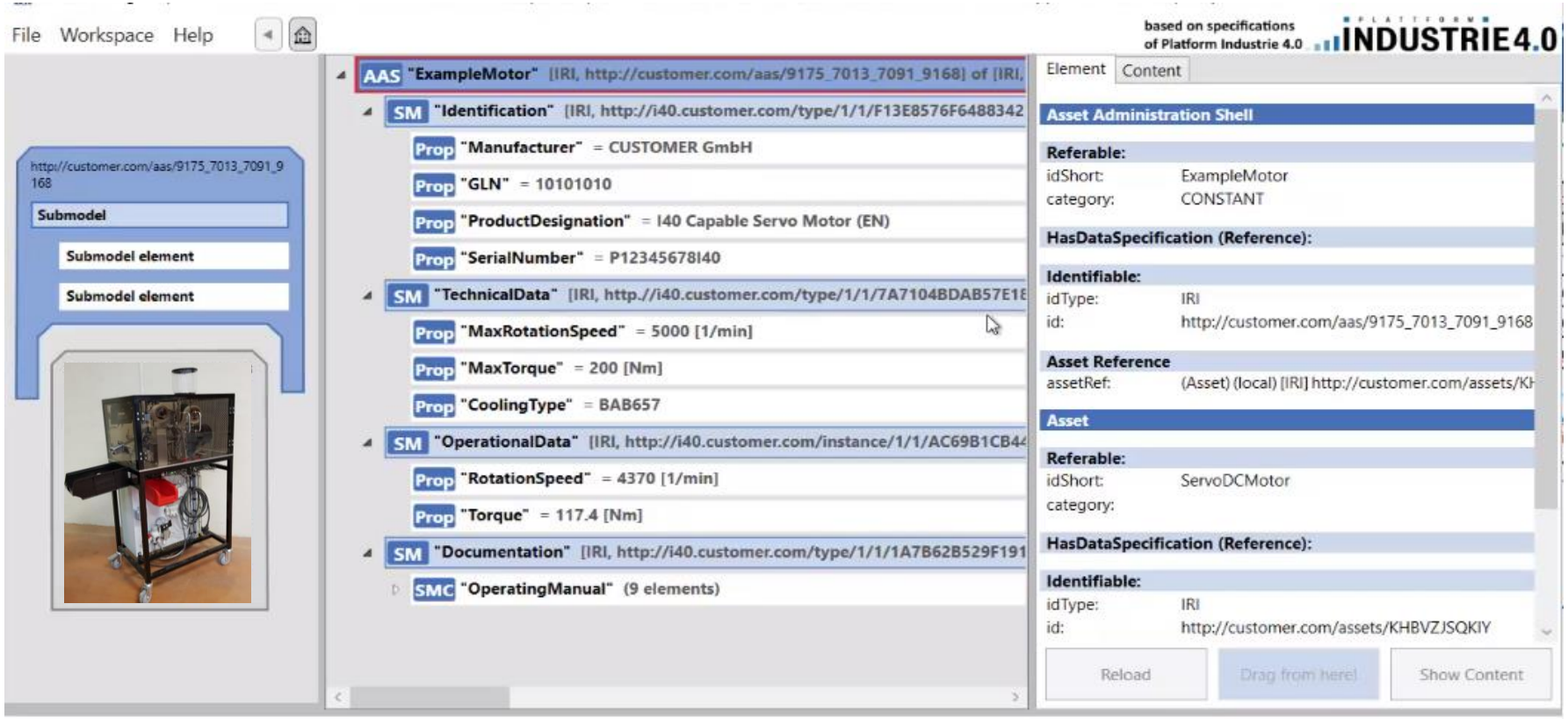


- Connections are made through Industry 4.0 communication
- The shell administration defines the digital part (property, operations, events) of the physical asset
- The asset (everything that is valuable to a company) defines the real part

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



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Industrie 4.0 concepts Presentation

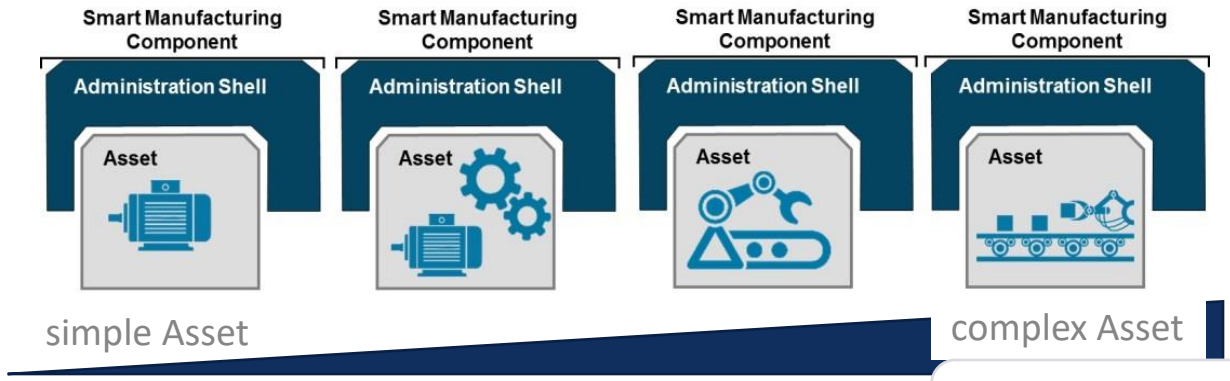
Combination of Asset Administration Shell

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

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

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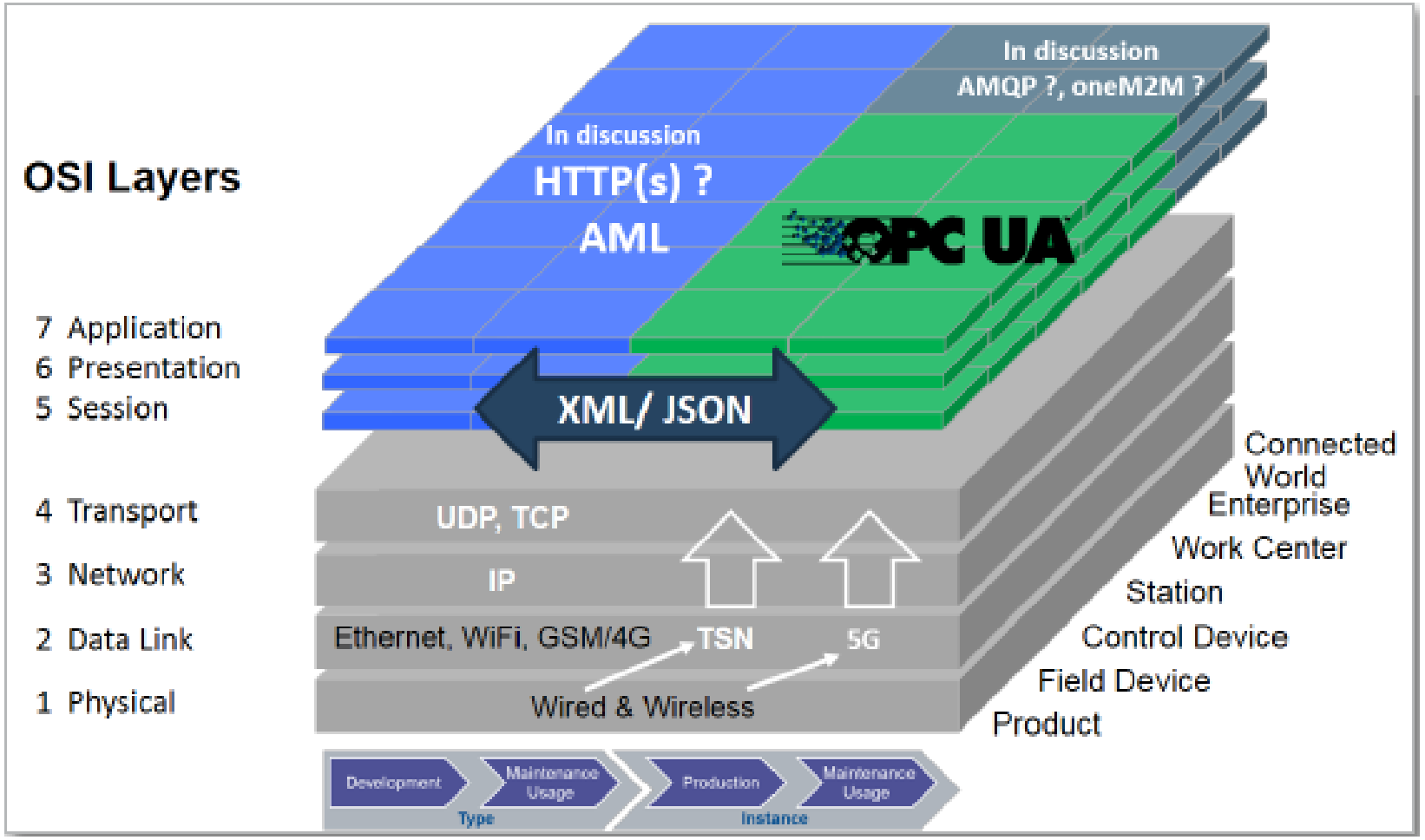
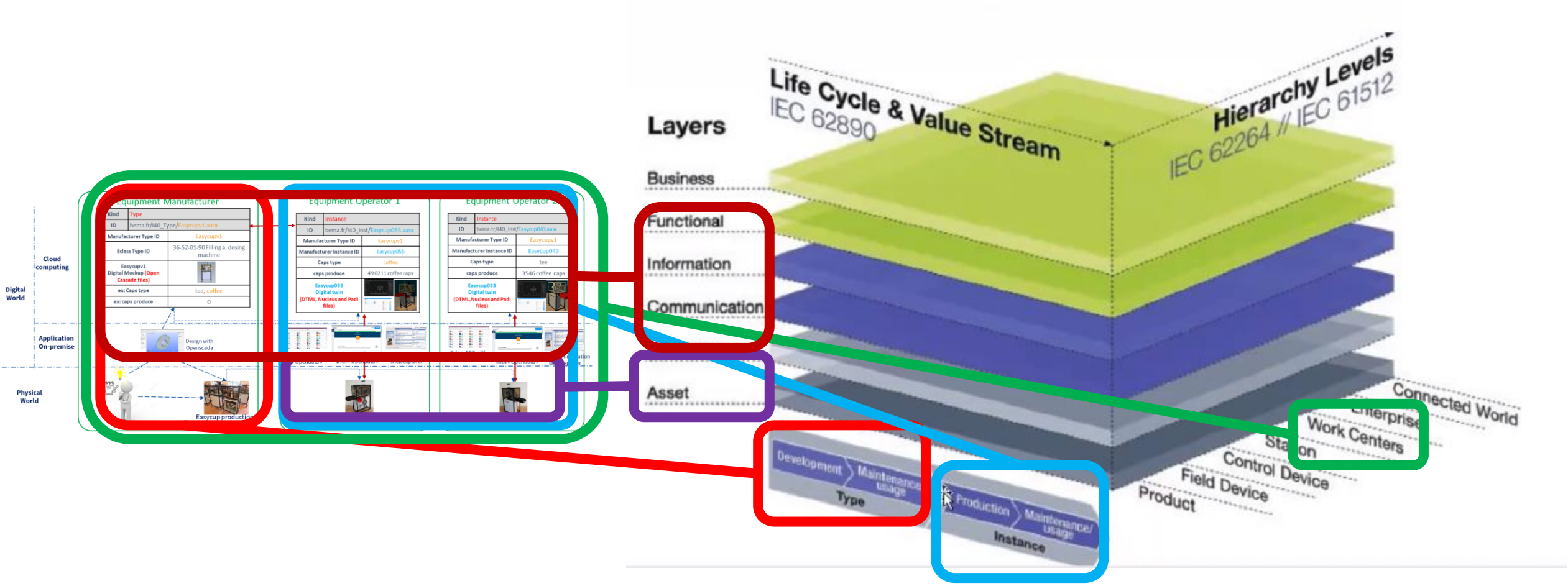
Industrie 4.0 concepts Presentation

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**.

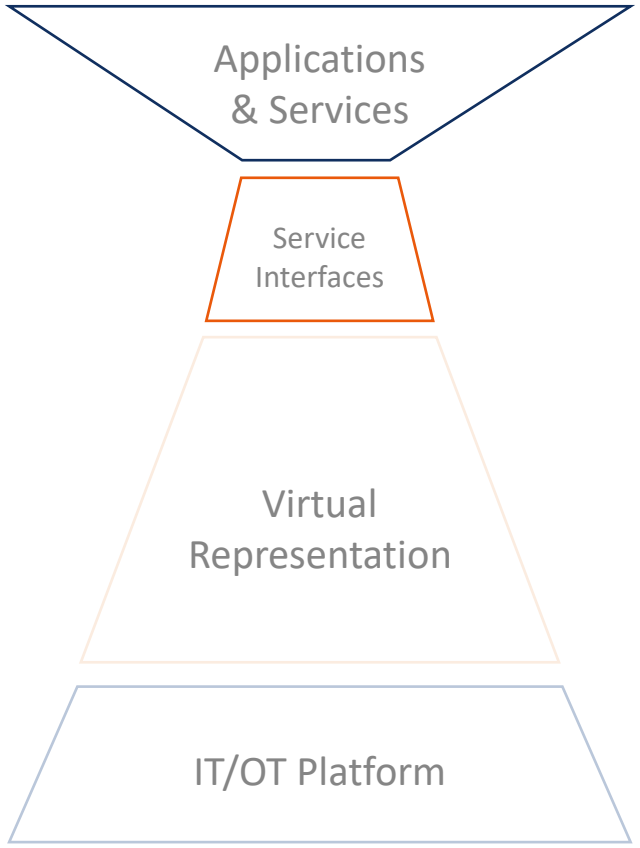
Digital twin systems transform business by accelerating holistic understanding, optimal decision-making, and effective action.

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

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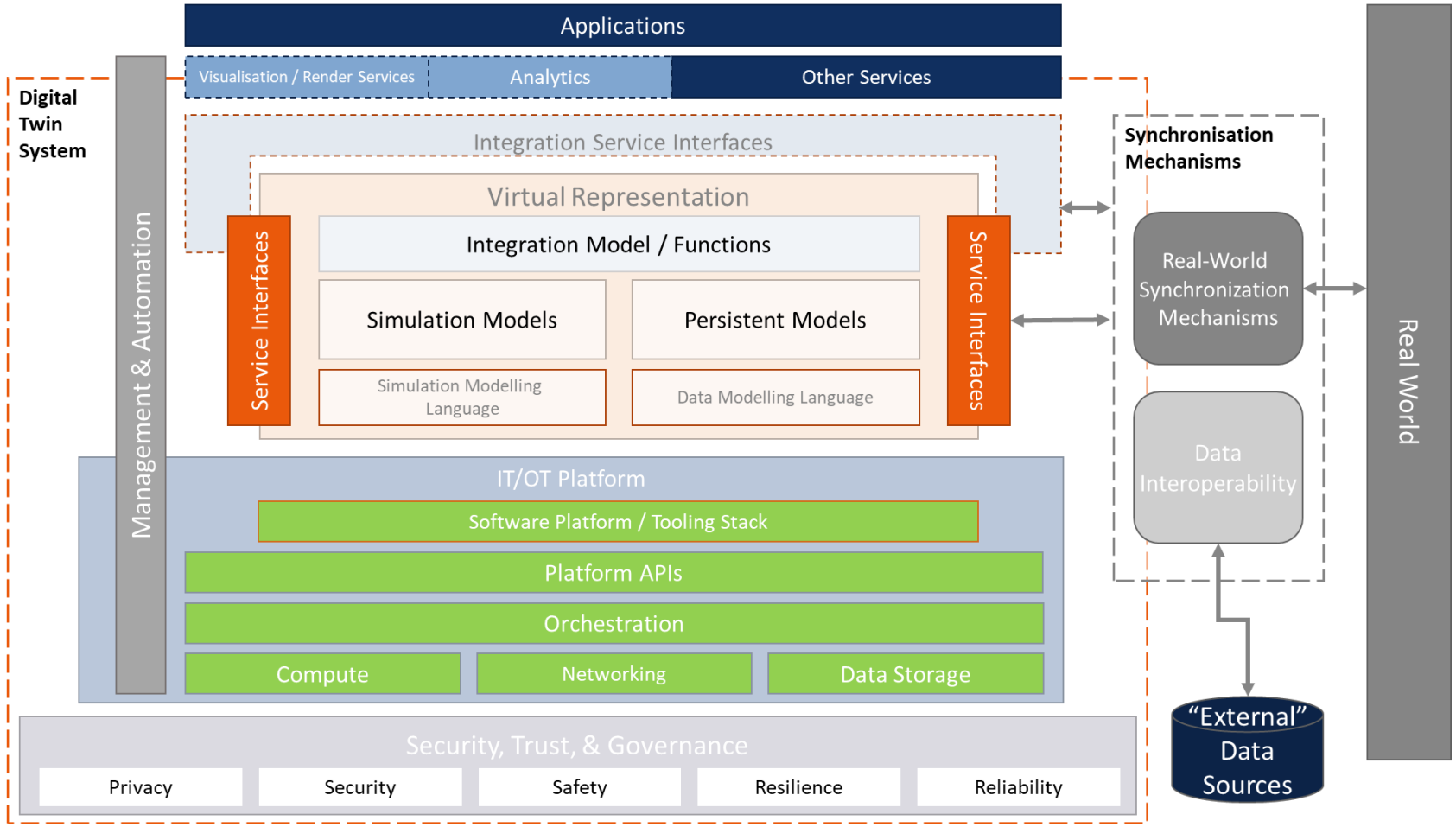
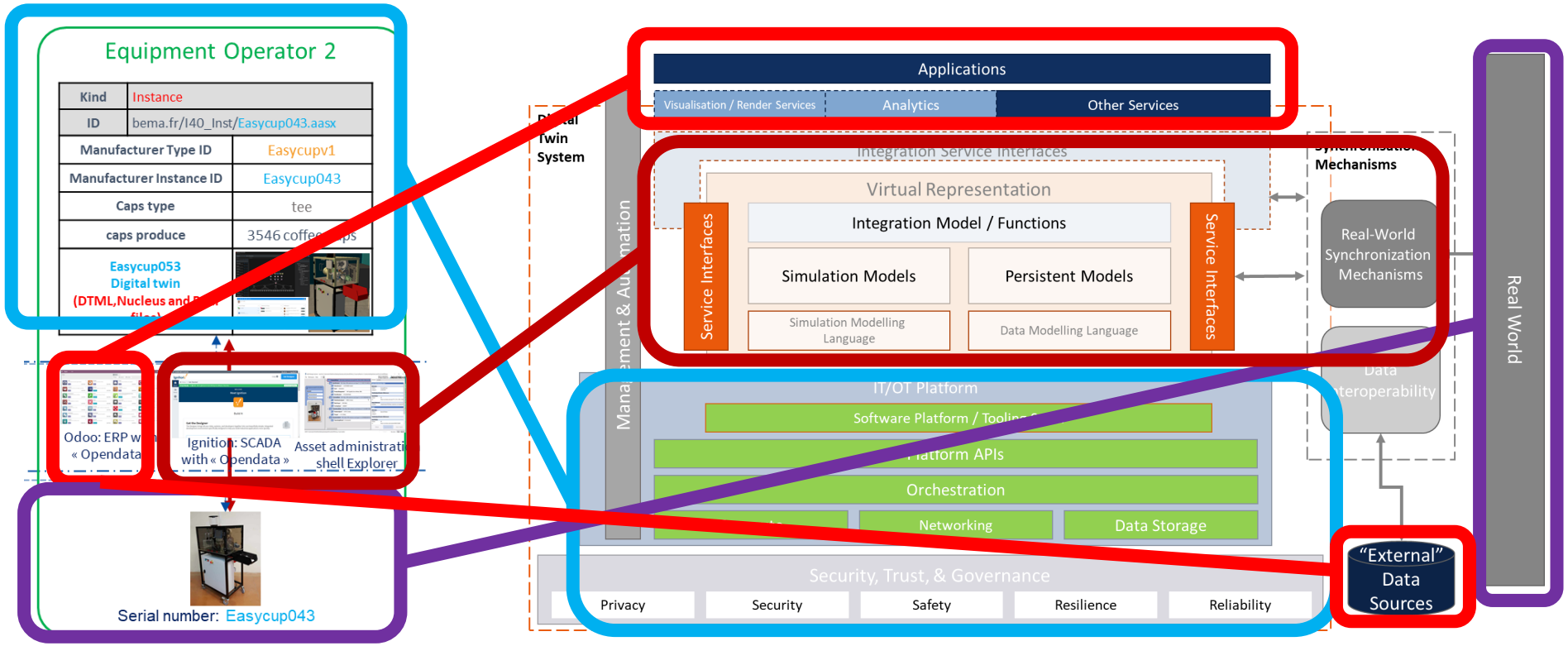
Presentation of Digital Twin concepts

Plattform 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).

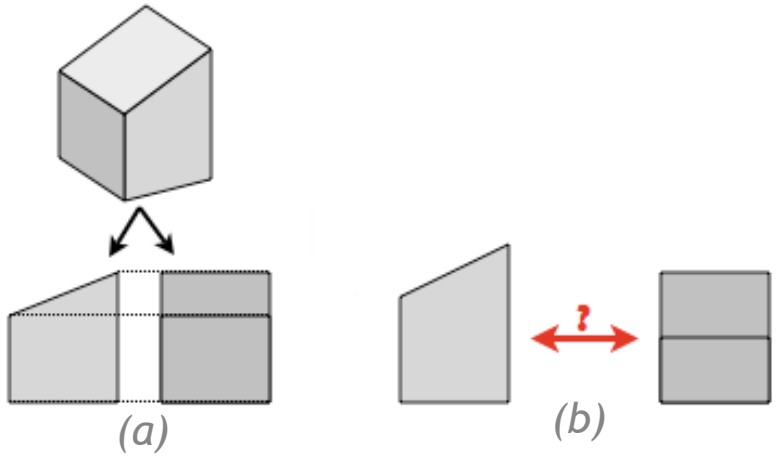


Figure 3 : (a) A model whose consistent views are extracted
(b) a set of views drawn independently, and therefore likely to contradict each other

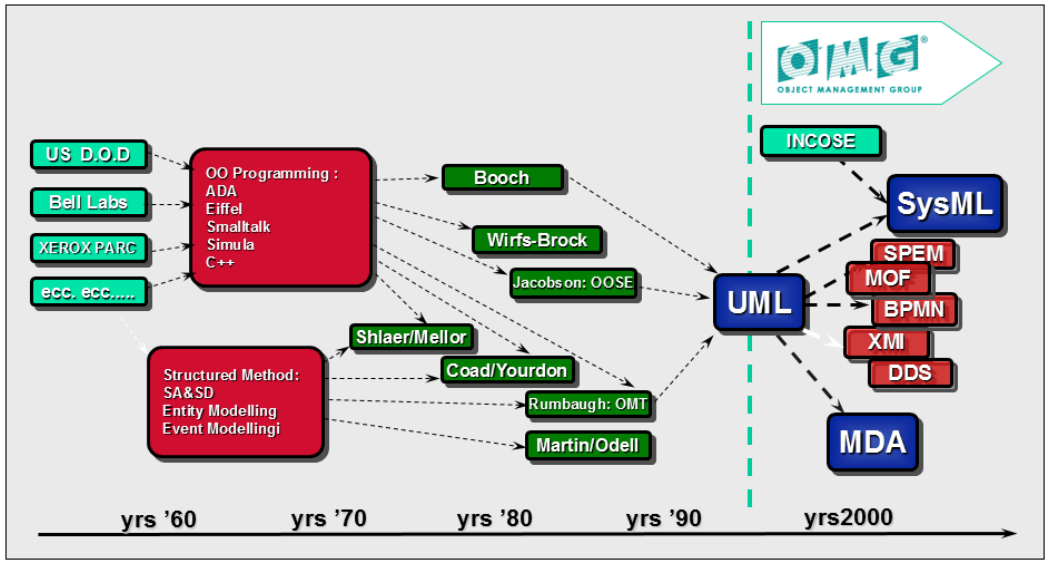
Source: ENS Cachan – Lionel Gendre

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.



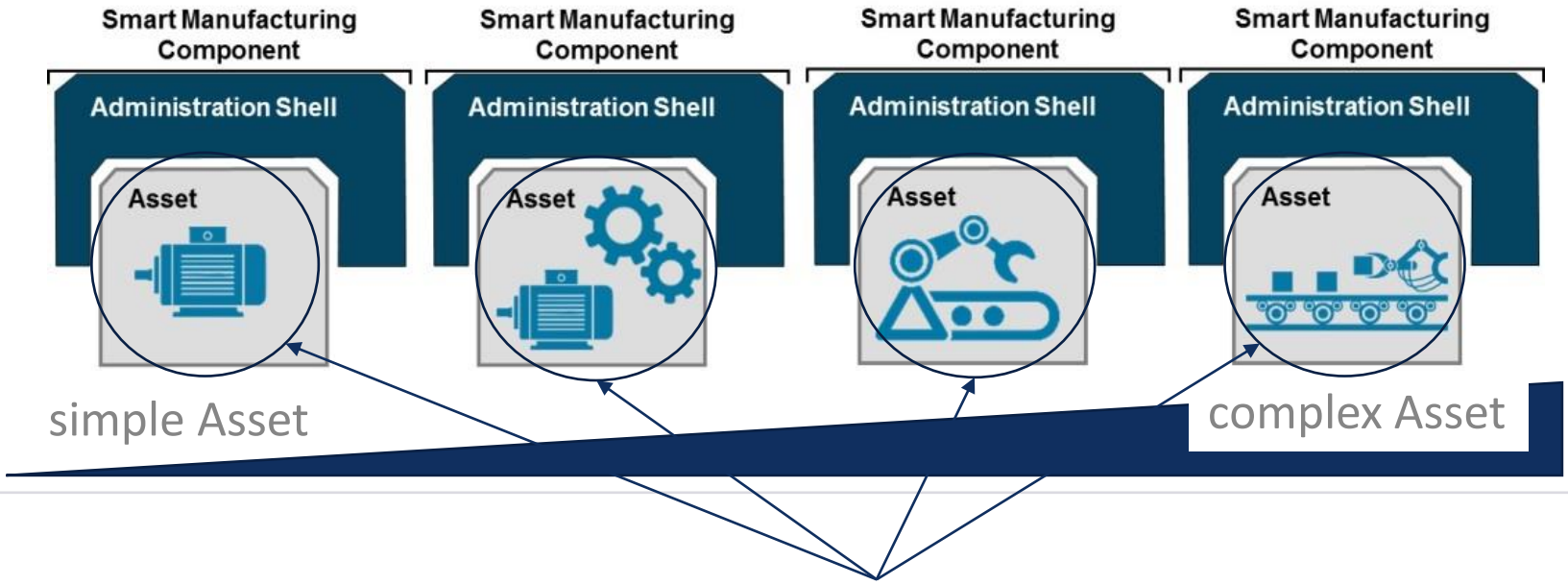
SysML background from OMG

Eric Truffet - e.truffet@iot-management.com

Systems engineering motivations

Administration shell examples system limits

As a flexible framework able to address all assets …



Differents levels of system of interest

Eric Truffet - e.truffet@iot-management.com

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:

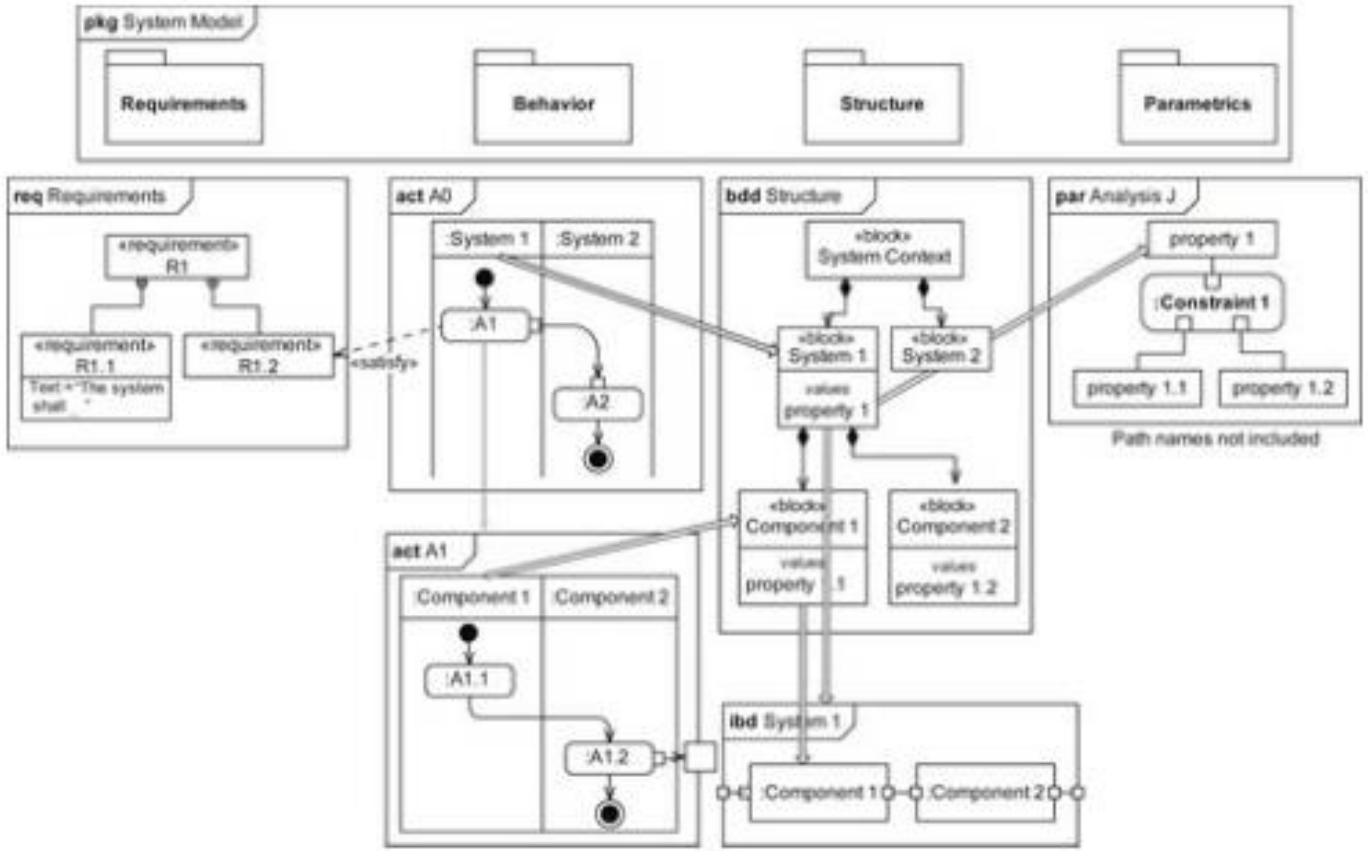
1. The **Goal view**, which is to describe the actions required performed by the system to answer the question «What is it for?»

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)

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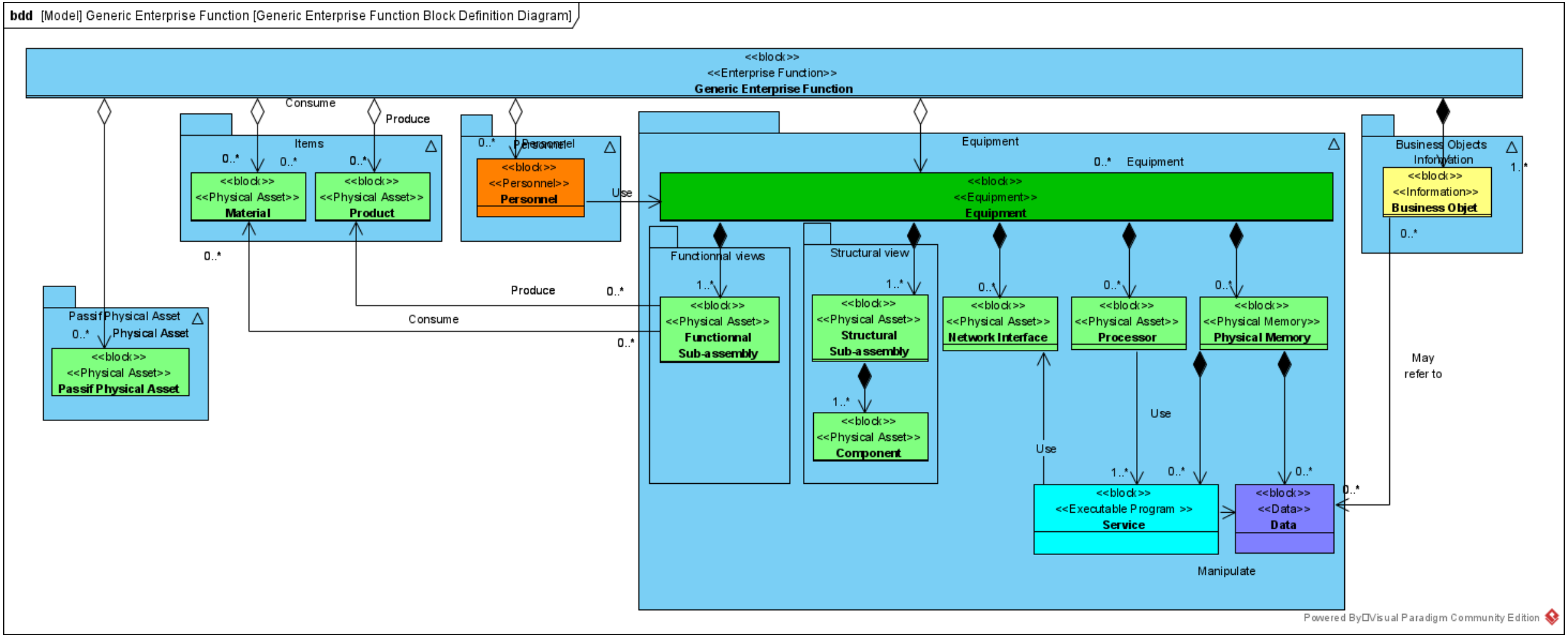
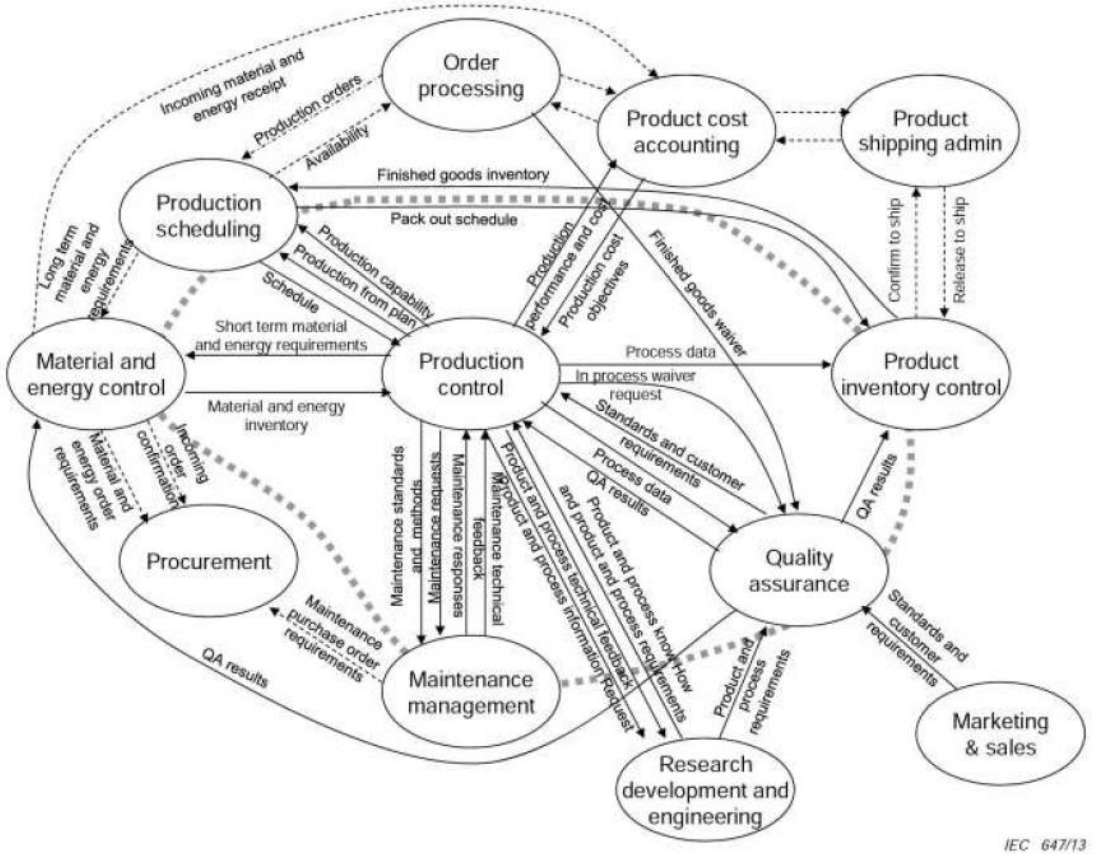
Basic Manufacturing System in SysML



ISA 95 Presentation

Functionnal Model



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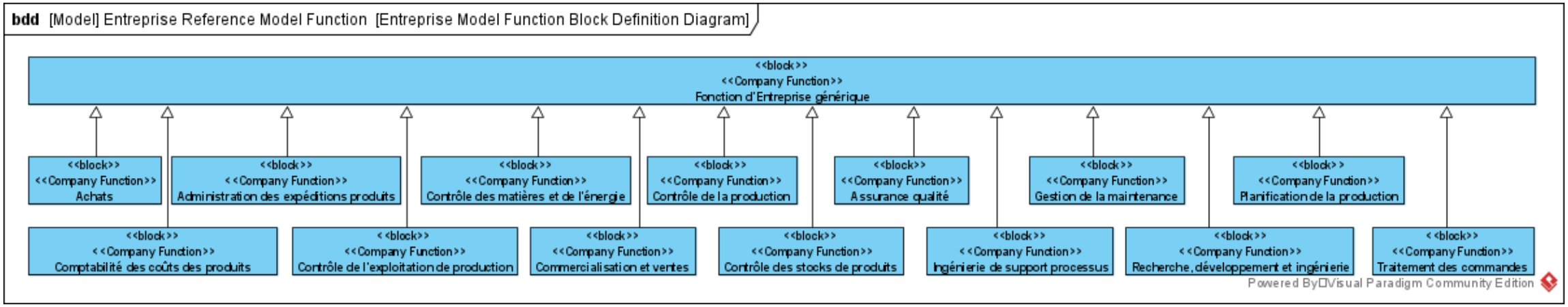
Functionnal Model in SysML



Source: Norme IEC/NF 62264-1

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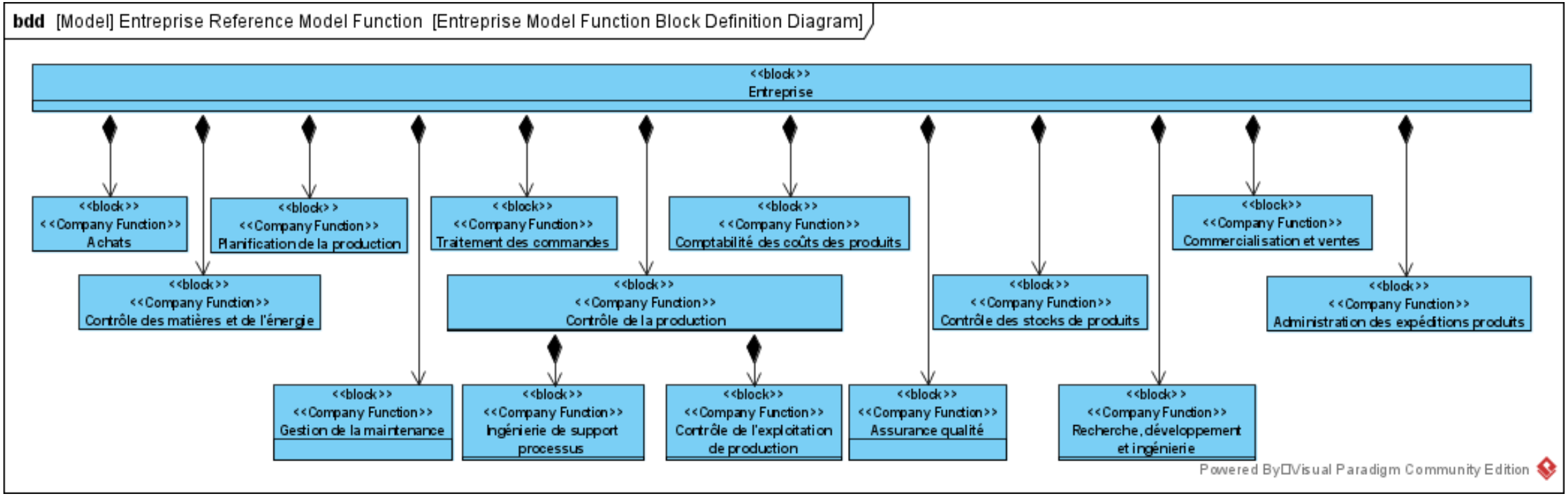
Functionnal Model in SysML



Source: Norme IEC/NF 62264-1

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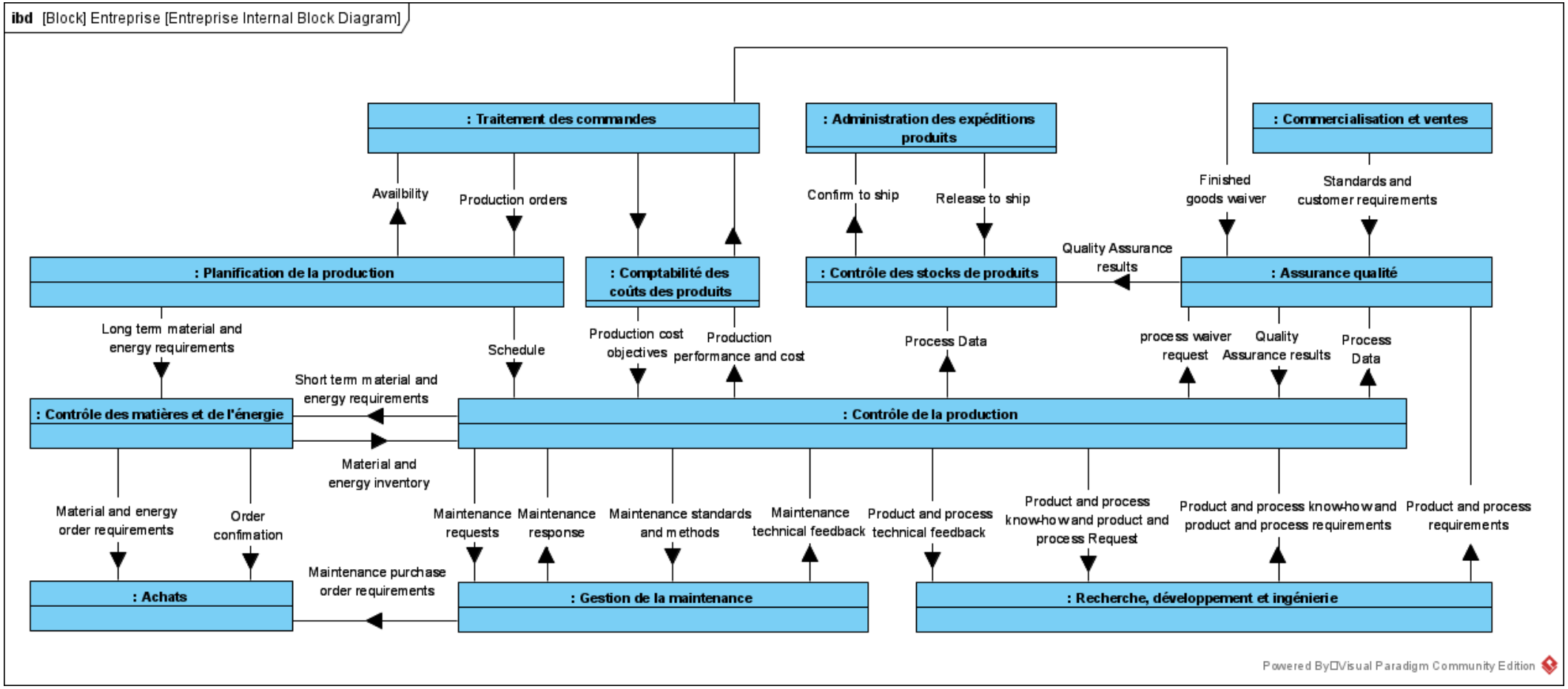
Functionnal Model in SysML



Source: Norme IEC/NF 62264-1

Thanks for attention

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