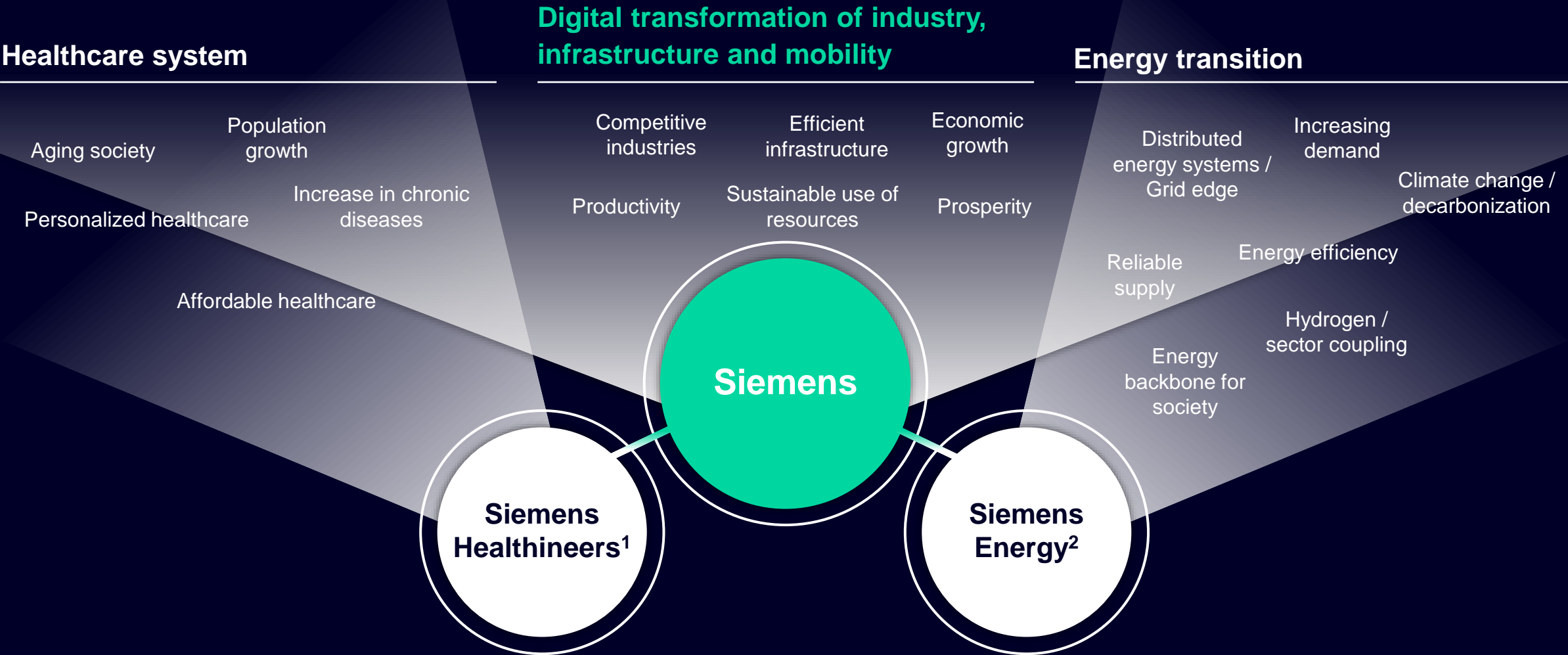# Knowledge representation as a building block for digital transformation at Siemens
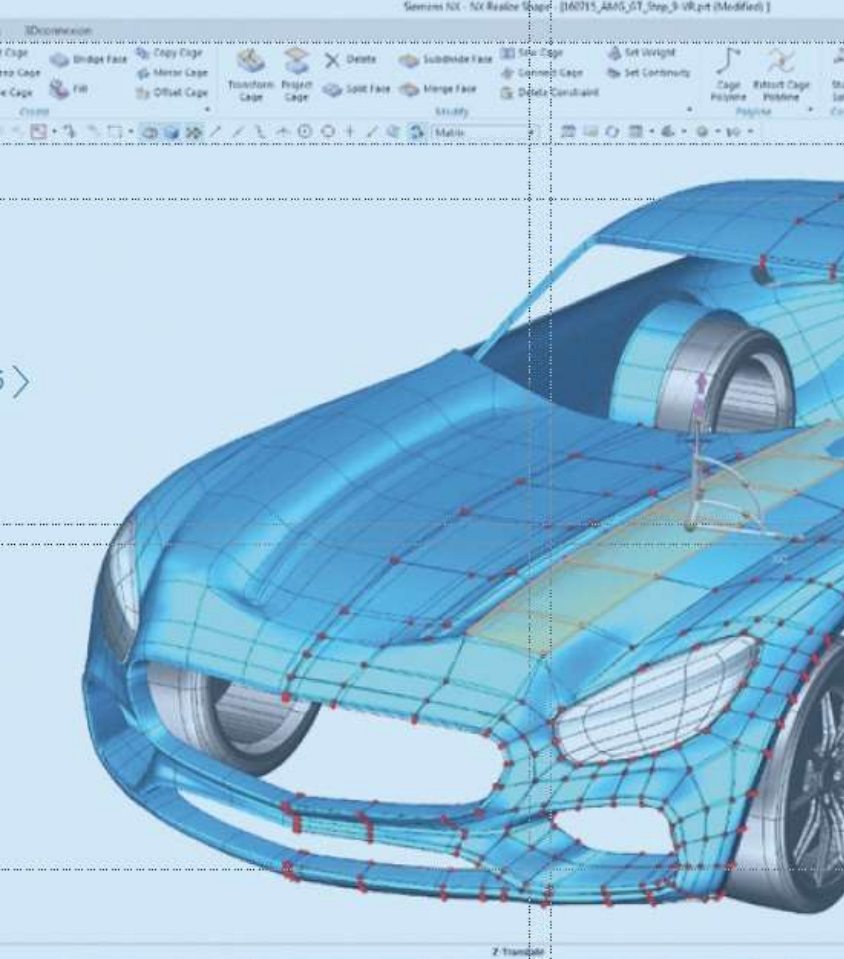
Dr. Sebastian Brandt
Siemens Technology

Data Week Leipzig, June 2022

SIEMENS

Providing technology solutions to address the greatest challenges of our time

Healthcare system

Digital transformation of industry, infrastructure and mobility

Energy transition

Aging society

Population growth

Personalized healthcare

Increase in chronic diseases

Affordable healthcare

Competitive industries

Efficient infrastructure

Economic growth

Productivity

Sustainable use of resources

Prosperity

Distributed energy systems / Grid edge

Increasing demand

Climate change / decarbonization

Reliable supply

Energy efficiency

Energy backbone for society

Hydrogen / sector coupling

Siemens

Siemens Healthineers[1]

Siemens Energy[2]

1 Publicly listed subsidiary of Siemens | **2** Publicly listed associate

SIEMENS

We commute in cars designed with **Siemens software …**

… built in factories running on **Siemens automation …**

… charged by a renewable and decentralized **Siemens smart grid.**

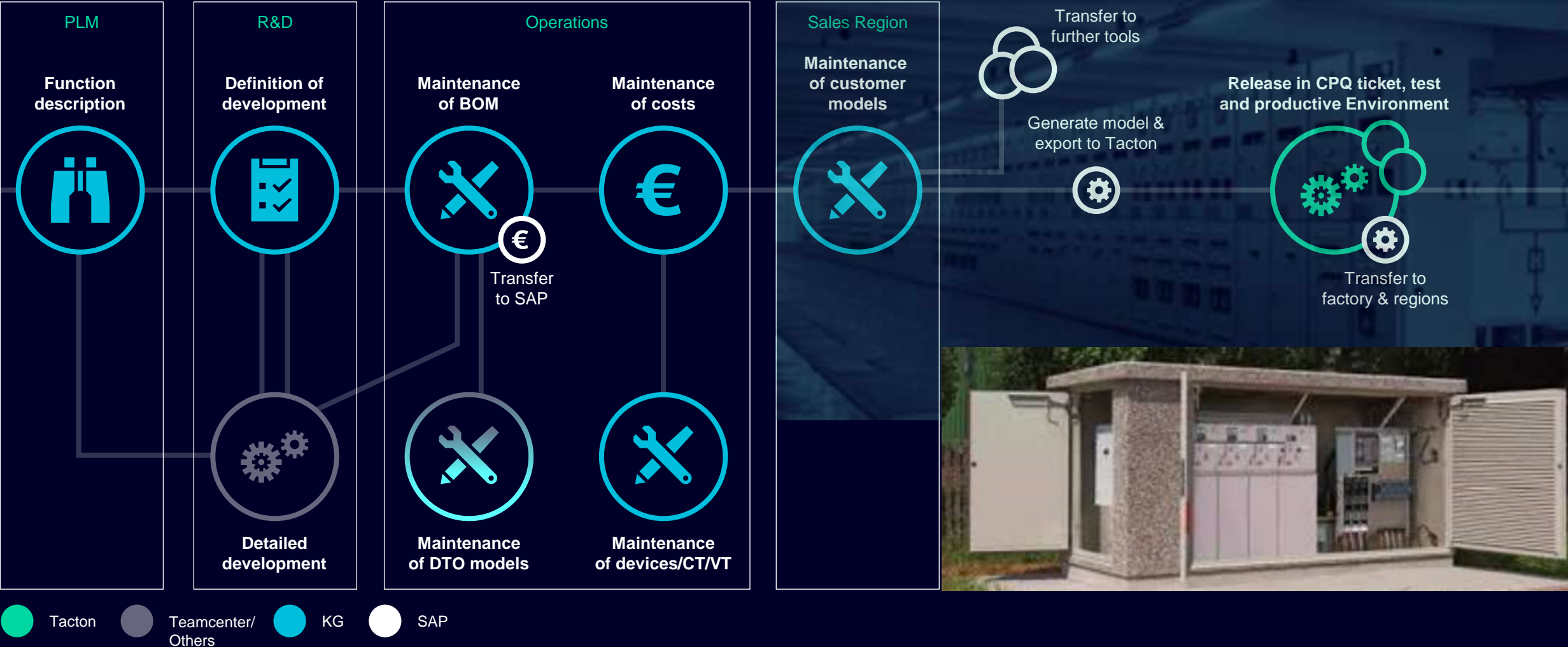**SIEMENS**

We travel on **Siemens trains …**

… and on planes brought to life using **Siemens technology.**

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Product life-cycle
Example: switchgears for smart grids

PLM	R&D	Operations		Sales Region

Function description

Definition of development

Maintenance of BOM

Maintenance of costs

Maintenance of customer models

€ Transfer to SAP

Transfer to further tools

Generate model & export to Tacton

Release in CPQ ticket, test and productive Environment

Transfer to factory & regions

Detailed development

Maintenance of DTO models

Maintenance of devices/CT/VT

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Knowledge Graphs – Siemens Technology drives innovation from world-class research to company-wide adoption

Milestones

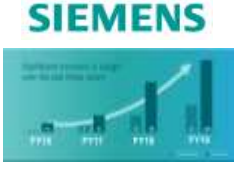Google Knowledge Graph announced

Breakthrough: ML on graphs

Startups & big players entering KG market

Gartner add KGs to hype cycle

Mindsphere SDI adding graph support

> 30 KG projects,
> 10 productive use
> 6 CCTs

Shared ontologies

Technology innovation activities

Ontology libraries
Shared & reusable ontologies

Data Strategy
Accelerate adoption & roll-out projects

Funded projects

Cognitive Deep Learning

Business Buy-in
Proof-of-values and competence ramp-up

Machine Learning on graphs

Optique

Knowledge Graphs as data layer on top of SQL Databases

THESEUS

Semantic knowledge graphs & reasoning

Technology Investments

Research

Product DEV
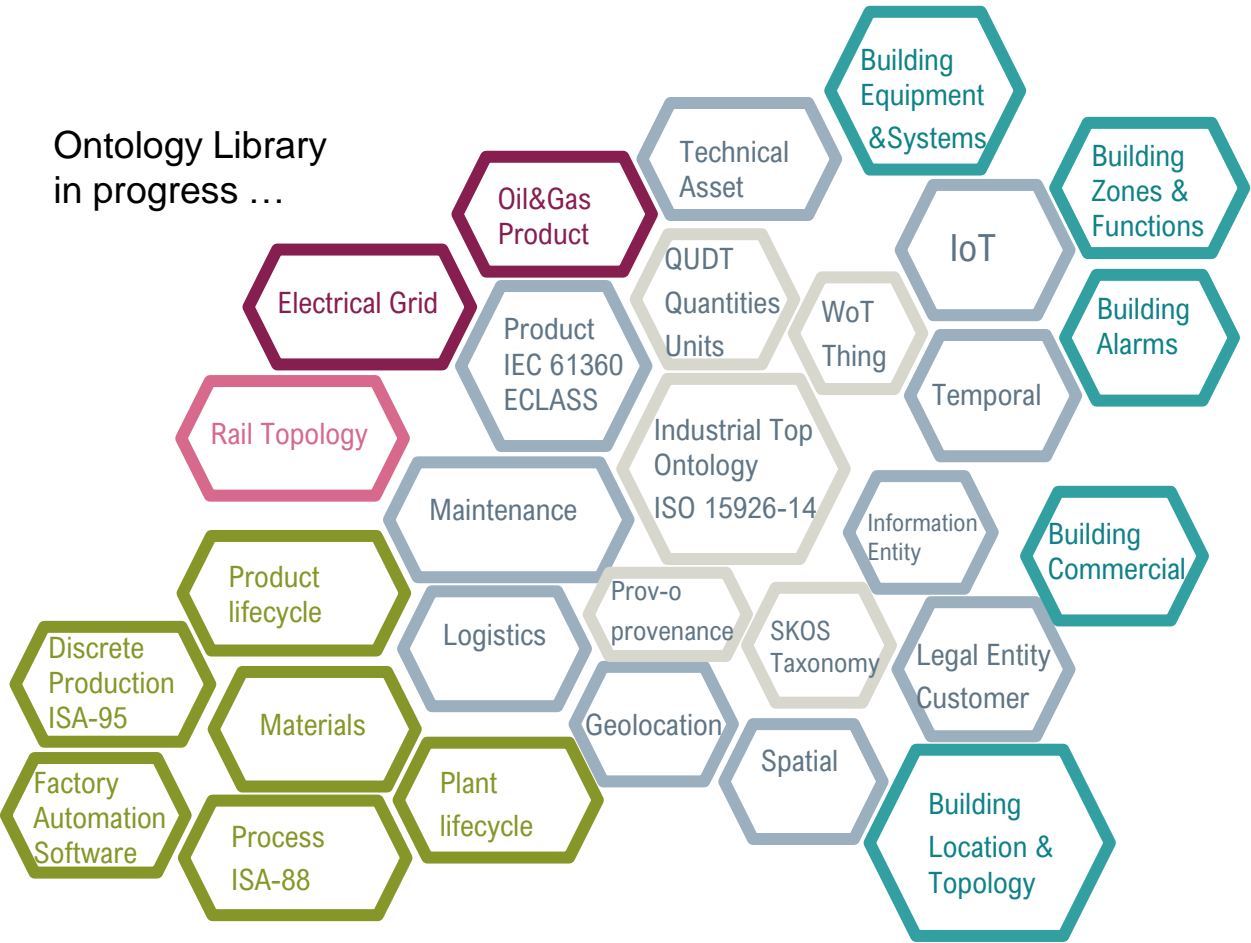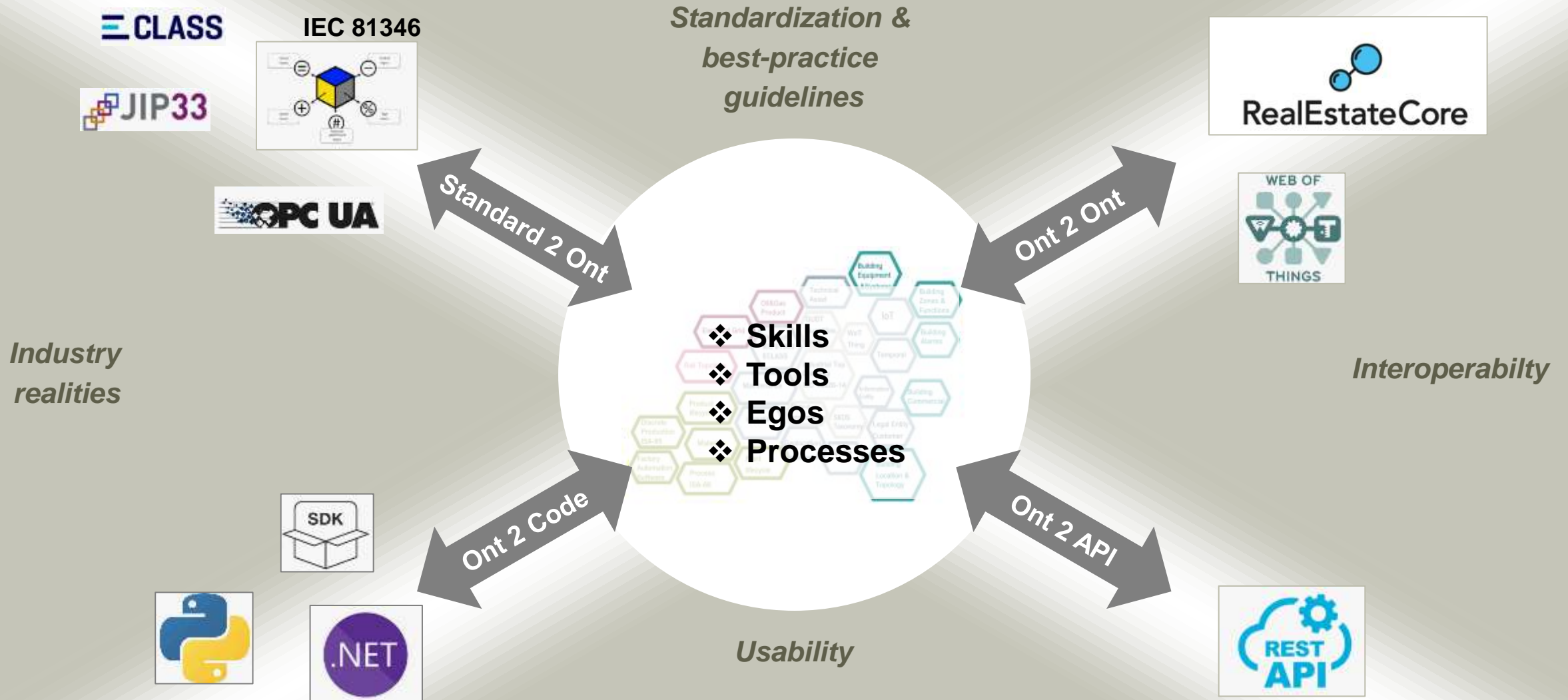
FY12

FY21

Siemens-wide Ontology Library
Ontology Publication Platform, Shared Guidelines and Upper-Ontology

Ontology Library in progress …

Hexagon labels:
- Building Equipment &Systems
- Technical Asset
- Building Zones & Functions
- Oil&Gas Product
- IoT
- Electrical Grid
- QUDT Quantities Units
- WoT Thing
- Building Alarms
- Product IEC 61360 ECLASS
- Temporal
- Rail Topology
- Industrial Top Ontology ISO 15926-14
- Maintenance
- Information Entity
- Building Commercial
- Product lifecycle
- Logistics
- Prov-o provenance
- SKOS Taxonomy
- Legal Entity Customer
- Discrete Production ISA-95
- Materials
- Geolocation
- Spatial
- Factory Automation Software
- Process ISA-88
- Plant lifecycle
- Building Location & Topology

Legend:
- Industry Standard
- Siemens Core
- Building
- Energy
- Rail
- Production

A growing core ensures model quality and interoperability!!!

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Challenges
example: Siemens Ontology Library

ECLASS   IEC 81346

JIP33

OPC UA

Standardization &
best-practice
guidelines

Standard 2 Ont

Ont 2 Ont

RealEstateCore

WEB OF THINGS

- ❖ **Skills**
- ❖ **Tools**
- ❖ **Egos**
- ❖ **Processes**

Industry realities

Interoperabilty

SDK

Ont 2 Code

Ont 2 API

Usability

REST API

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Challenges
misconceptions and false friends

- **Semantic-*ish* ?**
  - **Do you really need semantic technology for your use-case?**
  - **If you do, get semantic technology!** ☺

- **Why not buy a complete solution?**
  - **consultancy problem**
  - **median life-span of tech startups: 5 years**
  - **existing information landscape?**

- **Focus on processes, *not* tools!**

Half of the time when companies say they need "AI" what they really need is a SELECT clause with GROUP BY.

You're welcome.

Buy tool	Change Process

PSPACE	SPARQL query	SQL query	ALC reasoning (OWL)	Graph non-isomorphism
NP	Conjunctive queries	Graph homomorphism	3-SAT	
P	Basic Graph Patterns (SPARQL)	Xpath 1.0 query	Graph shortest path	
NL (Non-deterministic logarithmic space)	Graph-QL query	Graph reachability	2-SAT	

WAS **FRISEURE** KÖNNEN, KÖNNEN NUR **FRISEURE**.

Friseure bewegen

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Which Graph Database ?

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