

Agenda

- Role of Data in Circular Economy Context
- Semantic Modelling and MBSE
- **Cognitive Digital Twin concept**
- Application case of Airbus
- IMF & CDT in new EU projects

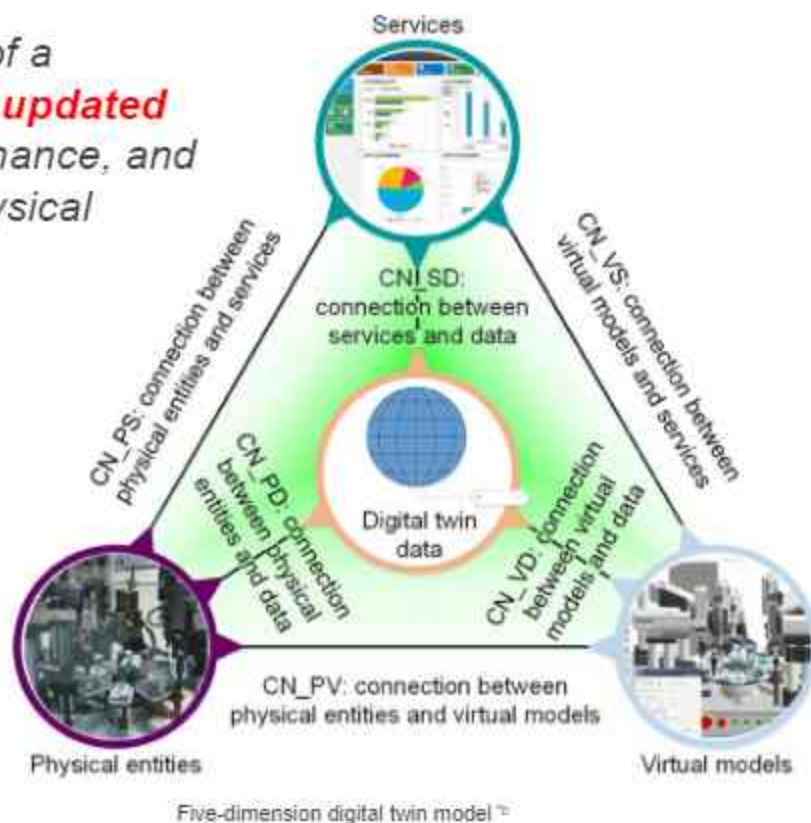


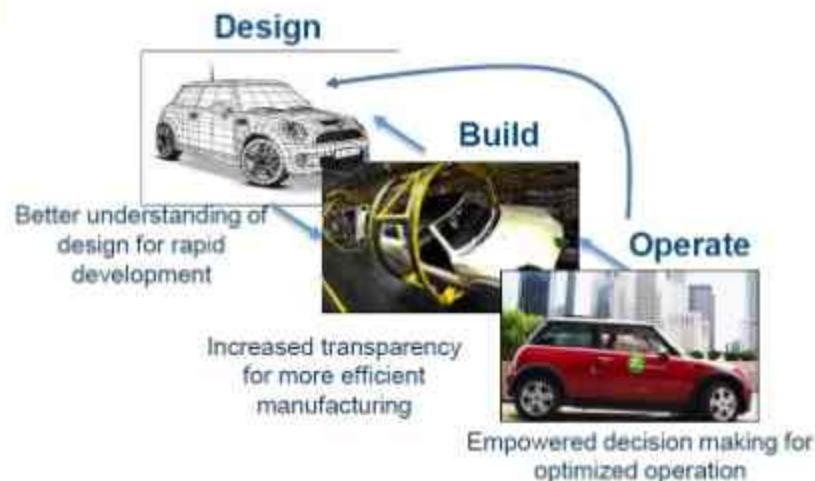
Digital Twin - Concept

- “A *Digital Twin* is a **virtual instance** of a **physical system** that is **continually updated** with the latter’s performance, maintenance, and health status **data** throughout the physical system’s life cycle.”^{3a}

- Key elements:

- Physical entities
- Virtual instances
- DT data
- Services
- Connections





- High complexity of modern industrial systems
- Heterogeneous DT models corresponding to
 - related systems, subsystems and components
 - different lifecycle phases
 - different stakeholders, protocols and standards
- Lack of unified platform for integrating all relevant DT models



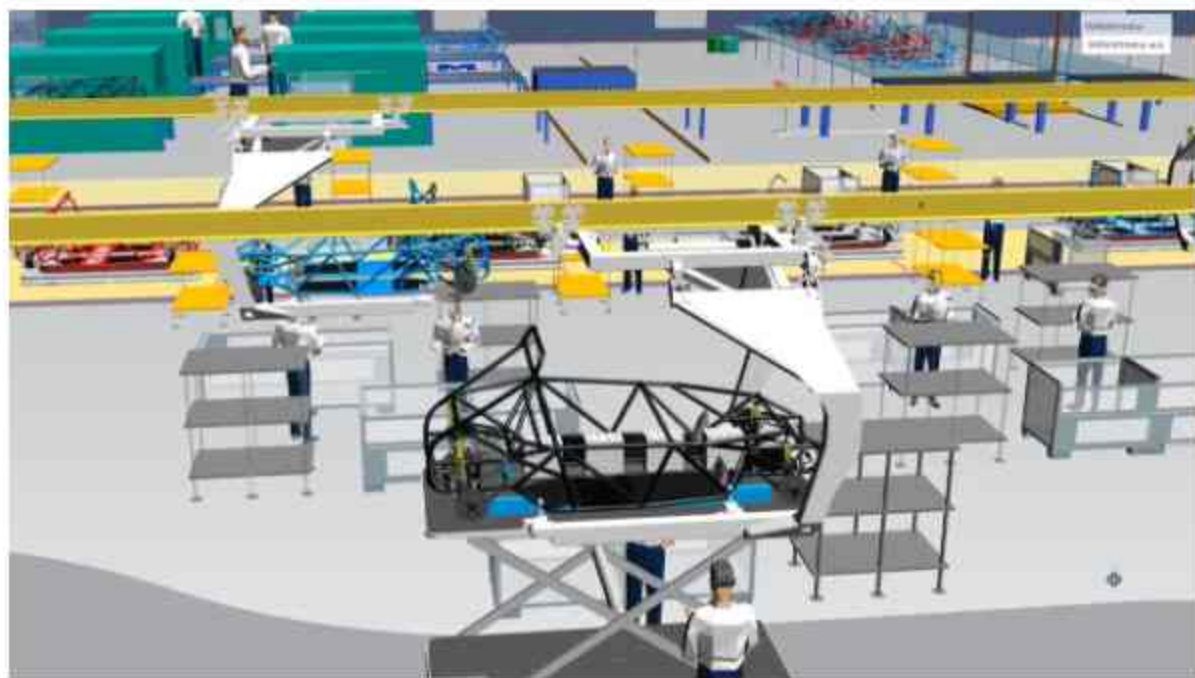
Design, simulate,
and verify products
digitally, including
mechanics and multi-
physics, electronics
and software
management



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Plan, simulate,
predict and optimize
production digitally
with PLC code
generation and
virtual
commissioning



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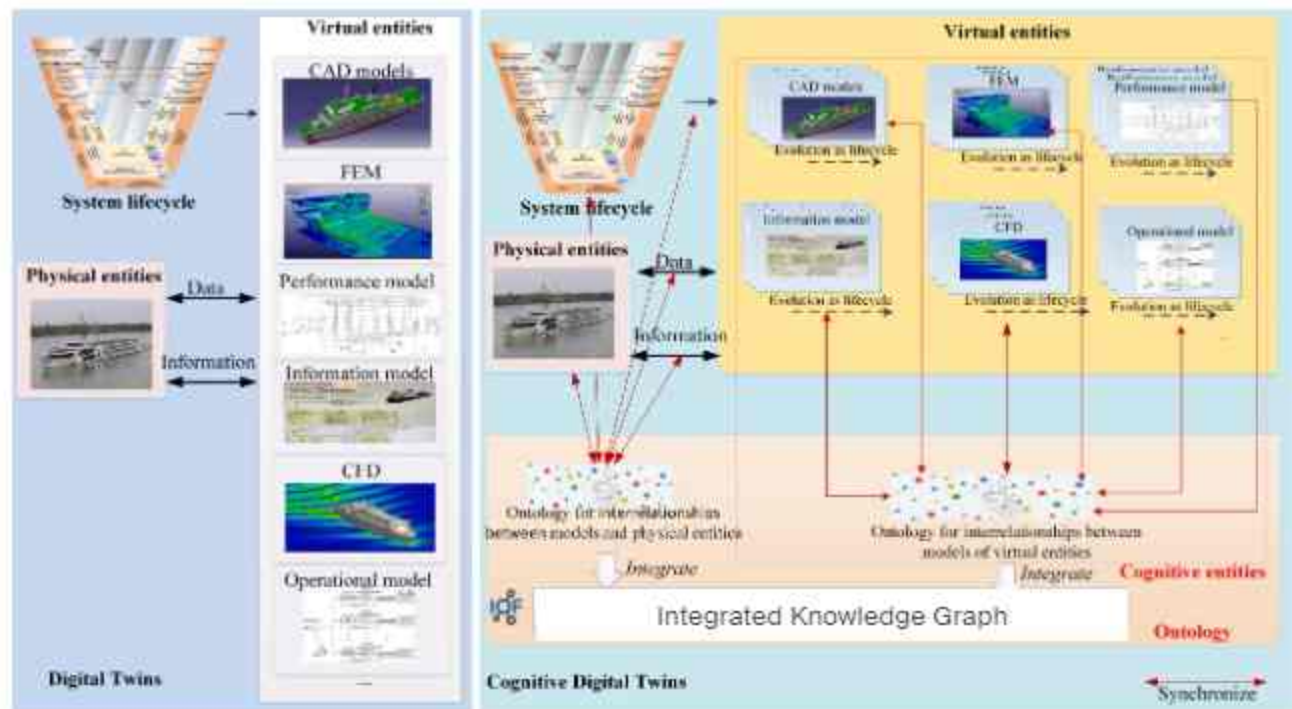
Run production
efficiently and securely
with Totally Integrated
Automation.
Continuously
optimize with
data insights.



Slide produced by SIEMENS-CH

Cognitive Digital Twin

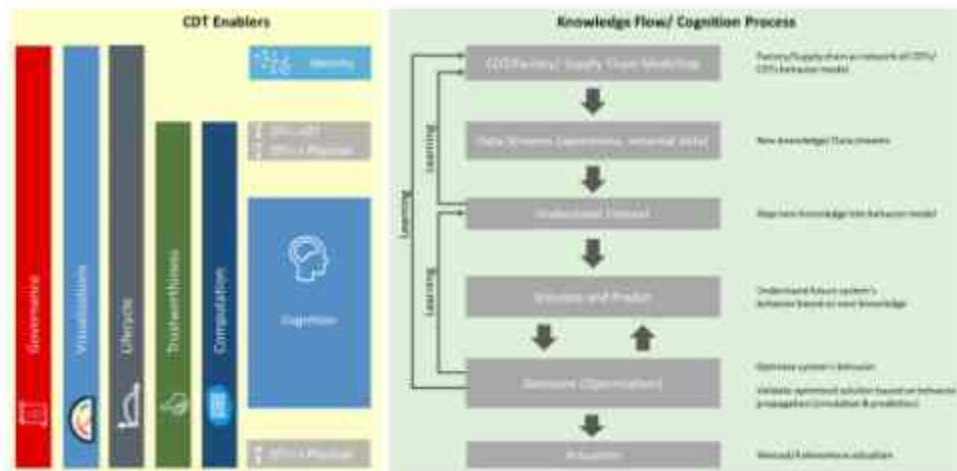
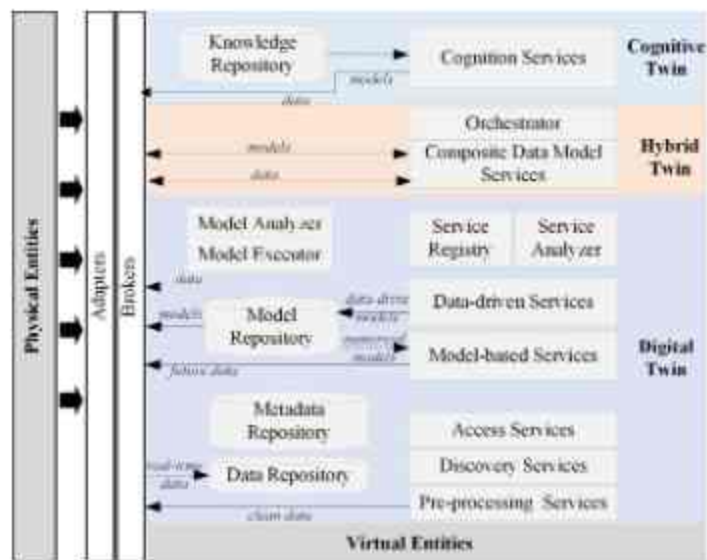
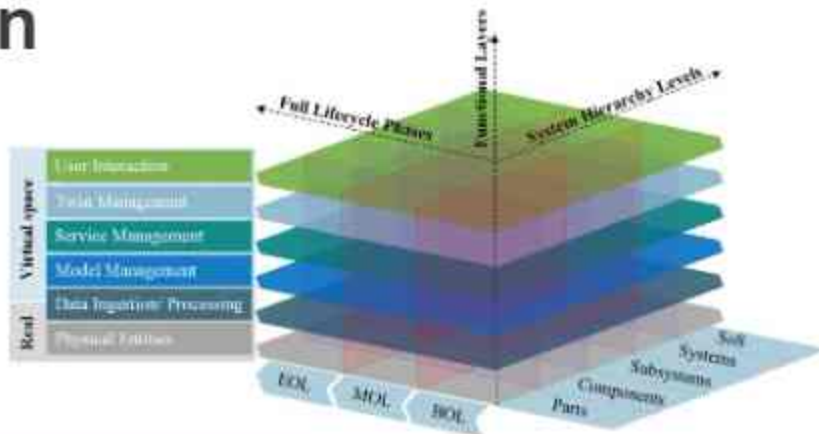
- Cognitive Digital Twin: a digital representation of a physical system augmented with **cognitive capabilities** and enables **autonomous activities**; comprises **semantically interlinked digital models** related to **different lifecycle phases**; **continuously evolves** with the physical system across the entire lifecycle.



Cognitive Digital Twin

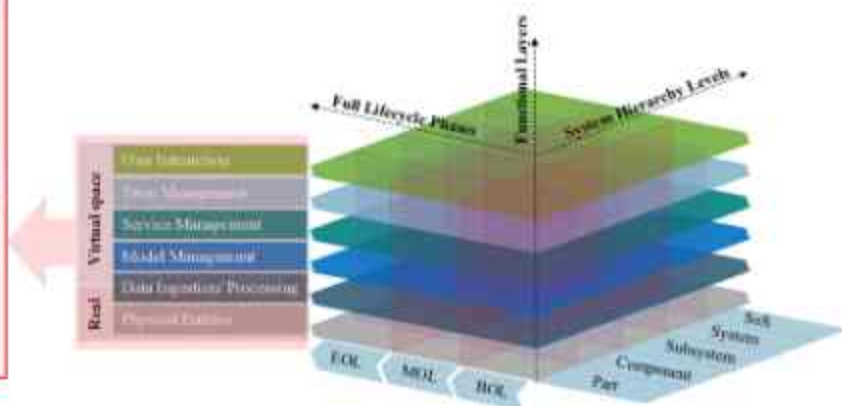
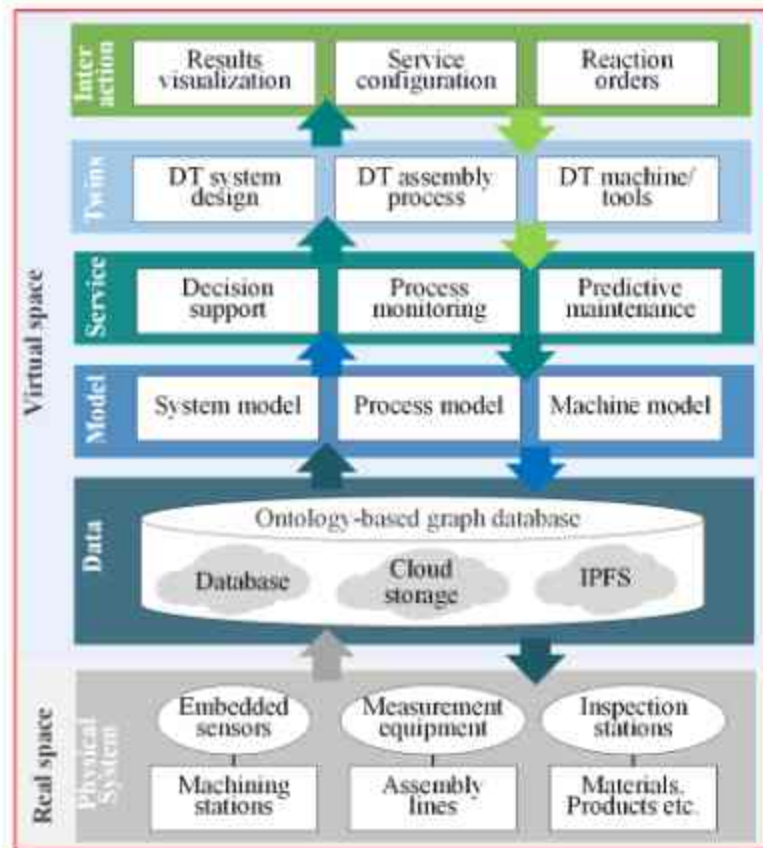
Reference Architecture

- Full lifecycle phases
- System Hierarchy levels
- Functional layers



Application cases

- Multiple lifecycle phases:



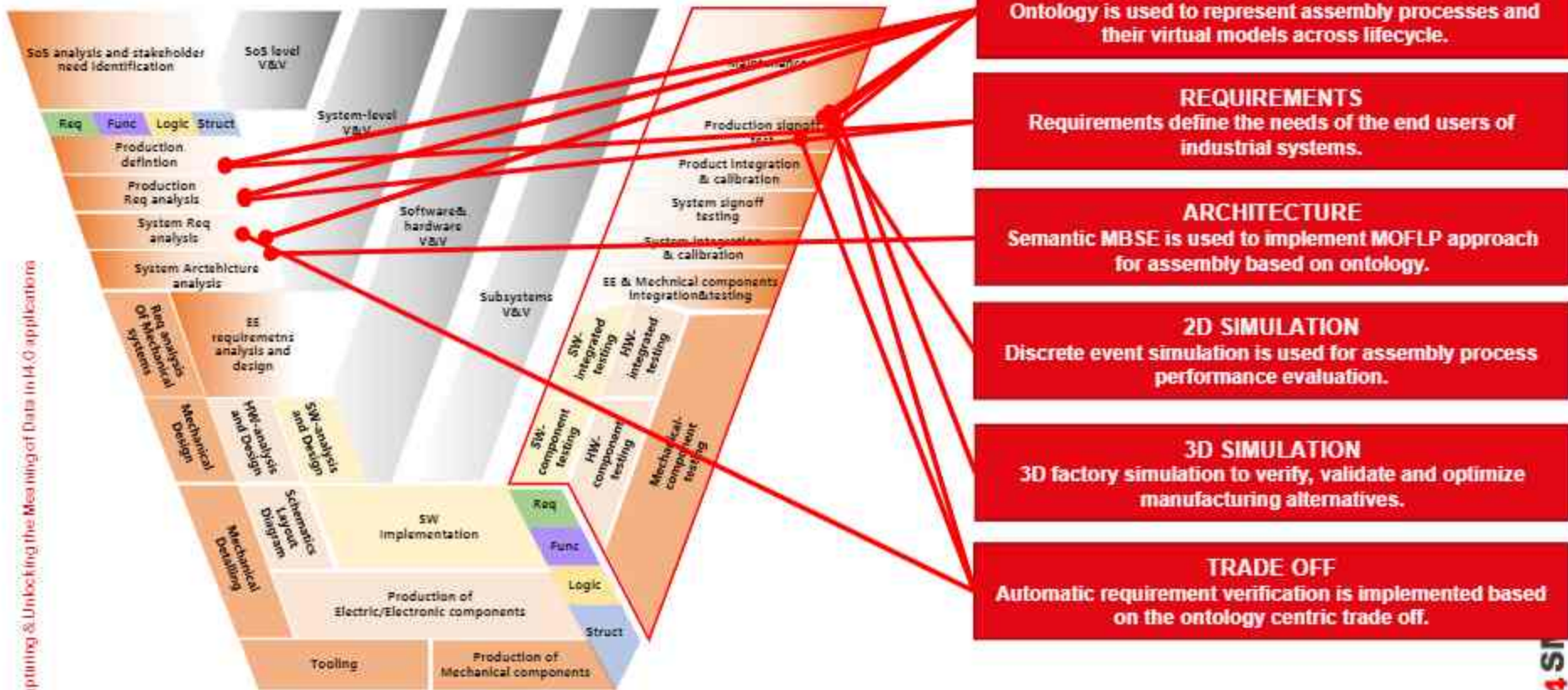
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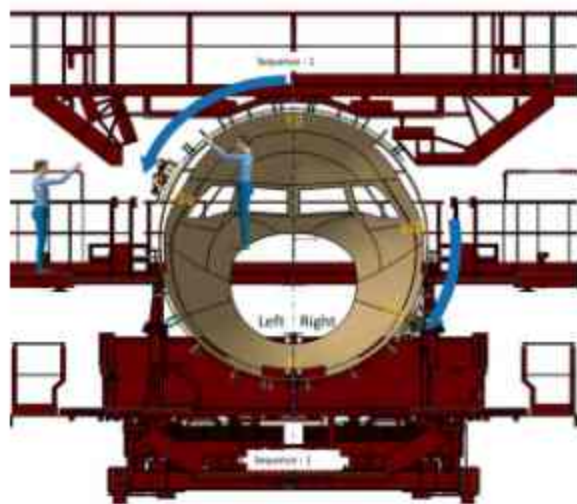
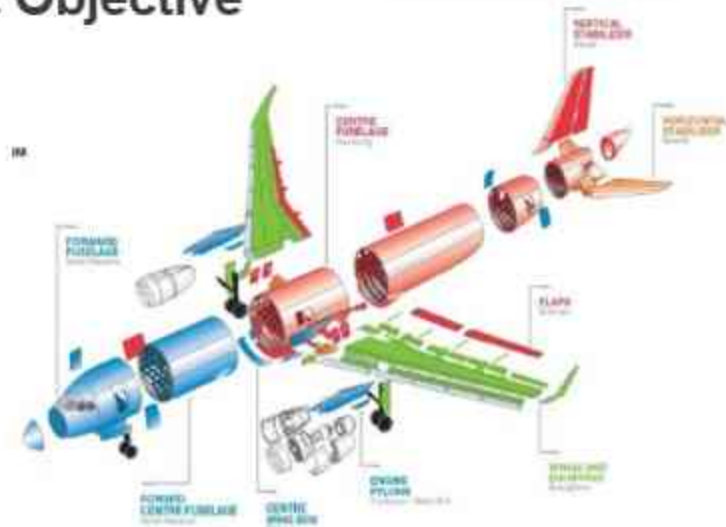


**COGNITIVE DIGITAL TWIN
MAKES MODELS
UNDERSTANDABLE!**

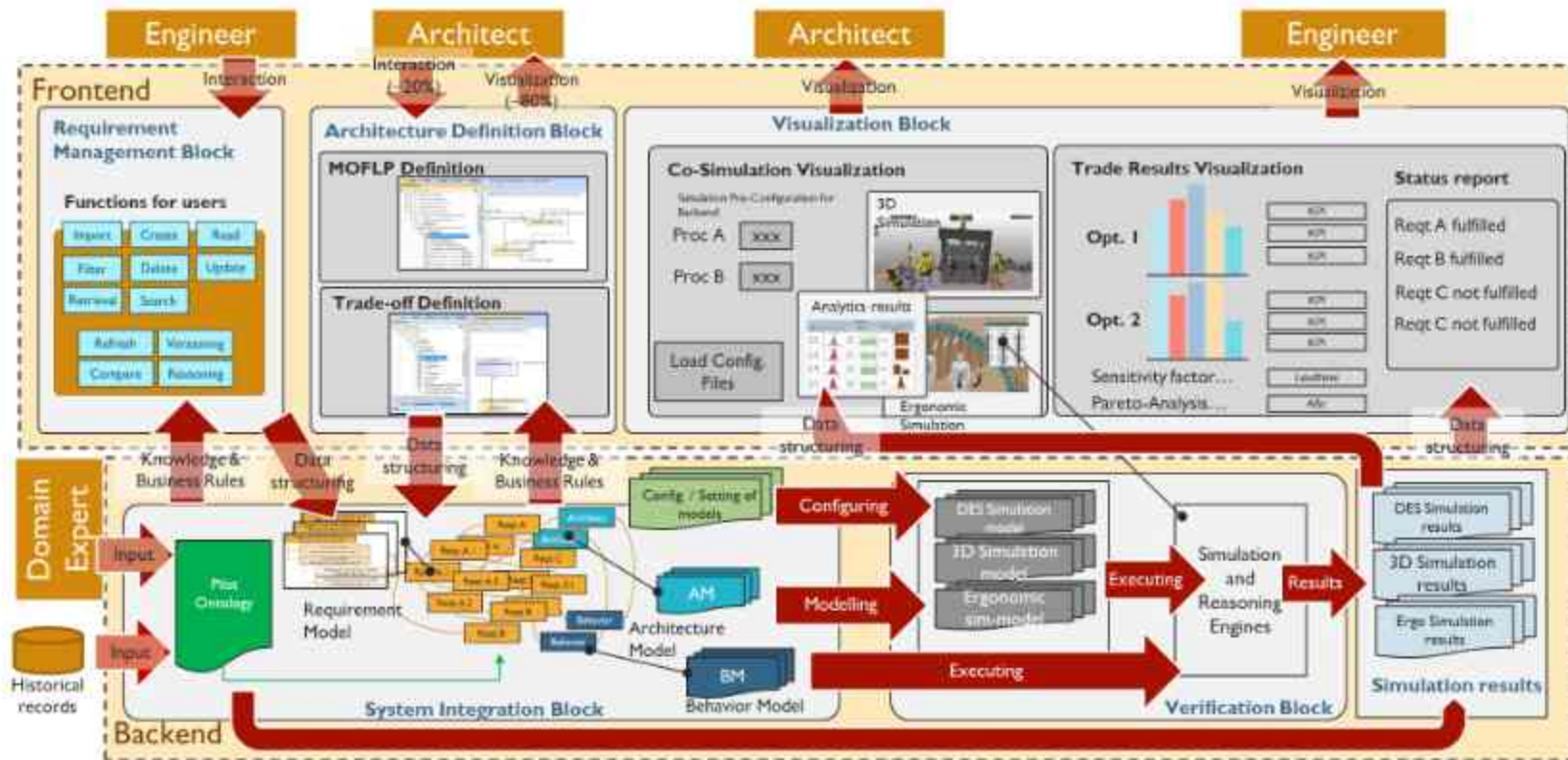


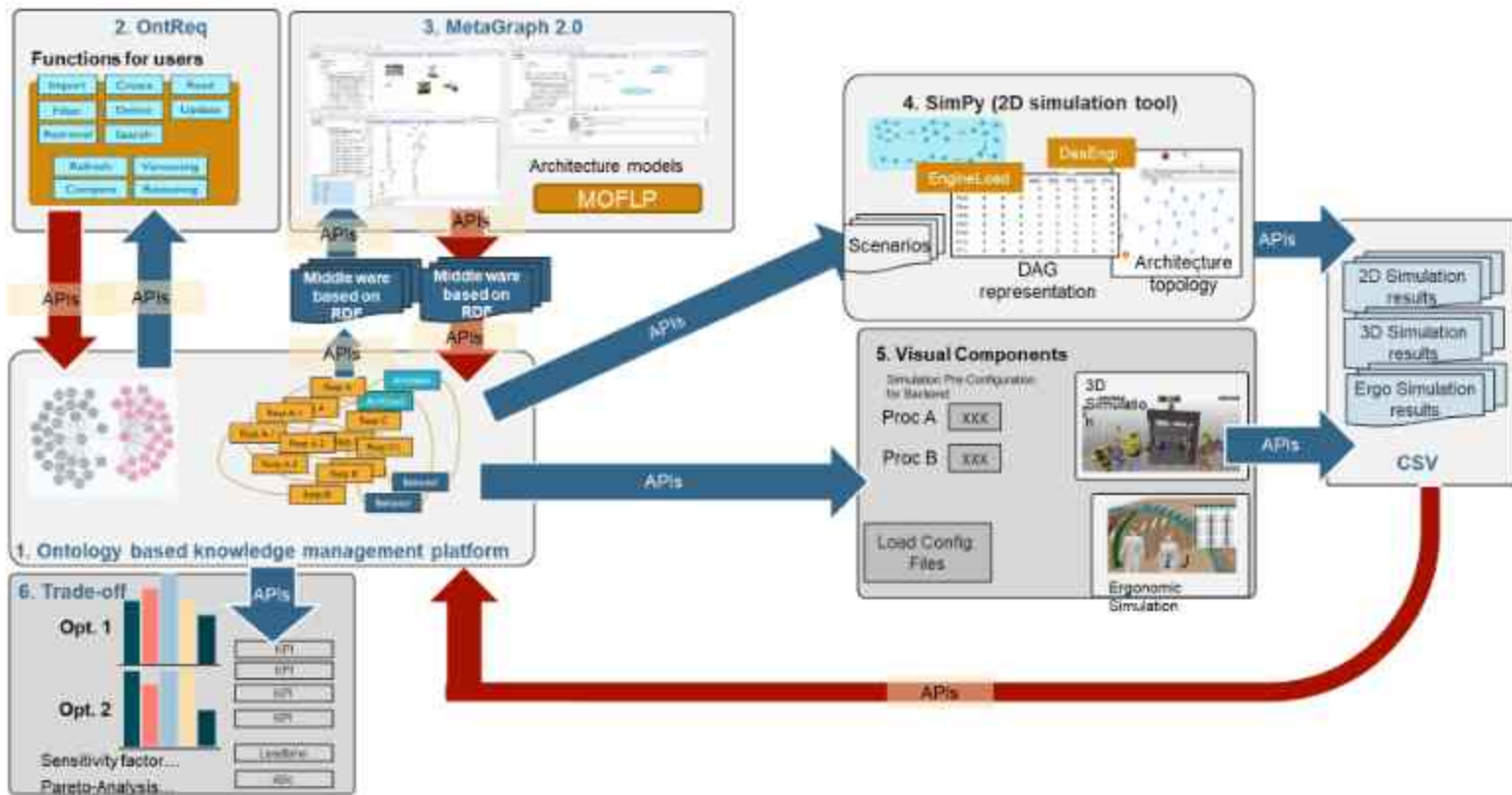


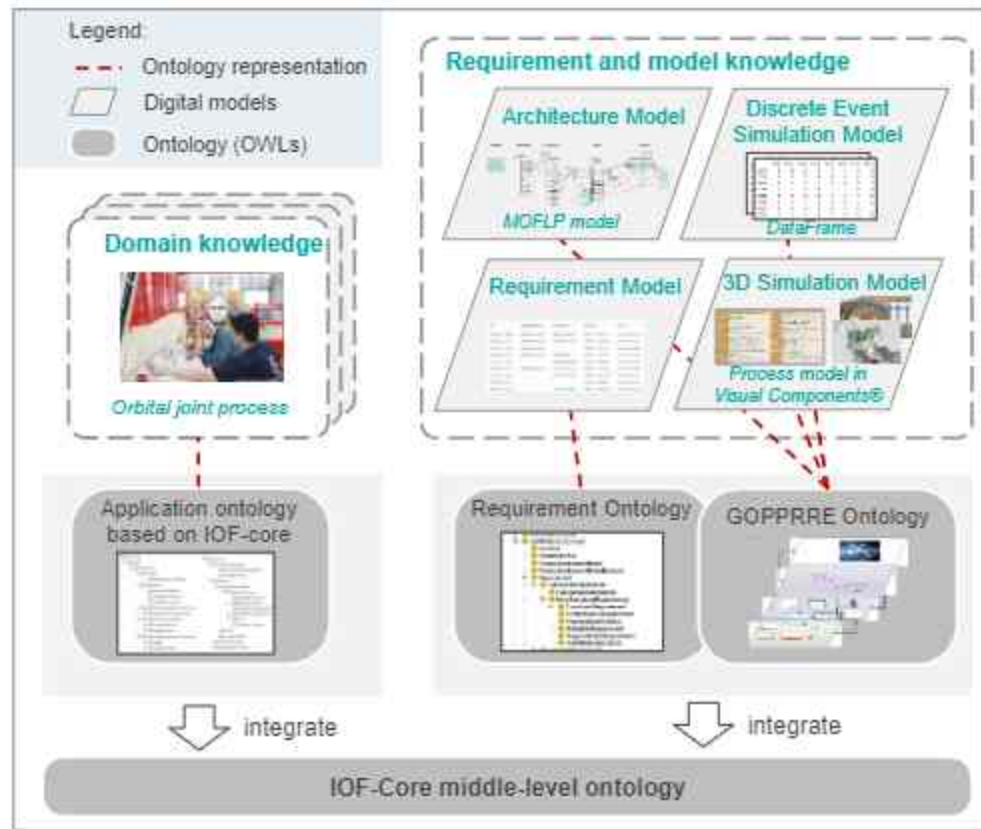
- Enable an **MBSE** and collaborative design process between the **Aircraft** and **Industrial System** domains.
- Overcome bottlenecks concerning **knowledge management**, **interoperability** and **decision making** in the design process.



- Use Case: the design process of the Aircraft fuselage Orbital Joint Process, in the Final Assembly Line (FAL) to be reconfigured/redesigned for new industrializations
- MVP5 prototype enables Orbital Joint Process trade-off analysis, by generating and simulating all possible design alternatives based on defined requirement targets.



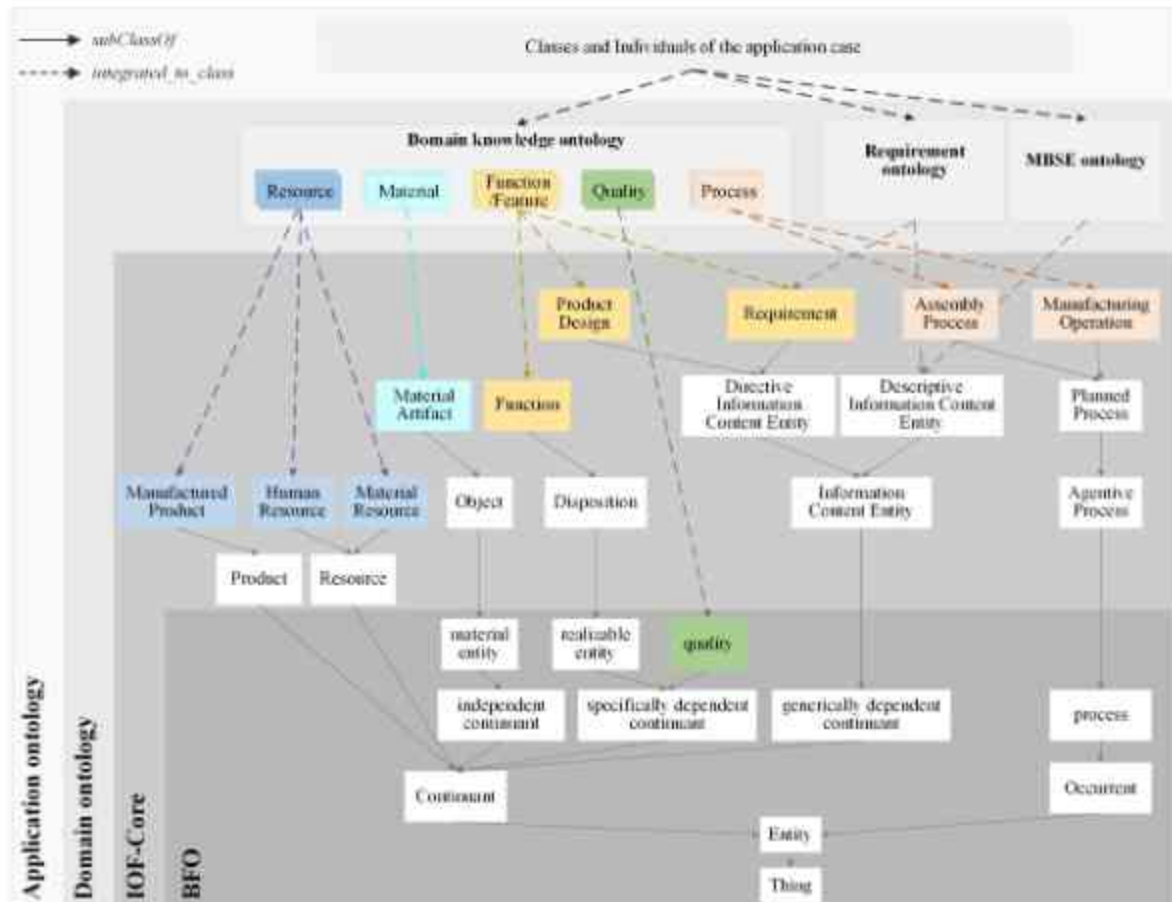




- Application ontology is developed to capture domain knowledge, requirement and modelling knowledge.
 - Assembly system application ontology
 - Requirement ontology
 - GOPPRRE ontology (MBSE)
- Three ontologies integrated into the IOF-Core middle level ontology.
- Main knowledge sources:
 - Documented knowledge
 - Expert knowledge

Application Ontology

- Hierarchical strategy
- Based on IOF Core & BFO



Development of application ontology

Application Ontology

- Main knowledge sources:



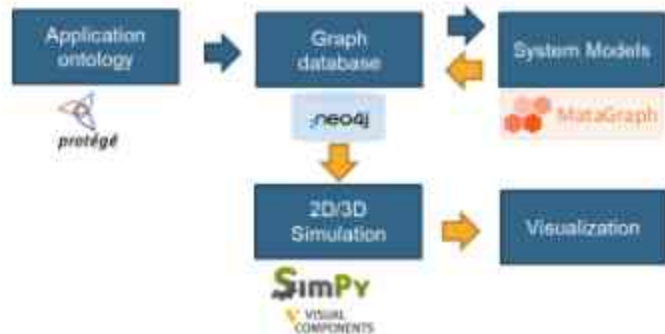
Knowledge source 1:
Historical Orbital Joint Process specifications.

Materials	Customer	Release	Revision
0010100100001001	01101	01	001001_0
0010100100001002	01101	01	001001_1
0010100100001003	01101	01	001001_2
0010100100001004	01101	01	001001_3
0010100100001005	01101	01	001001_4
0010100100001006	01101	01	001001_5
0010100100001007	01101	01	001001_6
0010100100001008	01101	01	001001_7
0010100100001009	01101	01	001001_8
0010100100001010	01101	01	001001_9
0010100100001011	01101	01	001001_10
0010100100001012	01101	01	001001_11
0010100100001013	01101	01	001001_12
0010100100001014	01101	01	001001_13
0010100100001015	01101	01	001001_14
0010100100001016	01101	01	001001_15
0010100100001017	01101	01	001001_16
0010100100001018	01101	01	001001_17
0010100100001019	01101	01	001001_18
0010100100001020	01101	01	001001_19
0010100100001021	01101	01	001001_20
0010100100001022	01101	01	001001_21
0010100100001023	01101	01	001001_22
0010100100001024	01101	01	001001_23
0010100100001025	01101	01	001001_24
0010100100001026	01101	01	001001_25
0010100100001027	01101	01	001001_26
0010100100001028	01101	01	001001_27
0010100100001029	01101	01	001001_28
0010100100001030	01101	01	001001_29
0010100100001031	01101	01	001001_30

Knowledge source 2:
Domain experts' knowledge.

Material (M_i) → Process (P_i) → Resource (R_i) → Feature/Function (F_i) → Quality (Q)

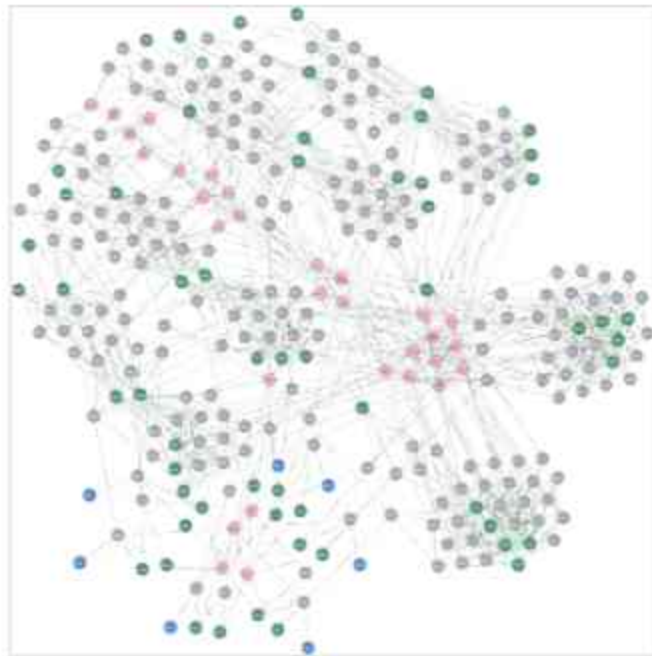
- Material:**
 - Technical characteristics
 - Requirement data collection
- Process:**
 - Parameter configuration
 - Process sequence
- Resource:**
 - Test condition
 - Setup condition
 - Machine condition
- Feature/Function:**
 - Performance indicator
 - Measure data
- Quality:**
 - Quality parameters
 - Design specifications



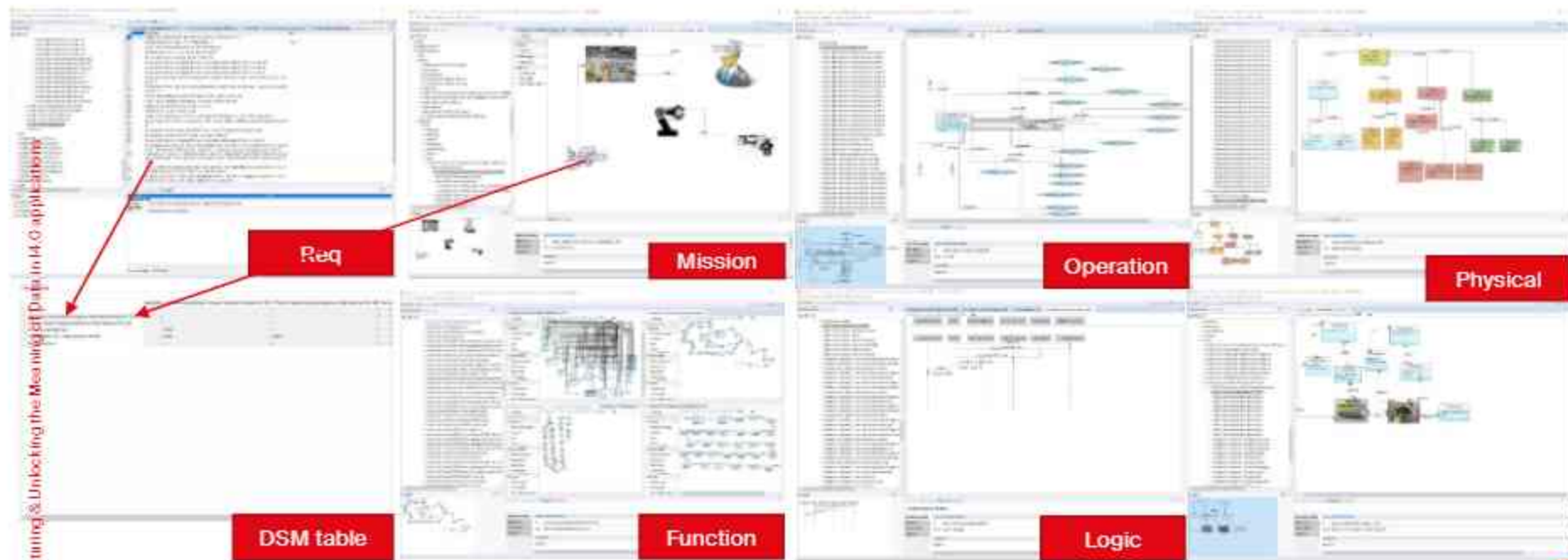
- Application ontology imported to graph database **neo4j** to create knowledge graph.
 - neo4j + Azure Cloud service
- Knowledge graph serves as the integrated knowledge hub to connect all function blocks.



automatically
generate new
solutions



- Architecture modeling with **MetaGraph 2.0**
 - Develop Architecture models based on a MOFLP approach
 - **MOFLP**: Mission, Operation, Function, Logic, Physical structure



The QU4LITY AIRBUS demonstrator



- **Knowledge Management**
 - Knowledge representation
 - Knowledge acquisition
 - Knowledge update
- **Integration of DT models**
 - Interoperability issues: cross-domain, cross-lifecycle-phases, multiple stakeholders etc.
 - Use of semantic and MBSE technologies as solutions
- **Standardization**
 - Lack of a universal standard
 - Existing options:
 - Platform Industrie 4.0 - Asset Administration Shell (AAS)
 - ETSI Industry Specification Group (ISG) - Next Generation Service Interfaces-Linked Data (NGSI-LD) APIs
 - W3C WoT working group - WoT Thing Description (WoT TD)
 - IMF
 - IDO
 - IOF ontologies
- **Implementations and Applications**
 - Align IMF & CDT in different industrial sectors
 - Verify, evaluate, validate and accelerate IMF & CDT developments

Agenda

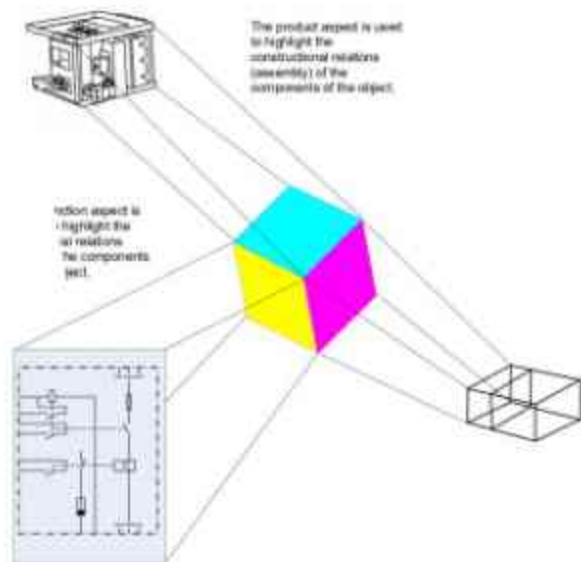
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- **IMF & CDT in new EU projects**



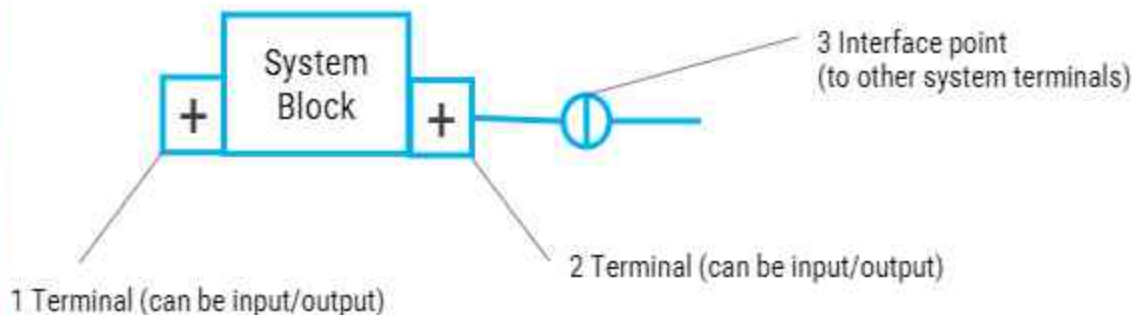
Aspects: principles of system breakdown

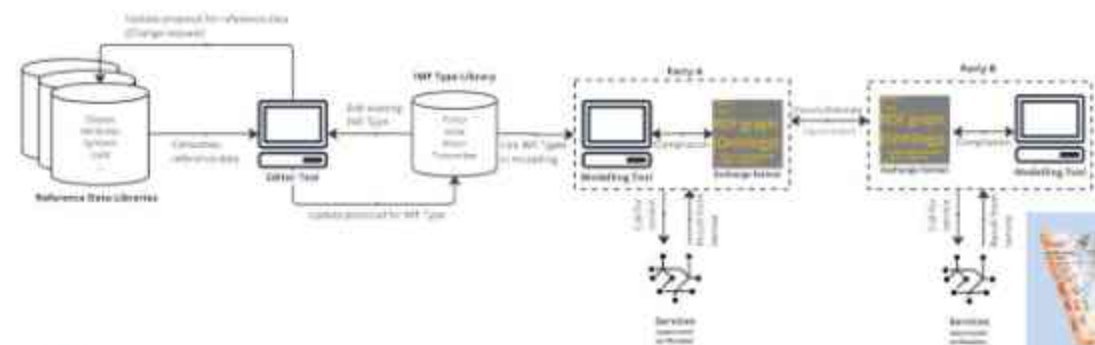
Perspective:

- **Function:** breakdown of activities of a system
- **Product:** breakdown of artifacts of a system
- **Location:** breakdown of spatial extension of a system



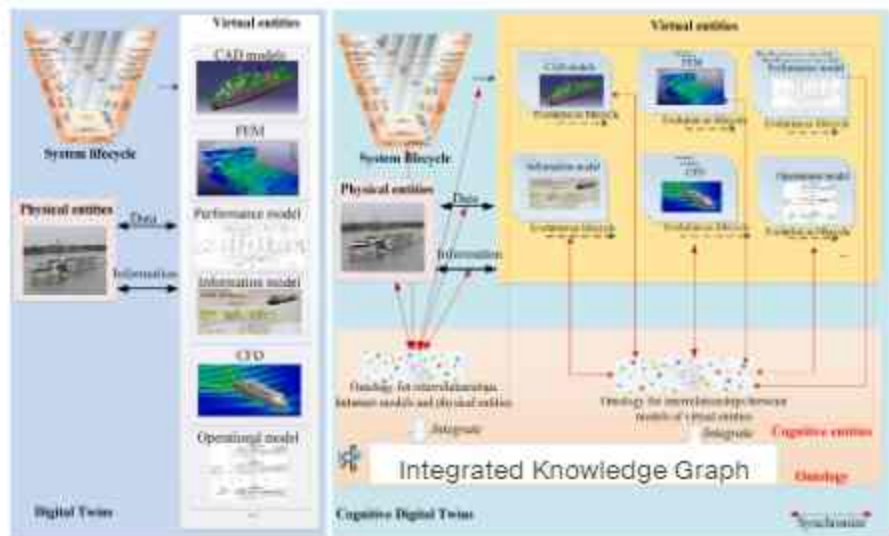
ISO/IEC 81346





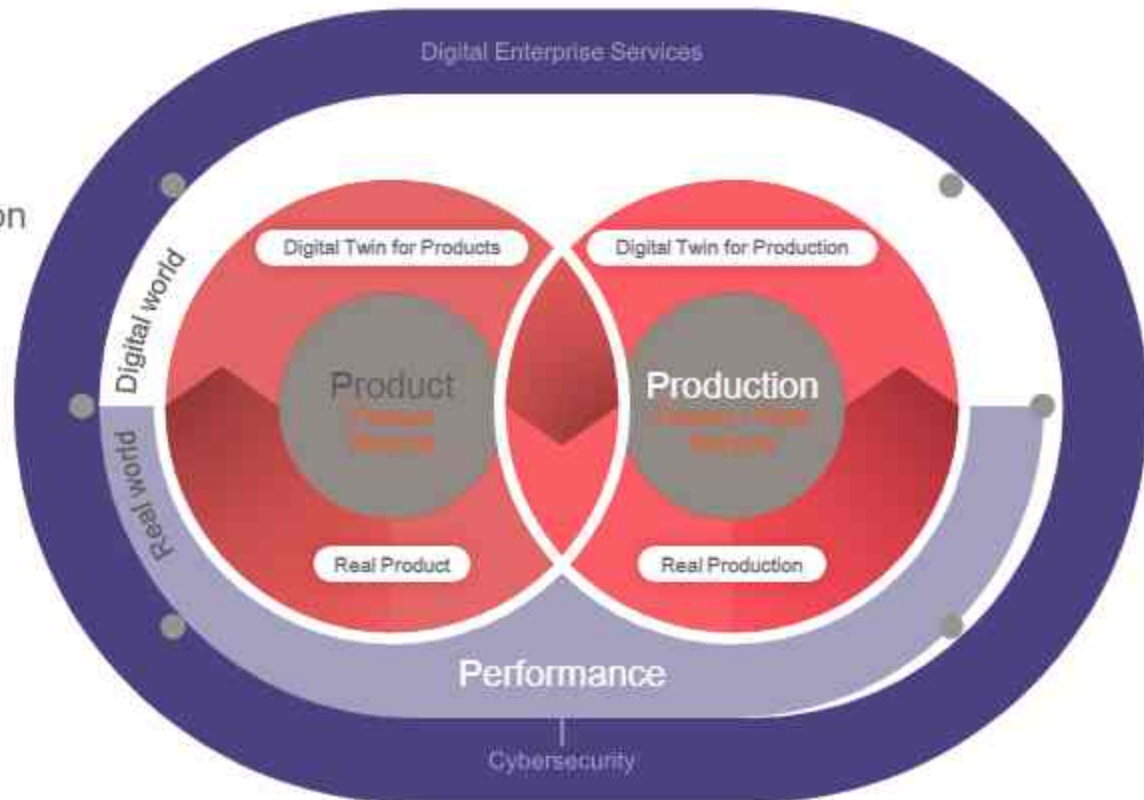
IMF Eco-System

CDT



<https://re4dy.eu/>

The comprehensive Digital Twin approach allows the realistic simulation and validation of products, machines, lines and complete plants

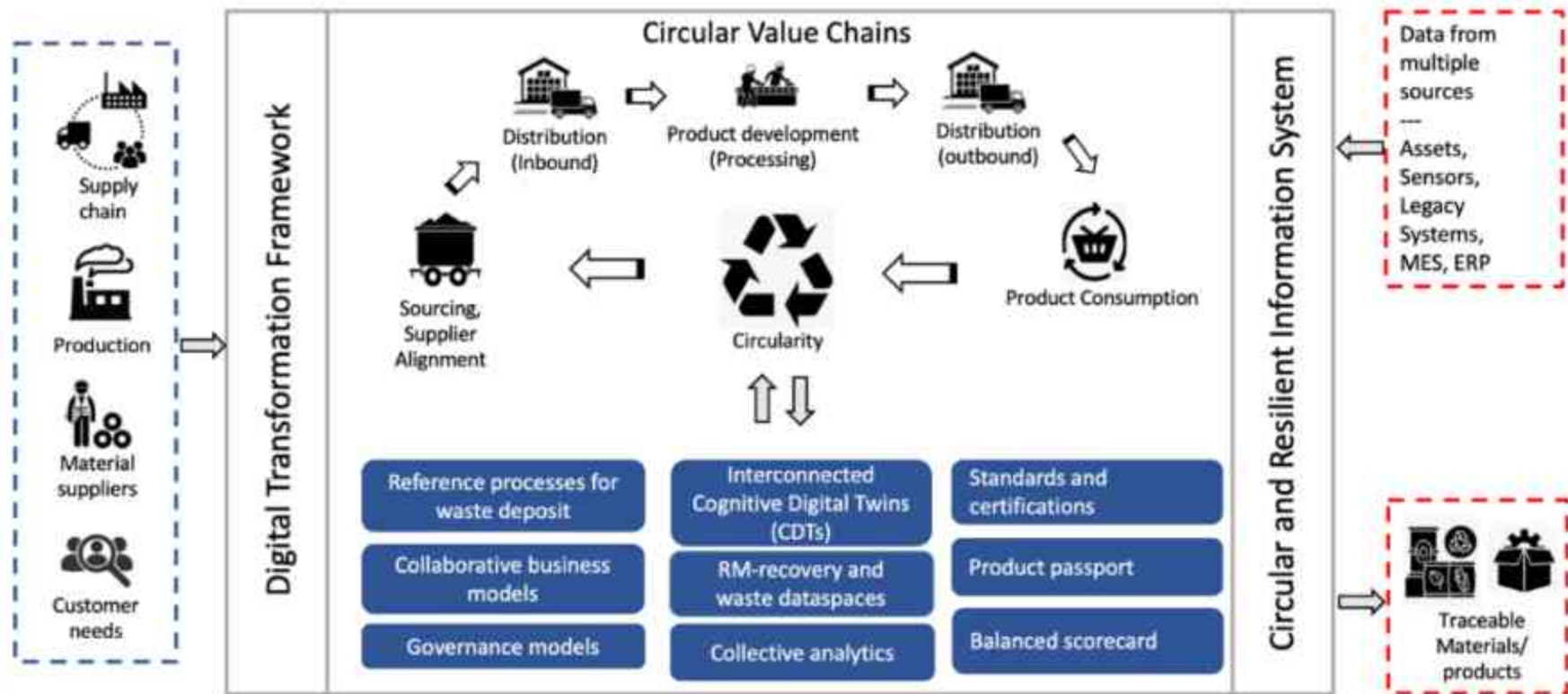


They're the foundation for flexible and efficient manufacturing

Slide produced by SIEMENS-CH

Product Passport through Twinning of Circular Value Chains

■ Capturing & Unlocking the Meaning of Data in IIo applications



European Deployment of Smart Manufacturing Asset 4.0 Multilateral Data Sharing Spaces for an Autonomous Operation of Collaborative Maintenance and Circular Services

Internal Operational Excellence

Collaborative Operations

Connected asset management



Focus on Connectivity and Data

Smart asset management



Focus on Smart Data and Device Functions

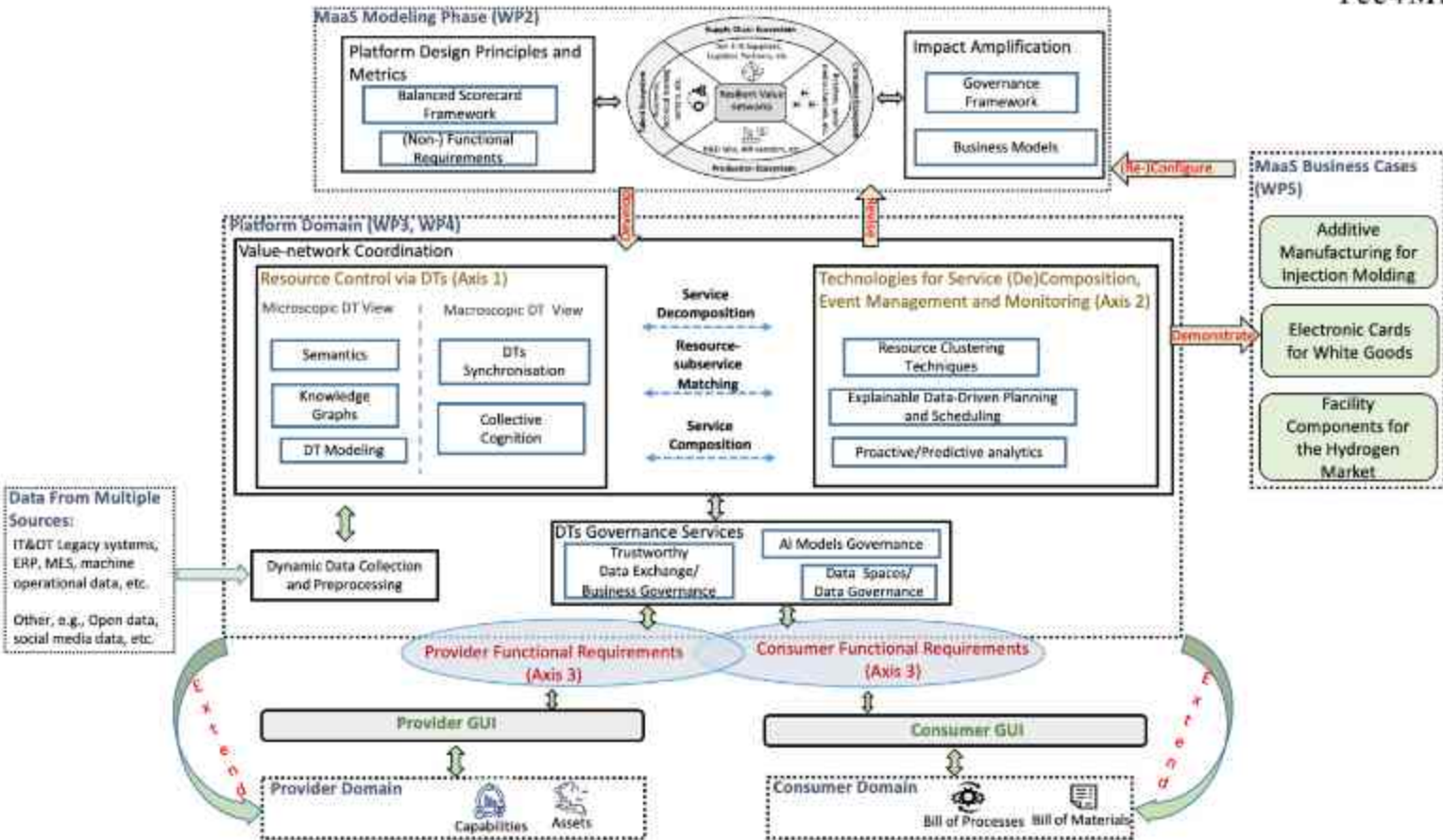
Autonomous asset management



Focus on Functional Profiles and System Synthesis

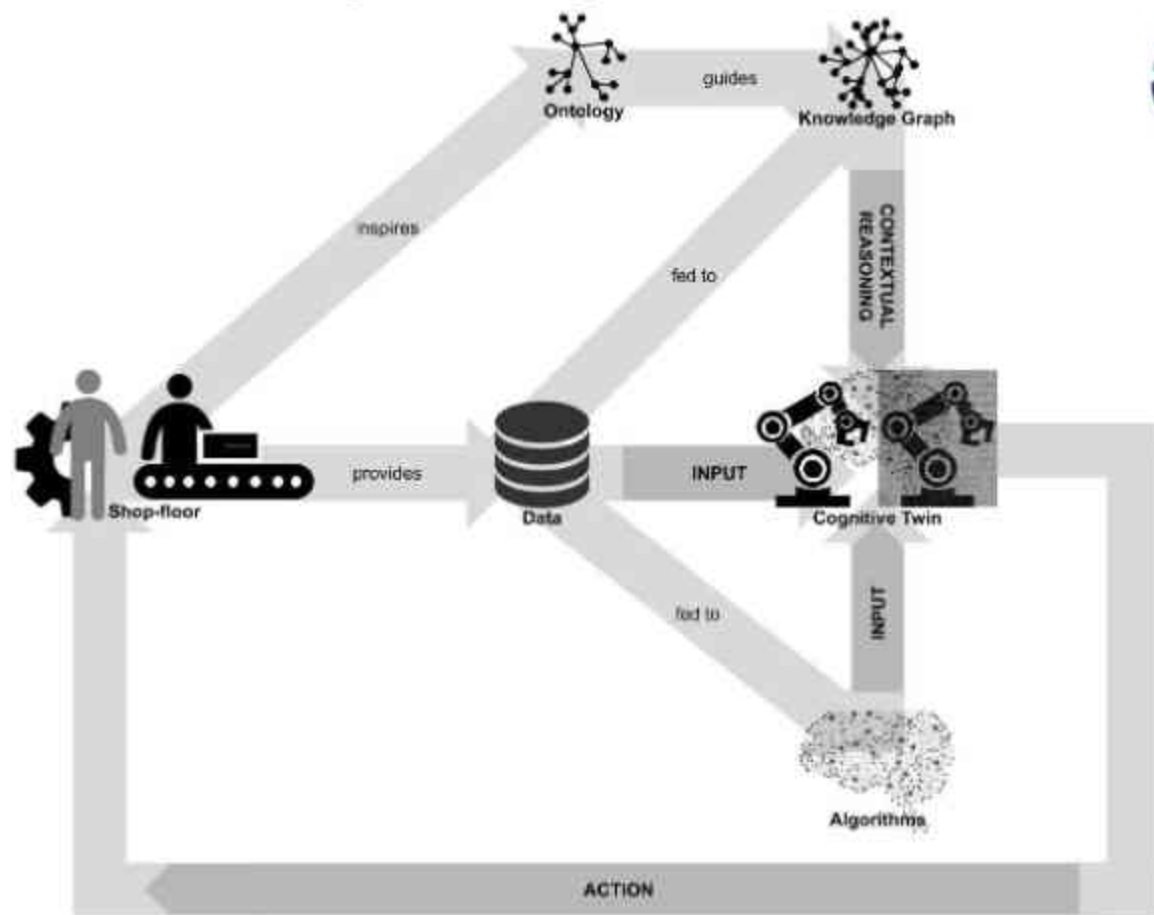
App-empowered 

Focus on Lifecycle Management and Eco-Systems





<https://www.factlog.eu/>



<https://www.tandfonline.com/doi/full/10.1080/00207543.2021.2002967>

Thank you for your attention!
Merci pour votre attention!



<https://people.epfl.ch/dimitris.kiritsis/?lang=en>



<https://www.linkedin.com/in/dimitris-kiritsis-07124/>



dimitris.kiritsis@epfl.ch

4TH INDUSTRIAL REVOLUTION FORUM

22-23 of November 2023
Thessaloniki, Greece

The project is co-funded by the European Regional Development Fund and by national funds of the countries participating in the Interreg V-A “Greece-Bulgaria 2014-2020” Cooperation Programme.

The Regional Chamber of Skilled Crafts Association

- Established with the Crafts Law
- Part of the national network, consisting of the National Chamber (based in Sofia) and 28 Regional Chambers
- Providing **training and issuing work license for number of professionals**

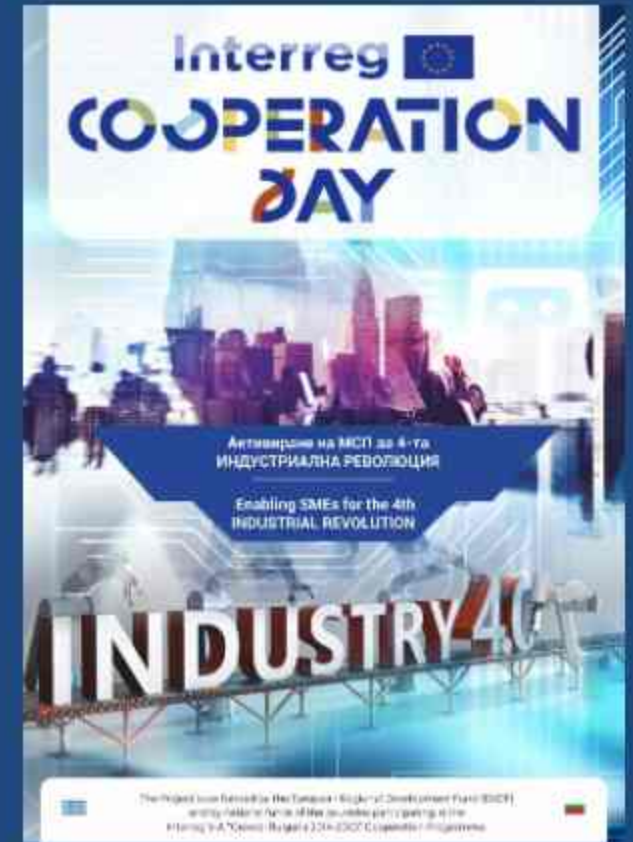
Correspondence directly with the **creative industries – main pillar in the ISSS 2021-2028 of Bulgaria!**



The project is co-funded by the European Regional Development Fund and by national funds of the countries participating in the Interreg V-A "Greece-Bulgaria 2014-2020" Cooperation Programme.

Events in Bulgaria

- Seminars
- Dissemination events



The project is co-funded by the European Regional Development Fund and by national funds of the countries participating in the Interreg V-A "Greece-Bulgaria 2014-2020" Cooperation Programme.

Events in Bulgaria

- Study visits for representatives of project partners, SMEs and business support organizations





The project is co-funded by the European Regional Development Fund and by national funds of the countries participating in the Interreg V-A "Greece-Bulgaria 2014-2020" Cooperation Programme.

Enabling SMEs for the 4th Industrial Revolution 4th Industrial Revolution



The project is co-funded by the European Regional Development Fund and by national funds of the countries participating in the Interreg V-A "Greece-Bulgaria 2014-2020" Cooperation Programme.

Q&A

Maria Malchanova | maria_bialkova@abv.bg
Rumyana Draganova | r.draganova@euroconsultants.com.gr

ПРОЕКТ „АКТИВИРАНЕ НА МСП ЗА ЧЕТВЪРТАТА ИНДУСТРИАЛНА РЕВОЛЮЦИЯ“

4TH INDUSTRIAL REVOLUTION

PВЗ Regional Crafts Association - Haskovo

The project is co-funded by the European Regional Development Fund and by national funds of the countries participating in the Interreg V-A “Greece-Bulgaria 2014-2020” Cooperation Programme.

Progress achieved

- Project Team assigned
- External management services – on going
- Logistics of all events within the project – implemented
- Promotional activities – implemented
- Office equipment – delivered
- Analysis within WP3 – implemented

Payments and FLCs

Concluded contracts: **EUR 104 507,76 – 96,3% of total budget**

Payments & verified amounts:

FLC 1: **EUR 38 510,78 or 35,5% of total budget - finalised**

FLC 1: **EUR 39 822,94 or 36,7% of total budget – on-going**

FLC 3: **planned for Mid Dec 2023 (approx. EUR 30 160,00)**

Estimation of the final budget that will be used:
EUR 106 580,76 – 98,2% of total budget



Progress: Events

- 1st Seminar (Del. 4.3.1) – hold on 02nd of March, 2023
- 2nd Seminar (Del. 4.3.1) – hold on 06th&07th of March, 2023
- 1st Conference (Del. 2.3.4) – hold on 17th of March, 2023
- 1st Study visit (Del. 4.3.2) – hold on 27th&28th of March, 2023
- 2nd Conference (Del. 2.3.4) – hold on 07th of April, 2023
- 2nd Study visit (Del. 4.3.2) – 06th&07th of June, 2023
- Partners' Meeting (Del. 1.3.2) – 06th of June, 2023
- 3rd Seminar (Del. 4.3.1) – hold on 07th&08th of Sept, 2023
- 3rd Study visit (Del. 4.3.2) – 11th-13th of October, 2023
- 4th Seminar (Del. 4.3.1) – hold on 13th of November, 2023



Progress: Communication & Dissemination activities

- Plan for development of all activities of PB3 was developed
- All information materials approved by the JTS
- All information materials developed:
 - 2 banners, leaflets, pens, calendars, notepads – delivered
 - Project Website/Platform Design, Development, Translations & Updates – implemented
 - Social media promotion of project's activities – implemented



Progress: Analysis in the framework of WP3

- Del. 3.3.1 “Weaknesses & Gaps (SWOT Analysis) – Assessment of SMEs readiness & adaptability for the changing technology landscape - Survey (Questionnaires) in the Cross-Border Area”**
 - Implemented

- Del. 3.3.2 Identifying growth opportunities for the SME ecosystem given the economic and societal change brought about by the 4th Industrial Revolution / Identifying sectors and opportunities - Proposing appropriate strategies, policies and methods:**
 - Implemented



Next steps

- Verification of all expenses (3 FLCs in total)
- Collection of all deliverables
- Support to the LP to implement all project closure procedures



Enabling SMEs for the 4th Industrial Revolution - “4th Industrial Revolution”

4th INDUSTRIAL REVOLUTION Project – Project Results

Project's Lead Beneficiary (LB):

Association of Information Technology Companies of Northern Greece (SEPVE), GREECE

Dr Eleni Feleki

SEPVE

“4th INDUSTRIAL REVOLUTION FORUM” event
Porto Palace Hotel & Conference Center

Wednesday

22nd of November 2023, Thessaloniki

The ‘4th INDUSTRIAL REVOLUTION’ project has been approved by the
Interreg VA “Greece - Bulgaria 2014-2020” Cooperation Programme

Association of Information Technology Companies of Northern Greece

The Association of Information Technology Companies of Northern Greece (SEPVE) was founded in April 1994 as a private non-for-profit organisation.



From its foundation it has been the only collective body representing the interests and concerns of the IT businesses active in Northern Greece.

SEPVE has taken on the role of promoting the interests of its members and actively intervening in many areas related to the economy, digital strategy, digital transformation, as well as social issues related to these changes.

SEPVE works in cooperation with the relevant state institutions and the Greek government to promote, strengthen and develop Greek industry and the Greek economy in general.

SEPVE also undertakes initiatives such as studies and scientific workshops to strengthen entrepreneurship, which is a key factor for growth and job creation.

Website: <http://www.sepve.org/>