ETSI **IoT Week 2022**

ONTO COMMONS | ONTOLOGY-DRIVEN DATA DOCUMENTATION FOR INDUSTRY COMMONS

EU‑IoT

Ontological Interoperability and Standardization
Recommendations and Application of Ontologies in Cross-Domain

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Is Ontology still a thing?

➢ Ontology is not a data model but a model for relating data to the "Reality".

➢ Ontology helps us in having a shared view of the "Reality", based on:
   ➢ Consensus
   ➢ Common sense
   ➢ Metaphysics

"Allegory of cave" – Plato

➢ Ontology may help in making data interoperable, but the ontologies are not themselves interoperable.

➢ The scope and purpose of Semantic web (or data) and Ontology overlaps but still different.

➢ Ontology often perceived as "difficult", "academic", "for experts only".
   ➢ Different contexts, No unified methodology, Lack of tools

From Data to Insight: The Generation of Value for Digitized Industry (Data Value Chain)

Generation – recording and capturing data **=> IOT & Cyber Physical Systems**

Collection – collecting data, validating and storing it **=> Big Data**

Analytics – processing the data to generate new insights and knowledge **=> Semantics & Artificial Intelligence**

Exchange – putting the outputs to use (share internally or externally). **=> Interoperability**
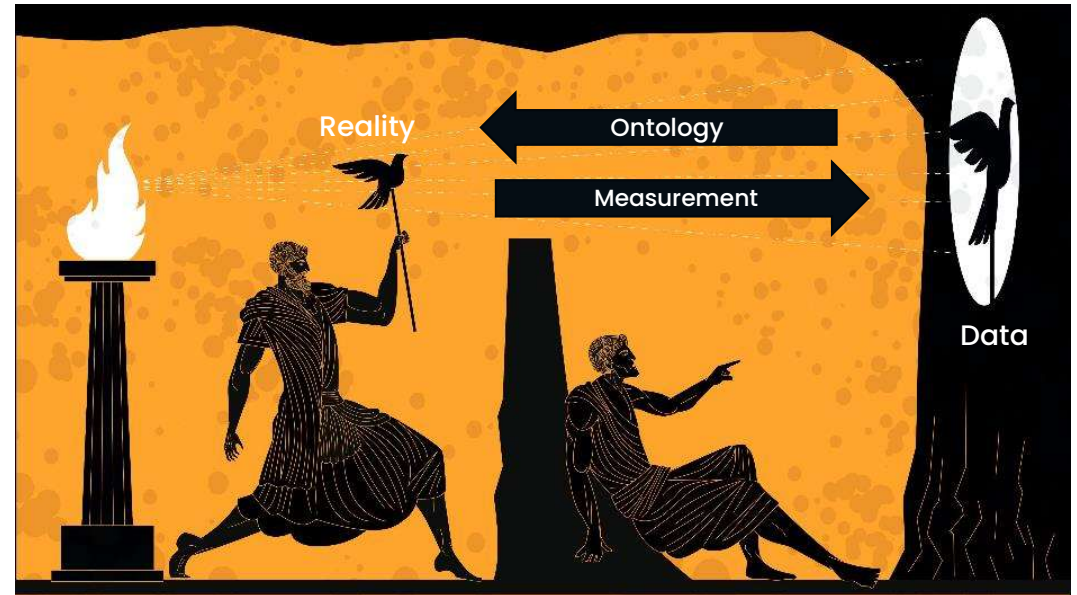
Ontology as the *formal science of what is?* *can play* a key role in all those steps

OntoCommons – a snapshot

➢ **Consortium**
  ➢ 19 Partners from 10 EU countries
  ➢ 15 RTDs and 4 companies

➢ **Timeline:** Started › November 1st, 2020 (36 months)

➢ **Overarching Goals**
  ➢ Overcoming interoperability bottlenecks & facilitating data sharing and valorization.

➢ **Coordination and Support Action –CSA**
  ➢ Bringing together and coordinating activities of the most relevant EU and international stakeholders.

➢ **Development of an Ontology Commons EcoSystem –OCES**
  ➢ as a foundation for data documentation.

The most tangible outcome – OntoCommons EcoSystem

OCES is a combination of fully harmonized ontology artifacts (from top to domain) and associated tools and methodologies for building upon existing and creating future ontologies. The complementary components of OCES therefore provide a complete solution for data documentation in the NMBP domains.
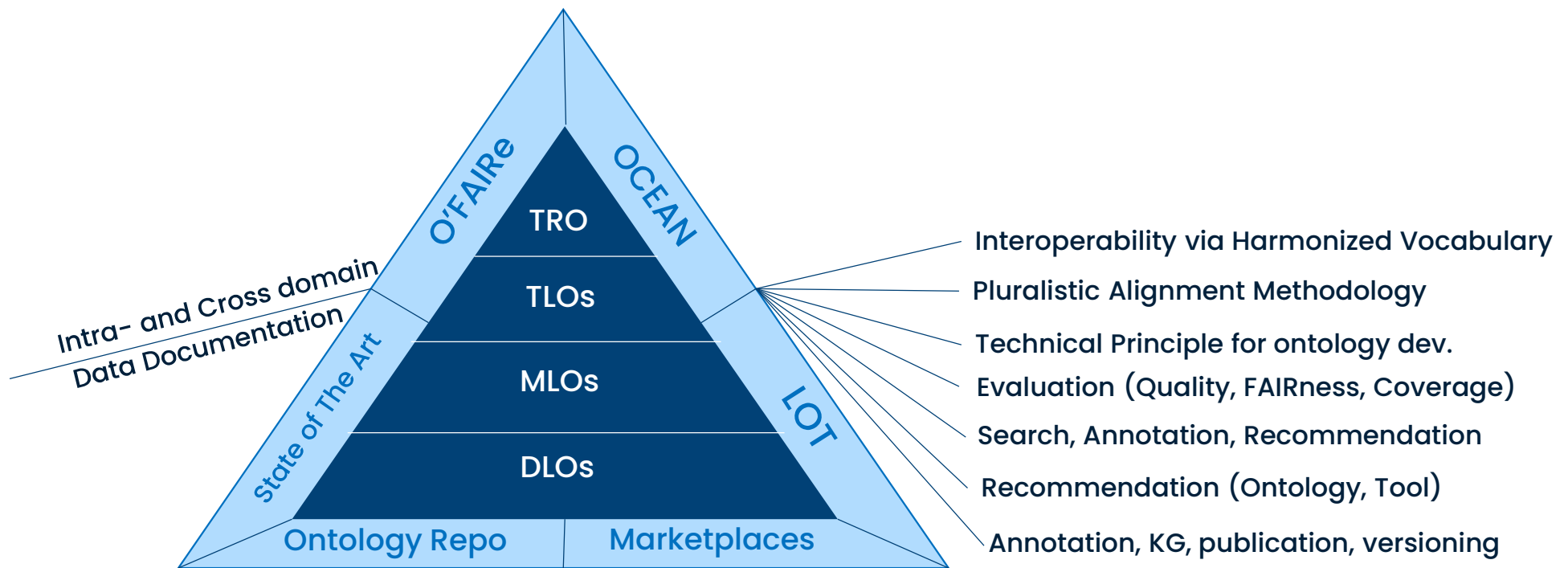
How OntoCommons endorses EU-IoT Directions

➢ THE IMPORTANCE OF OPENNESS
  ➢ Interoperable meta-models for assuring F.A.I.R-ness of Open Source, Open Data, Open Standards, Open Hardware. (catalogue, taxonomy, registry)
  ➢ Standardized data documentation for both intra- and cross-domain technology and know-how transfer.

➢ BLEND AND EVOLVE THE RELEVANT EUROPEAN COMMUNITIES
  ➢ OntoCommons, being a CSA project, is actively engaging SDOs, European and International initiatives and project to create synergy. (Next Slide)
  ➢ Create roadmap from stakeholder's input (Gap analysis)

➢ REFINE AND GROUND THE VISION FOR A COMPUTING CONTINUUM
  ➢ Repository for sharing semantically annotated, FAIR results of academic and industrial research results and best practices produced across the overall NGIoT ecosystem.
  ➢ Sustainability of IoT collaboration based on standardized knowledge exchange.

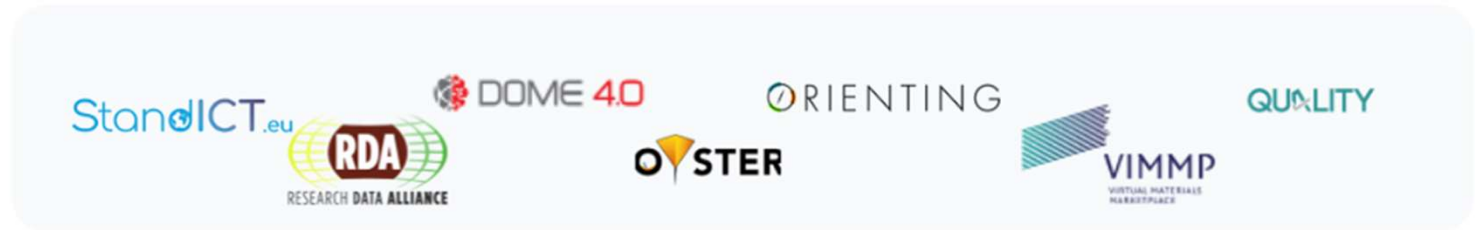# Initial mapping of all EU and International standardization initiatives

SDOs

IEEE · ETSI · CEN · CENELEC · ISO · NIST
OMG OBJECT MANAGEMENT GROUP · CO·LaN · ECLASS · incits · oneM2M · OAGi Open Applications Group

Initiatives & Associations

IOF · EMMC · IAOA · tekom iiRDS · BDV BIG DATA VALUE ASSOCIATION · CFPC
OPTiMaDe · AIOTI Alliance for Internet of Things Innovation · ncor national center for ontological research · OISPG · OPC FOUNDATION · OPEN INDUSTRY 4.0 ALLIANCE
INTERNATIONAL DATA SPACES ASSOCIATION · W3C WORLD WIDE WEB consortium

Projects

StandICT.eu · DOME 4.0 · ORIENTING · QUALITY
RDA RESEARCH DATA ALLIANCE · OYSTER · VIMMP VIRTUAL MATERIALS MARKETPLACE

ETSI · EU-IoT · ONTO COMMONS ONTOLOGY-DRIVEN DATA DOCUMENTATION FOR INDUSTRY COMMONS

AIOTI and OntoCommons

➤ Ontology landscape survey (AIOTI Report – 2021: http://tinyurl.com/y86s82ac)
  ➤ OntoCommons landscape survey (D3.2 – 2022 https://zenodo.org/record/6504553)
    ➤ 150 total ontologies, 90 machine readable in materials and manufacturing
    ➤ Performed classification by topics, TLO usage, topology
    ➤ FAIRness, coverage, overlap, semantic gaps, usage, maturity analysis
    ➤ Sources stored in IndustryPortal and OntoCommons Registry.
  ➤ EUOS ontology survey (Stand-ICT) – ongoing, over 130 ontologies collected

➤ Gap Analysis - Semantic Interoperability in Practice (https://tinyurl.com/799uy5kn)
  ➤ OntoCommons Roadmap (to be published)

| Industrial Needs	Gaps in Domain Ontology	Recommended Actions
• Data integration and sharing. • Standardisation • **Various domain Perspectives** • **Interface domain ontologies with TLOs** • Link domain experts to Ontologists	▪ Models granularity ▪ Lack of Generic and Application-specific Ontologies ▪ Lack of standardised methodology and tools ▪ Ontology as a conceptualization of reality vs information model ▪ Ontology Sustainability ▪ Lack of Standardised Method for Domain Ontology Evaluation	• Standardization of the ontology engineering steps • **TLO-MLO Alignment** • **Balance of Theory and Practice** • **FAIRness** • **Follow Domain related standards** • **Classify domains** • **Bridging the gap between domain experts and ontologists**

OCES solution – The Workflow
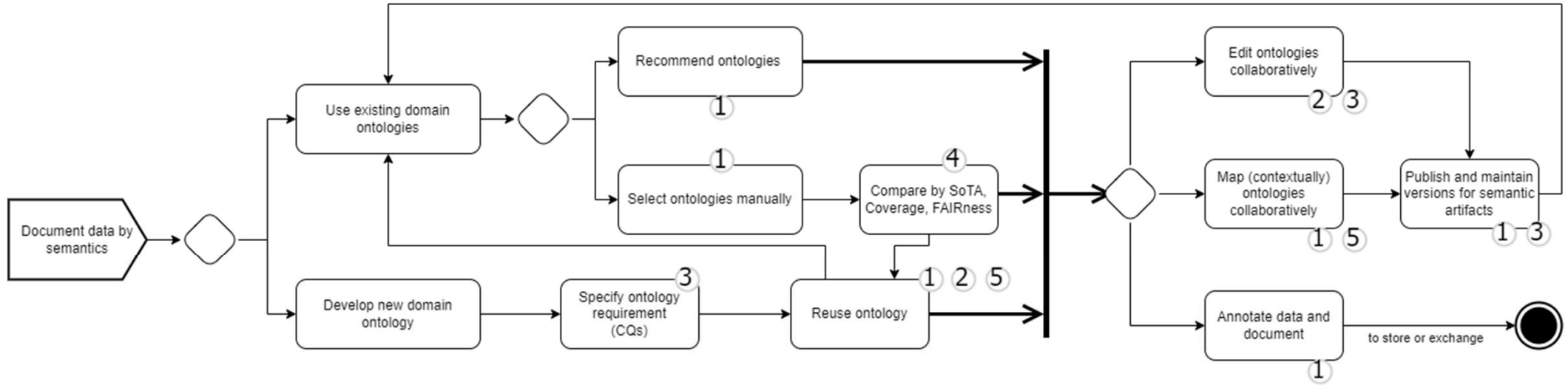
SAREF and OntoCommons
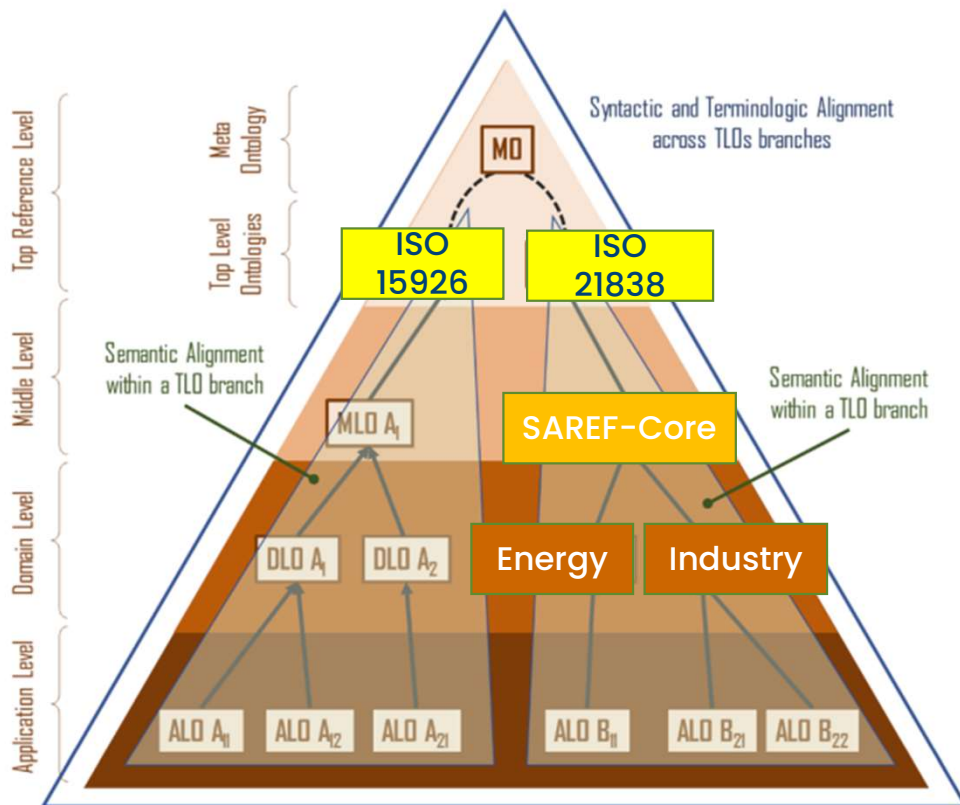
- Technical specification of ETSI TS 103 264 may be compared to OntoCommons Technical Principle, which has
  - Ontology alignment methodology (pluralistic)
  - Adopts LOT with some adjustments.
  - Detailed guide on IRI structure, expressivity, serialization, dependency resolution, FAIR metadata, CI/CD (devops)

- SAREF portal (https://saref.etsi.org/) may be compared to IndustryPortal (http://industryportal.space)
  - Ontology source and metadata
  - Ontology versioning
  - Ontology explorer, mapping, recommender
  - Ontology editing (coming up...)

Still to achieve: Endorsement of standardization bodies,
Post-project sustenance and evolution plan.

EU-IoT and OntoCommons Workshop (07 July 2022)

➢ 40 active participants: 27% SME, 20% Industry, 26% Research, 2% Policy maker.

➢ 26% interested in Ontology. Top domains: Manufacturing, Supply Chain, Maintenance. Top Ontologies: SAREF, EPSIS, ROMAIN, SOSA/SSN, IOF...

➢ Common challenges for ICE, M&M, Energy, Health, Agriculture:
   ➢ interoperability and data sharing
   ➢ lack of documentation (use-cases, best practices)
   ➢ Fragmentation
   ➢ security, privacy, accountability
   ➢ close communities and lack of communication

EU-IoT and OntoCommons (Recommendations)

- ➢ Separation of concern needs to be established with different level of interoperability to free ontologies from dependency on protocols
  - ➢ With an adequate design, people can create specific semantic models and encode it with any existing protocol.

- ➢ Cross-domain interoperability needs an adequate interfacing approach.
- ➢ Alternatively, "Esperanto of data science" needs definition of a flexible, common language.
  - ➢ OntoCommons provides "Bridge Concept" as interfaces, and TRO mediated harmonized set of TLO as the higher-level vocabulary.

- ➢ Open-source ontology and tooling (but avoid fragmentation and vendor-lock)

- ➢ Future plan: A jointly edited white-paper on challenges: fragmentation, cross-domain interoperability, lack of open tooling and application examples.

Thanks

Questions?