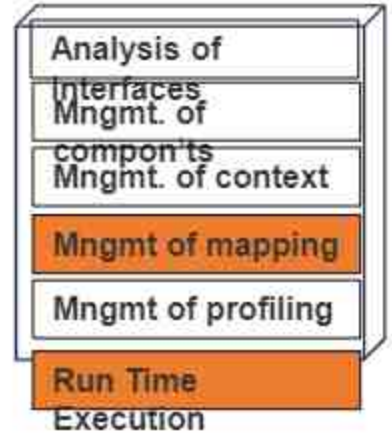
Integration demo – the background process

1. Find the PL profile for the source BC

2. PL profile -> standard component mapping (implicit)

3. Find the PL profile for the target BC

4. Find the mapping specs



5. Apply mapping specs to source-conformant data


```
{
    "PriceList": {
        "ItemLine": [
            {
                "productNumber": "123",
                "name": "Ameda Adapter Cap",
                "description": "Ameda Adapter Cap product description",
                "retailPricePerUnit":"1.09"
            },
            {
                "productNumber": "223",
                "name": "Ameda Flanges",
                "description": "Ameda Flanges product description",
                "retailPricePerUnit":"9.81"
            }
        ]
    }
}
```

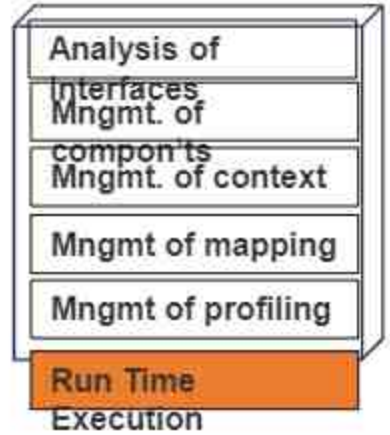
Integration demo – the background process

1. Find the PL profile for the source BC

2. PL profile -> standard component mapping (implicit)

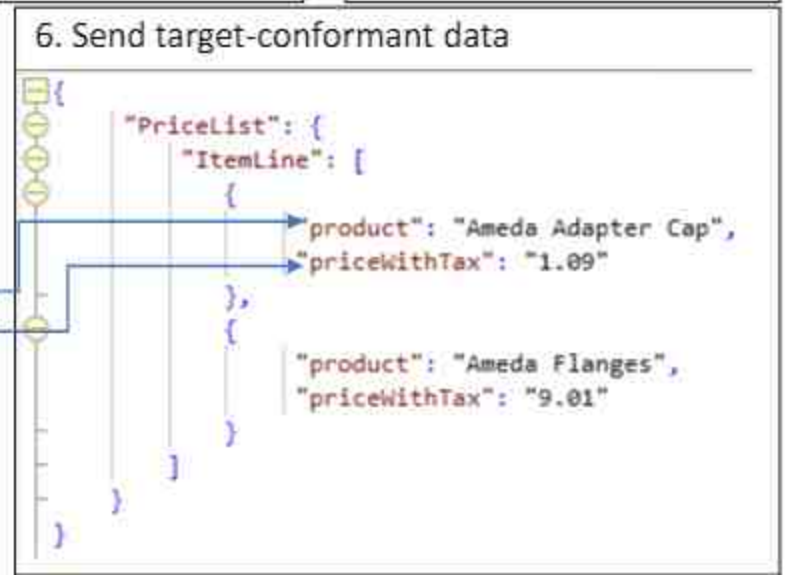
3. Find the PL profile for the target BC

4. Find the mapping specs

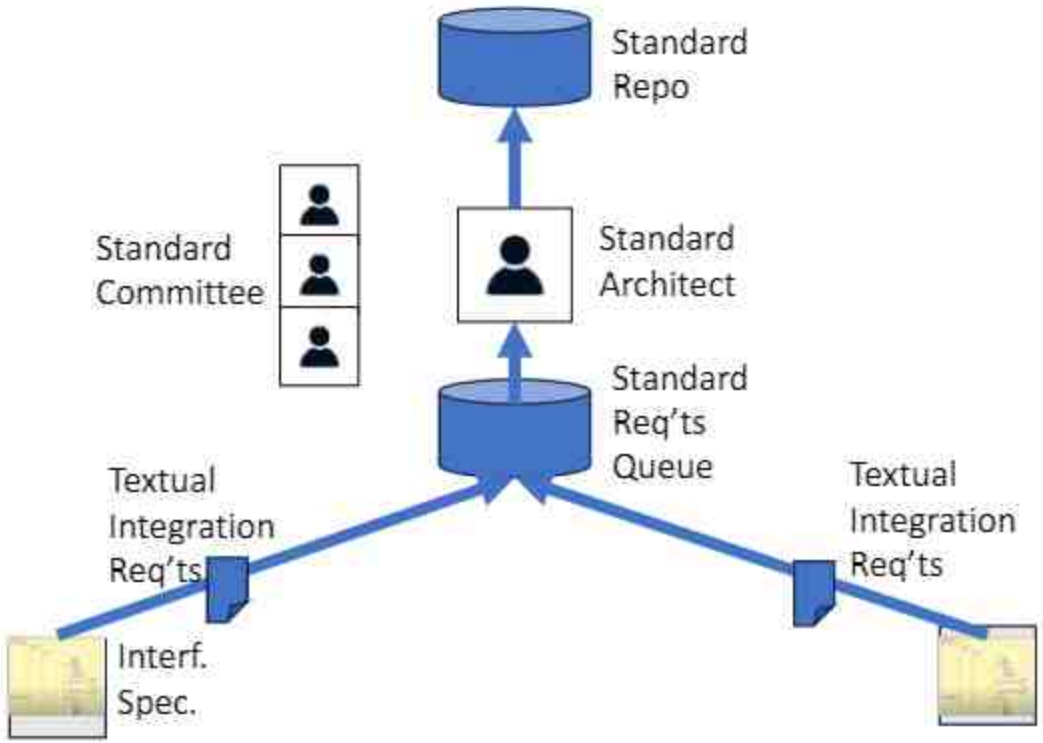


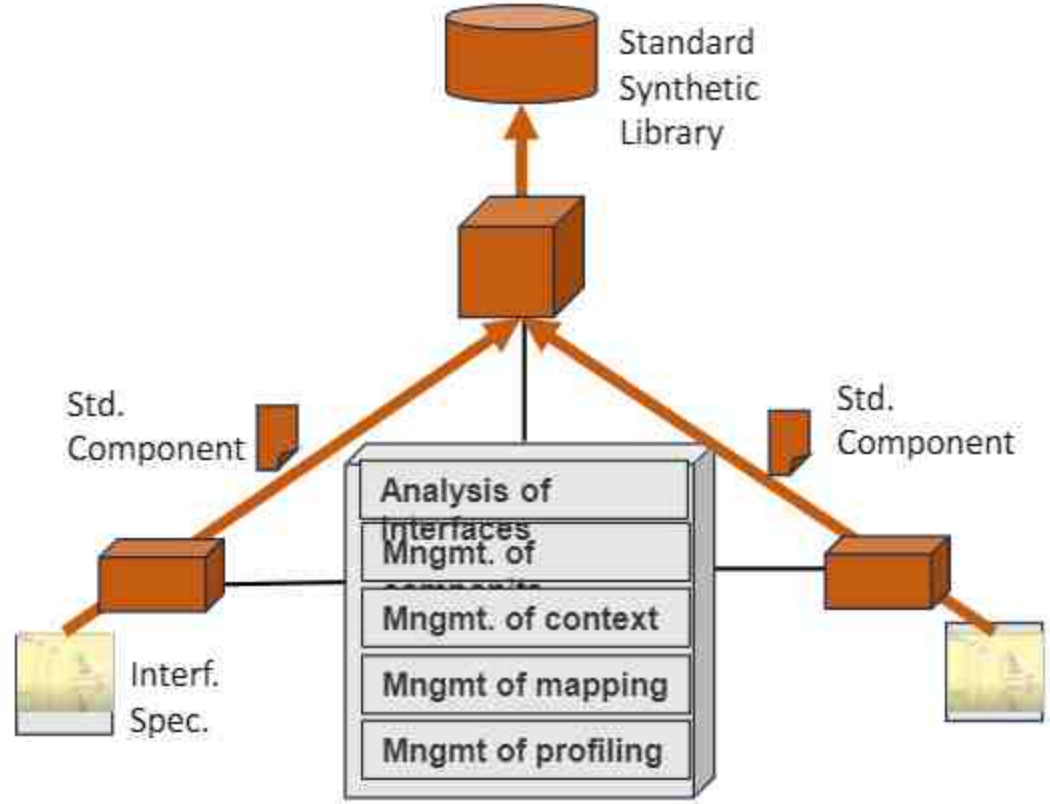
5. Apply mapping specs to source-conformant data

6. Send target-conformant data

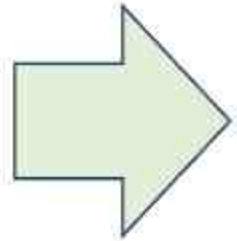


A New Idea: Decentralized and Federated Standardization



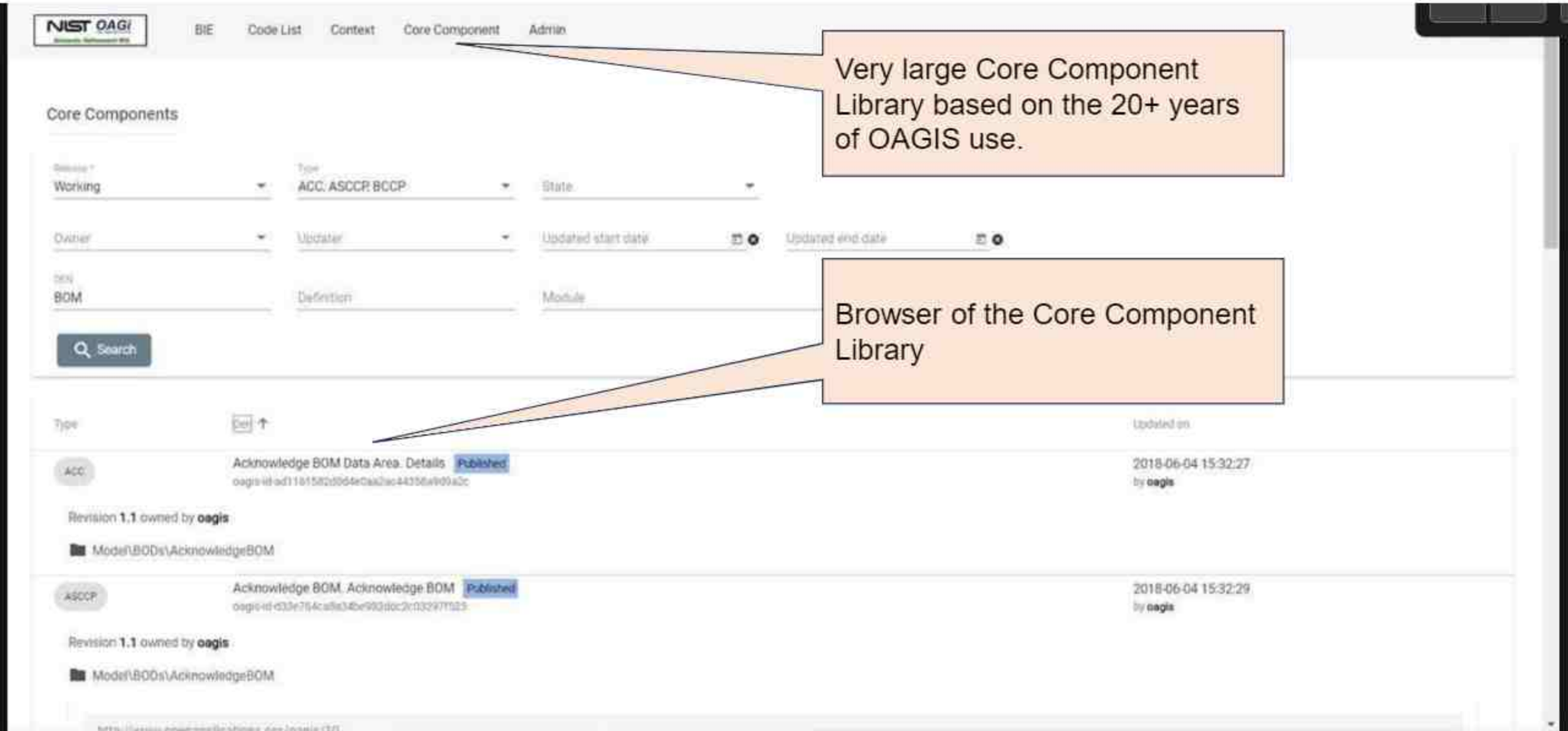


- Non-federated
- Centralized
- Approximate Requirements
- Imprecise Specification
- Very Limited Standard Reuse
- Non-Standard Mappings
- Manual End-to-End Integration



- Federated
- Decentralized
- Exact Requirements
- Precise Specification
- Extensive Standard Reuse
- Standard Mappings
- Automated End-to-End Integration

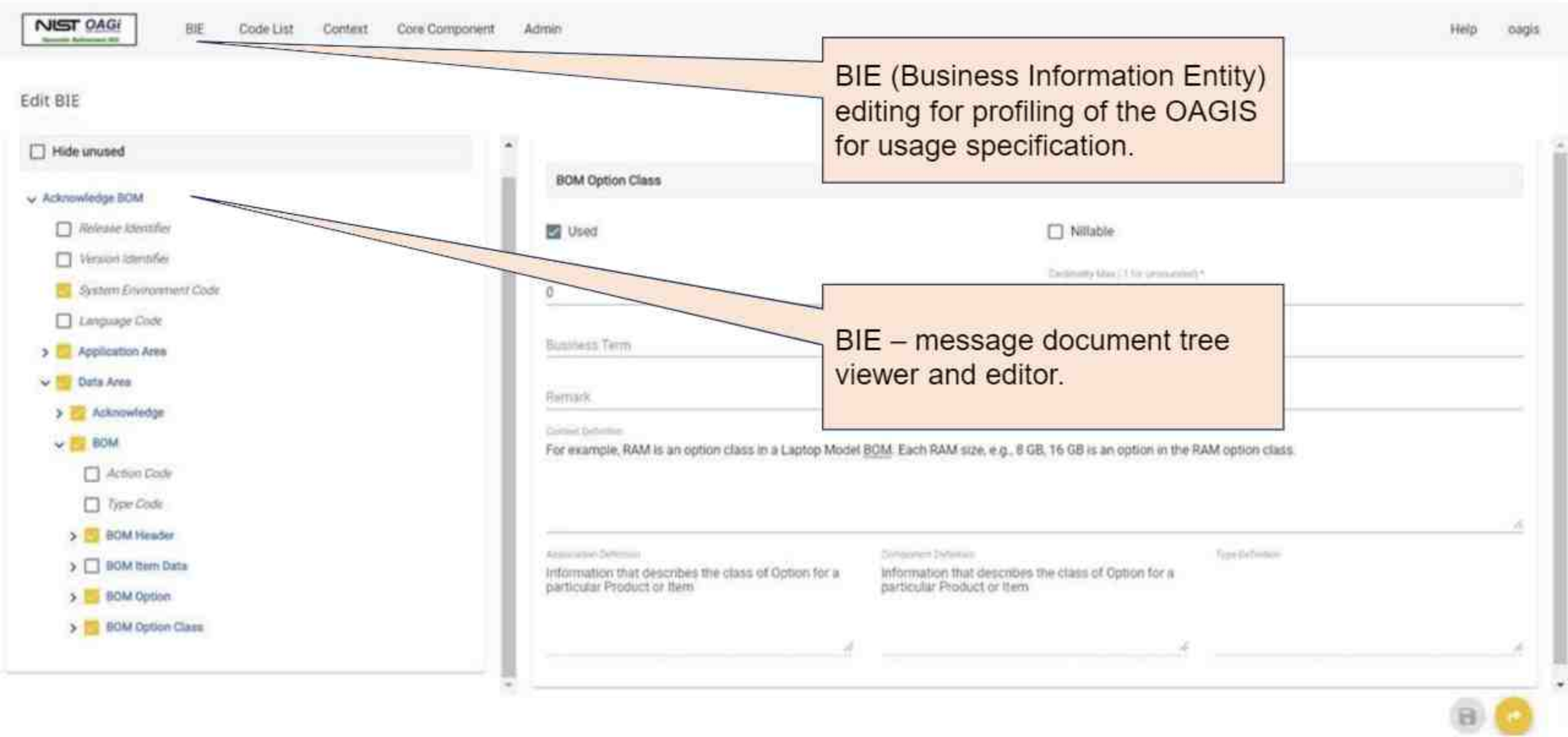
Current State of Practice: Score in Industry



Very large Core Component Library based on the 20+ years of OAGIS use.

Browser of the Core Component Library

Current State of Practice: Score in Industry



Moving the State of Art: Federated Decentralized Integration Tool

- Prototype of the Federated Decentralized Integration Tool
  - Developed at the Systems Integrations Division (SID), NIST
  - Soon to be made an Open Source project
- In collaboration with the Open Applications Group Inc. (OAGi)
  - Focus on A2A, B2B integrations, Small and Medium Enterprises
  - Large users and members: Land O' Lakes, Lockheed Martin, ADP, IBM …
  - If you are interested, contact OAGi or me for information: https://oagi.org/
- Interested to work with interested collaborators with particular focus in integration, standardization, AI and related topics
  - Interested in participating in US and EU projects
- My continued work in R&D
  - 20+ years of work with NIST, Systems Integration, Standardization Organizations
  - Currently external expert advisor, working with OAGi

NIST
Engineering Laboratory
SYSTEMS INTEGRATION DIVISION

OAGi
LAND O'LAKES INC.
LOCKHEED MARTIN
ADP
ORACLE
IBM

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10. Jelisic, E., Ivezic, N., Kulvatunyou, B., Charoenwut, P., & Nikolov, A. (2023). *An investigation into an approach for automated supply chain onboarding*.
11. Jelisic, E., Drobnjakovic, M., Kulvatunyou, B., Ivezic, N., & Oh, H. (2023). *Business Context-based Approach for Managing the Digitalization of Biopharmaceutical Supply Chain Operational Requirements*

Concluding Remarks

Concluding Remarks

- I4.0 Systems Integration Challenges are significant
- The New Integration Approach shows promises
- A prototype of the approach has been demonstrated at TRL 4
- A new way of standardization to complement the traditional
- Future work
  - Scaling the approach for TRL 5 and further
  - Business Context knowledge base management
  - Component identification mechanisms (AI-based)
  - Mapping language standardization
  - Business Context-based evaluation measures

Preserving Human Values in AI Driven Digital Transformation and Industry4.0

The Balancing Act!

Dr. Usman Wajid

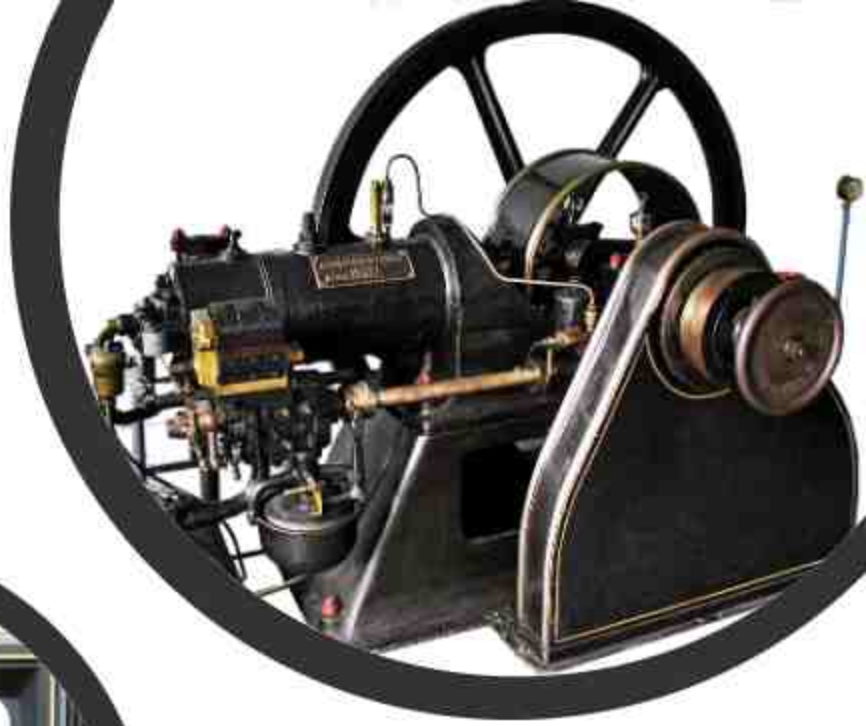
Managing Director

Information Catalyst

usman.wajid@informationcatalyst.com

- The Promise and Challenges
- Ethical Considerations in AI
- Social Impact
- Security, Privacy and Trust
- Cultural Impact
- Multi-Faceted Approach
- Education and Reskilling
- Societal Engagement
- Conclusion

The Promise and Challenges



Throughout history, we've invented technologies that extend our abilities.

Industry4.0 and AI presents a profoundly positive-sum proposition for businesses ..

The Promise and Challenges

Promising benefits are seen in terms of increased...

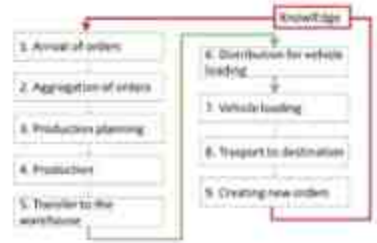
- Productivity
- Sustainability
- Efficiency
- Economy
- Safety
- ...
- ..
- .

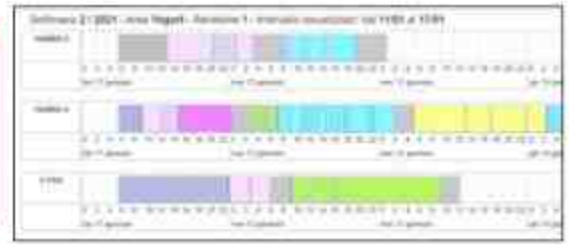
Towards AI powered manufacturing services, processes, and products in an edge-to-cloud-knowlEdge continuum for humans

knowlEdge

Dairy Food Production

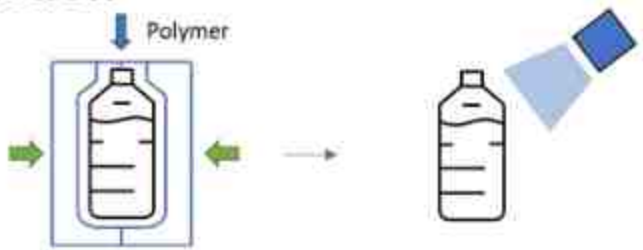






- Optimizing **production scheduling**, based on incoming order data
- Enhanced **process efficiency** based on dynamic scheduling

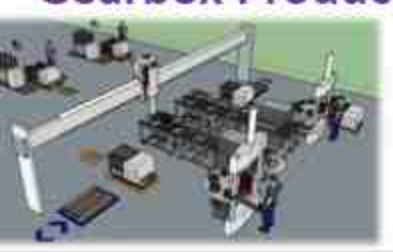
Automotive Production



- **Production Optimisation** for small batches based on adjustable information sources
- **Zero defect manufacturing** based on decision support of AI learning models

Gearbox Production




- **AI video assembly supervisor** based on historic data of assembly processes

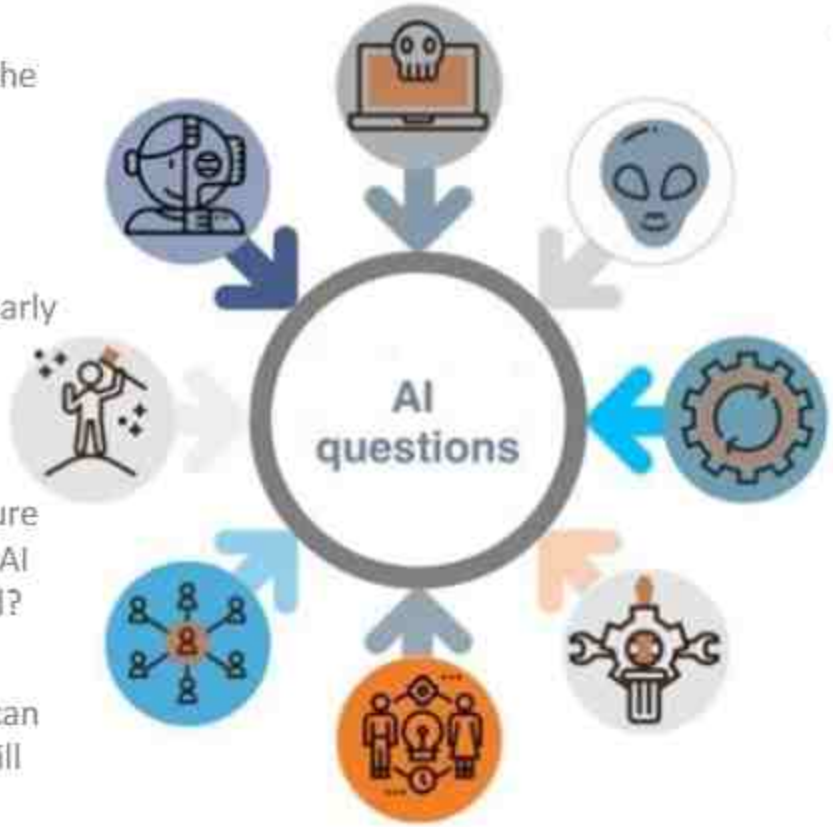
The Promise and Challenges

Robot Rights
At what points the machines are liable?

Human Role
Are the roles clearly defined and accepted?

Inequality
How do we ensure that benefits of AI are shared by all?

Employment
Everything that can be automated will be – what next?



Trust
How do we avoid critical errors ?

Bias
How do we prevent Bias?

Security
How we prevent malicious repurposing?

Control
How do we control self-learning systems?

Ethical Considerations

International Dimension

ASILOMAR AI PRINCIPLES

RESEARCH

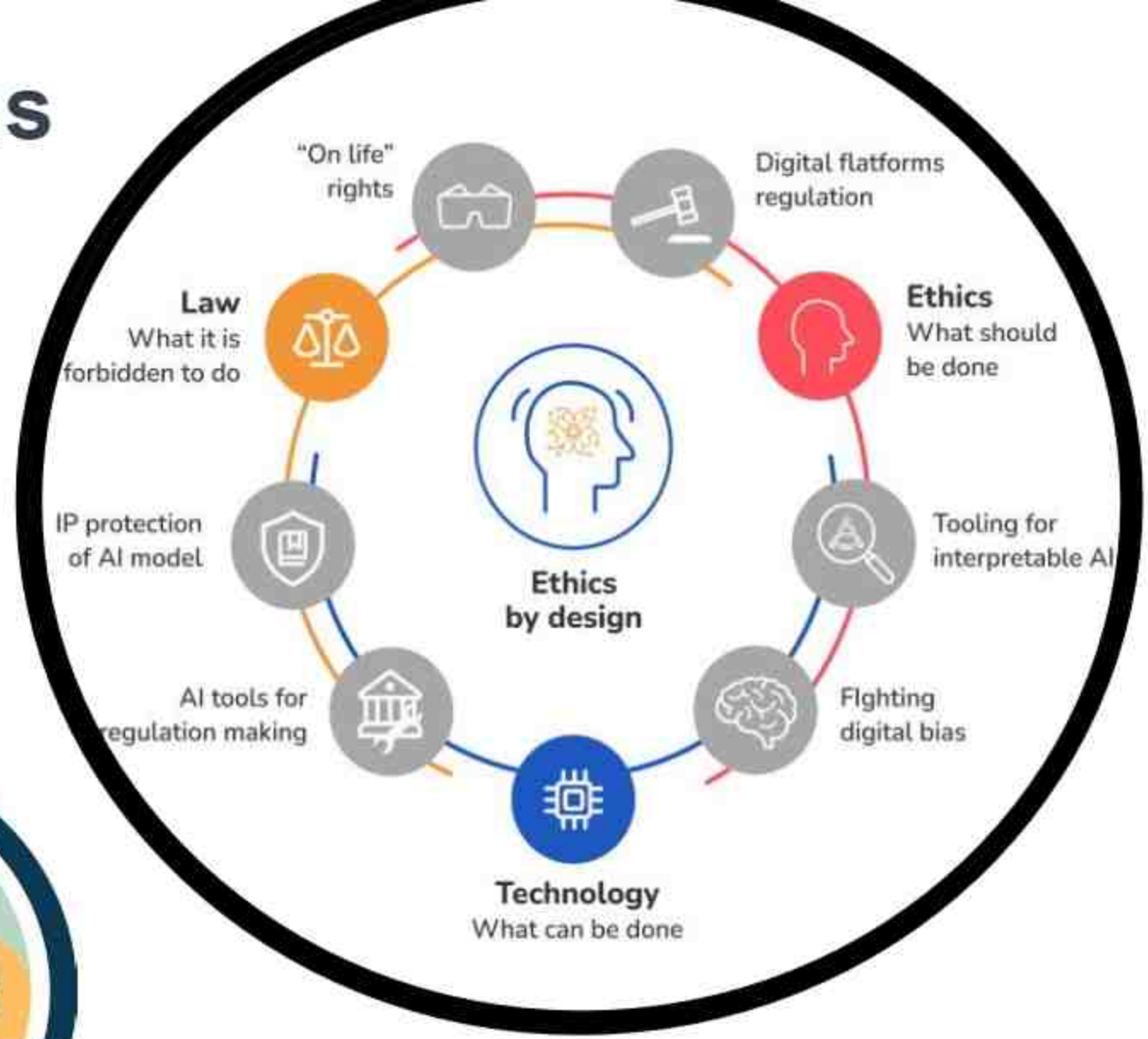
1. Research Goal
2. Research Funding
3. Sciense-Policy Link
4. Research Culture
5. Research Avoidance

RESEARCH

6. Safety
7. Failure Transparency
8. Judicial Transparency
9. Responsibility
10. Value Alignment
11. Human Values
12. Personal Privacy
13. Liberty and Privacy
14. Shared Benefit
15. Shared Prosperity
16. Human Control
17. Non-subversion
18. AI Arms Race

LONGER TERM ISSUES

19. Capability Caution
20. Importance
21. Risks
22. Recursive Self-Improvement
23. Common Good



Ethical Considerations

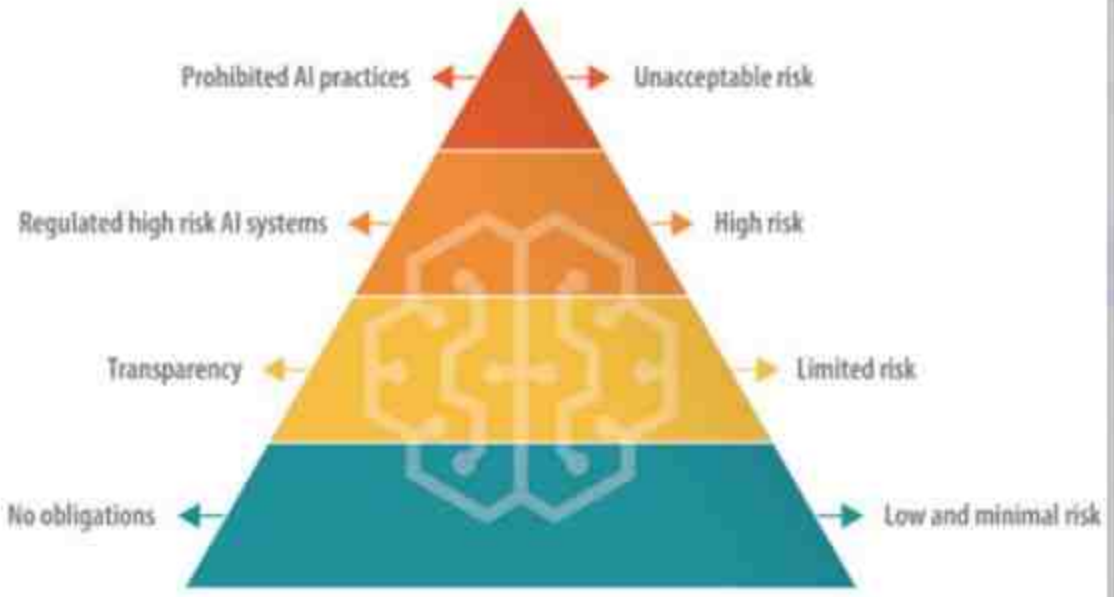
European Dimension

EU High-Level Expert Group on AI (2020)

Recommendations and checklist on ethical AI

EU AI Act (2023/2024)

The World's First Comprehensive Regulation on AI



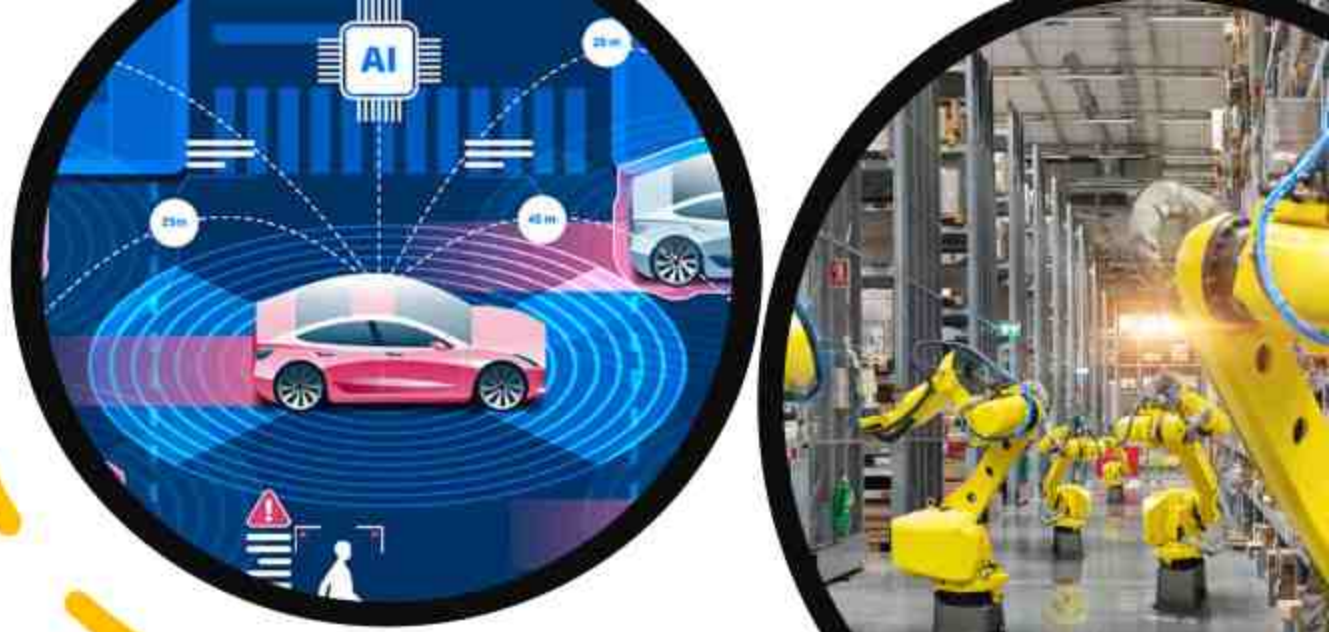
Risk-based Approach to AI Trustworthiness and Regulation

Societal Impact

… what is on stake here?

- Jobs
- Autonomy
- Security and safety
- Human intelligence

- Social interactions are the foundations of our society … is our dependence on digital technology washing that glue away?



Security, Privacy and Trust

advancements?

AI-BASED ASSESSMENT OF FAIRNESS

Fairness in AI includes concerns for equality and equity by addressing issues such as bias and discrimination. THEMIS acknowledges perceptions of fairness differ among AI users and may shift depending on usage of the AI system.

AI-BASED ASSESSMENT OF TECH ACCURACY & HUMAN

Assessment of technical accuracy and robustness i the 'AI-based Assessment of Technical Accuracy & Robustness' module will be implemented on the principles of an AI-driven anomaly detection system

THEMIS 5.0

AI-BASED EVALUATION OF TRUSTWORTHINESS

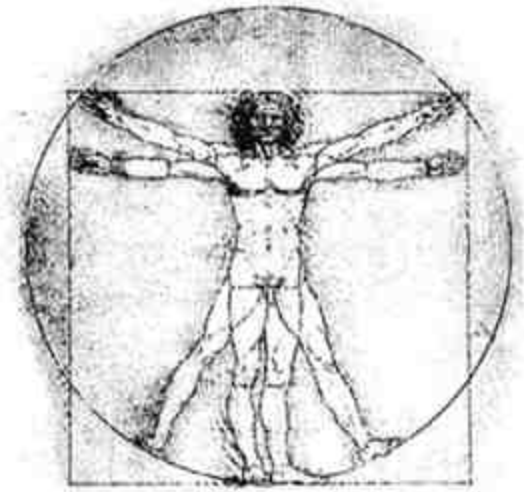
The THEMIS "AI-based Anonymous Assessment of Human" module will incorporate the human perspective to the evaluation of trustworthiness by assessing both human behavioural and moral value pects.

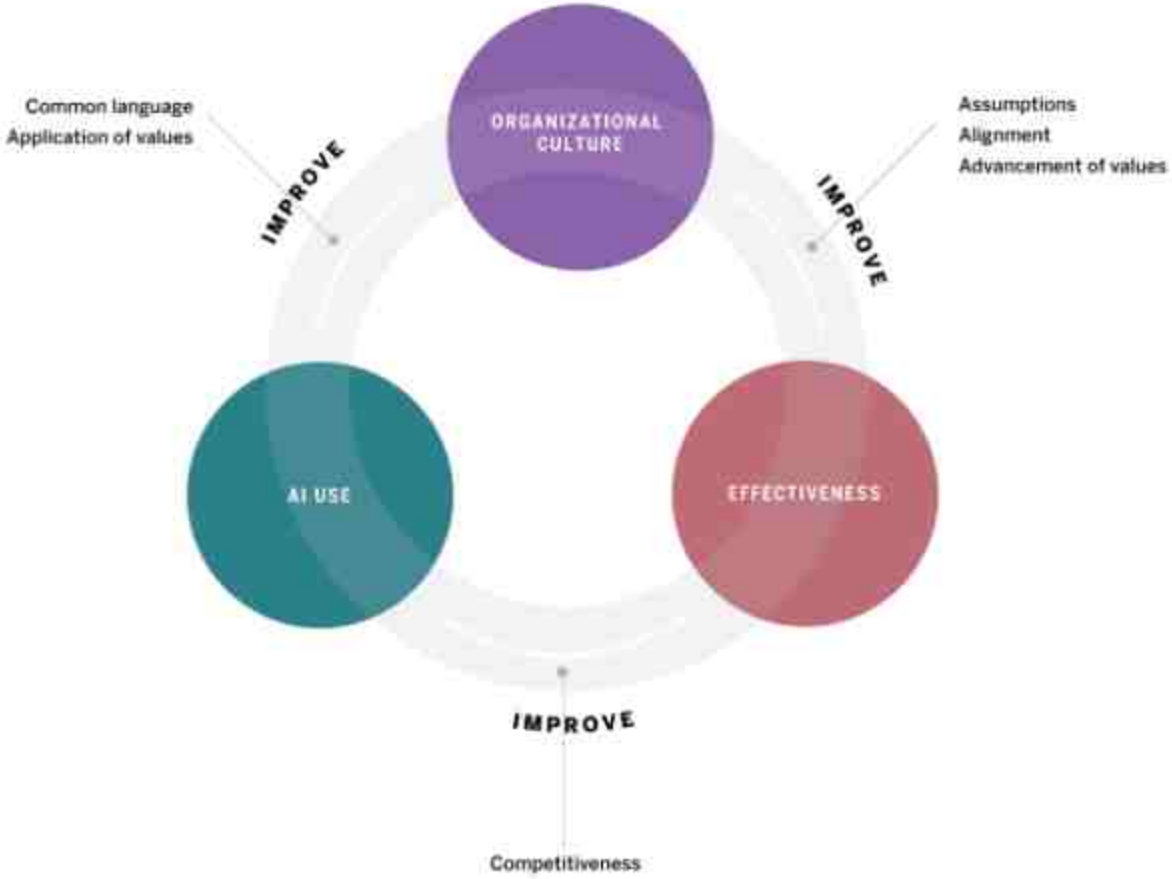
AI-BASED ASSESSEMENT OF DECISON IMPACT

"AI based assessment of Impact of Decision" will be a qualitative model of the socio-technical environment containing all the possible actions that the AI system can recommend, and all the KPIs that ight be affected by any of the possible actions

Cultural Impact

Are forward-looking companies most likely to make the most judicious use of Industry4.0 or does deploying I4.0 lead to more forward-looking companies?





Digitisation in the manufacturing domain can help improved collective learning, clarity of roles, collaboration, and morale.

Multi-Faceted Approach

Business must include self-governing ethical principles and transparency requirements in their technology implementation roadmaps …

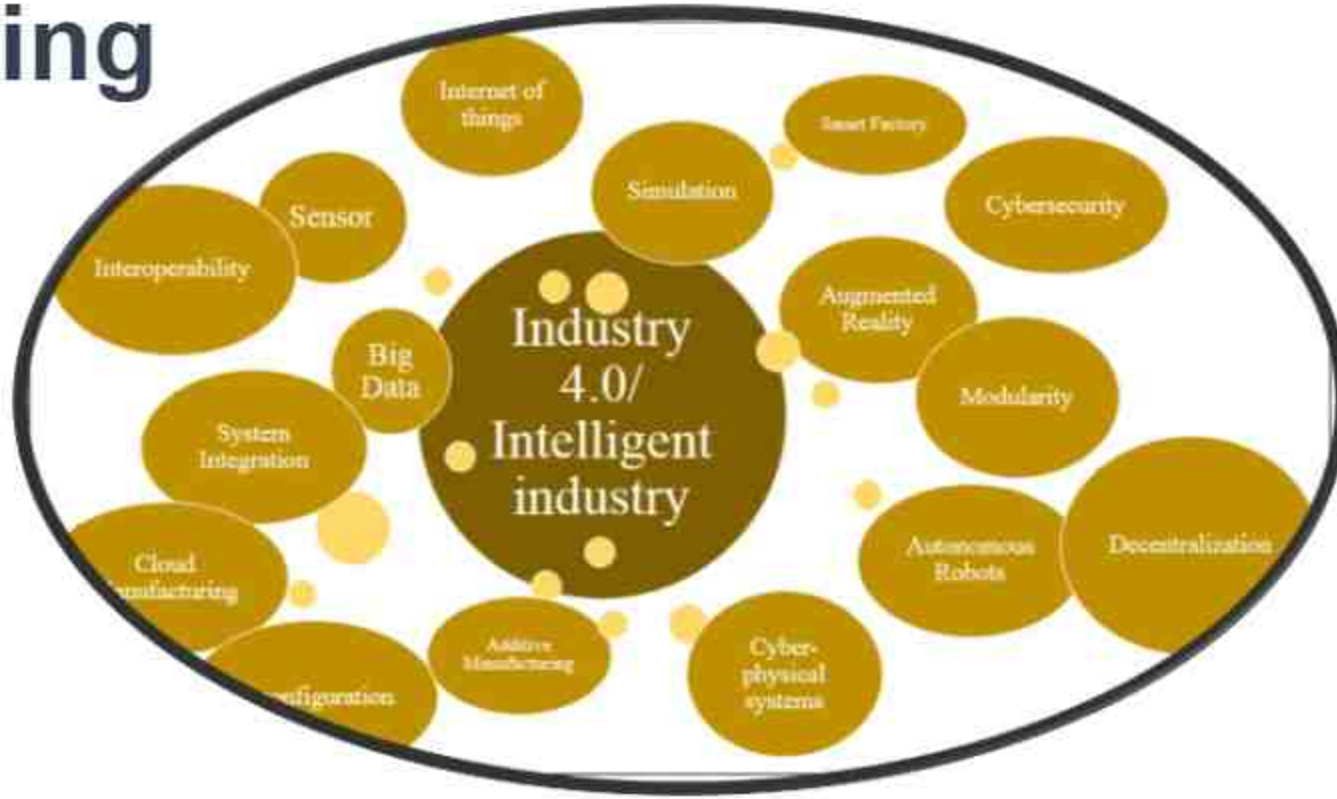
As with rapid technological evolution any regulation focused on technology will soon become obsolete, with potentially negative consequences for society and the economy.

Industry 4.0 is a collaborative effort!

Its about resilience … out-performance … sustainability … efficiency … productivity. It's about delivering a much stronger customer experience … making your products easier to produce and treat!

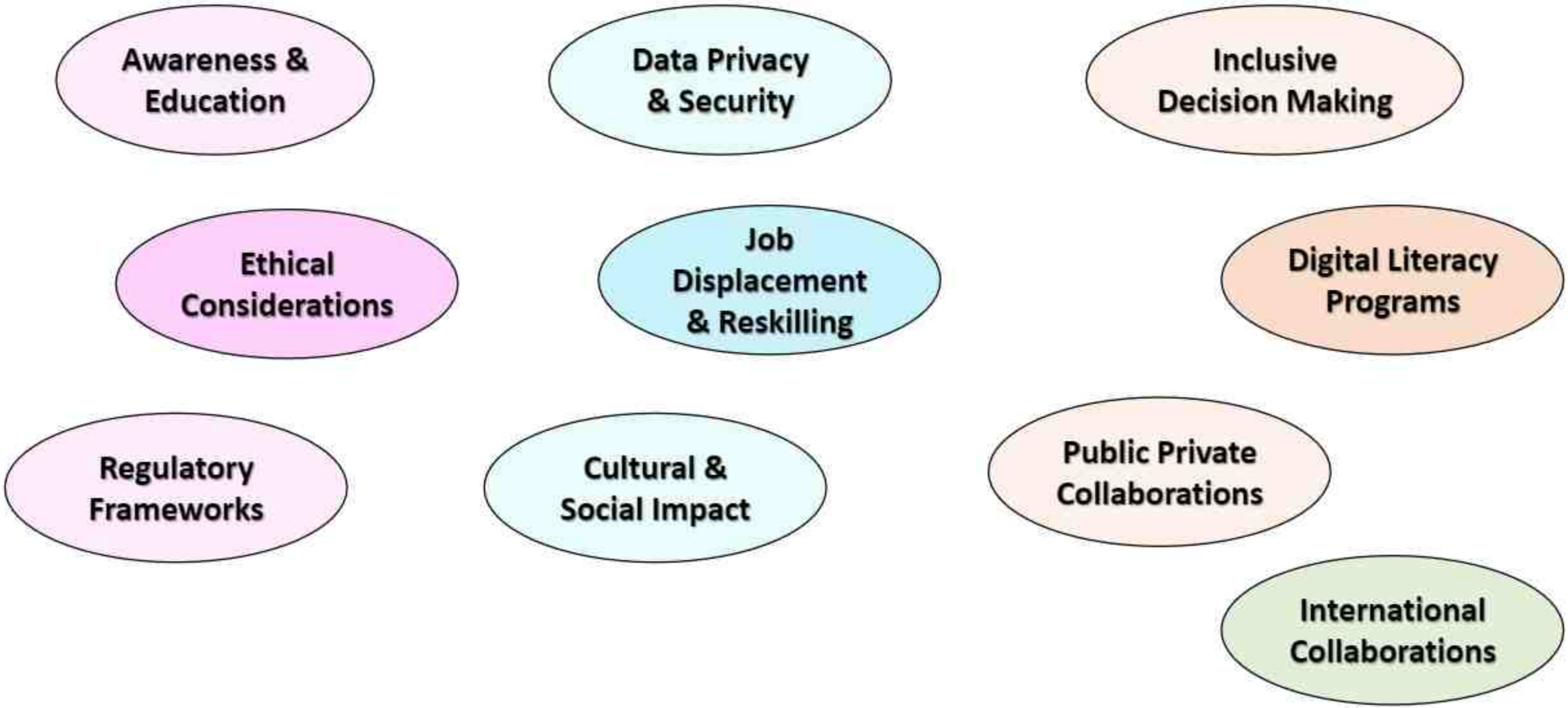
No enterprise needs to do it alone.

Education and Reskilling



DIHs aim to accelerate digital transformation, capability building and to build up the digital capacities of SMEs and public sector organisations throughout the European Union.

Societal Engagement



Conclusion

Preserving human values
in the age of AI and Industry 4.0 is
not just a challenge but an imperative!

Thanks for your audience!

Dr. Usman Wajid

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NESSI: www.nessi-europe.eu
AIOTI: www.aioti.eu

Ideas for Research & Innovation

Capturing & Unlocking the Meaning of Data in I4.0 applications

Dimitris Kiritsis (Kyritsis)

- *Professor Emeritus of ICT for Sustainable Manufacturing, EPFL*
- *Senior Adviser, UiO*

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École polytechnique fédérale de Lausanne

Industry 4.0

How can autonomous reaction take place?
"Self-optimising"

What will happen?
"Being prepared"

Why does it happen?
"Understanding"

What does happen?
"Seeing"

Digital Transformation
Business Value

Computing | Connectivity | Visibility | Analytic | Predictability | Autonomy

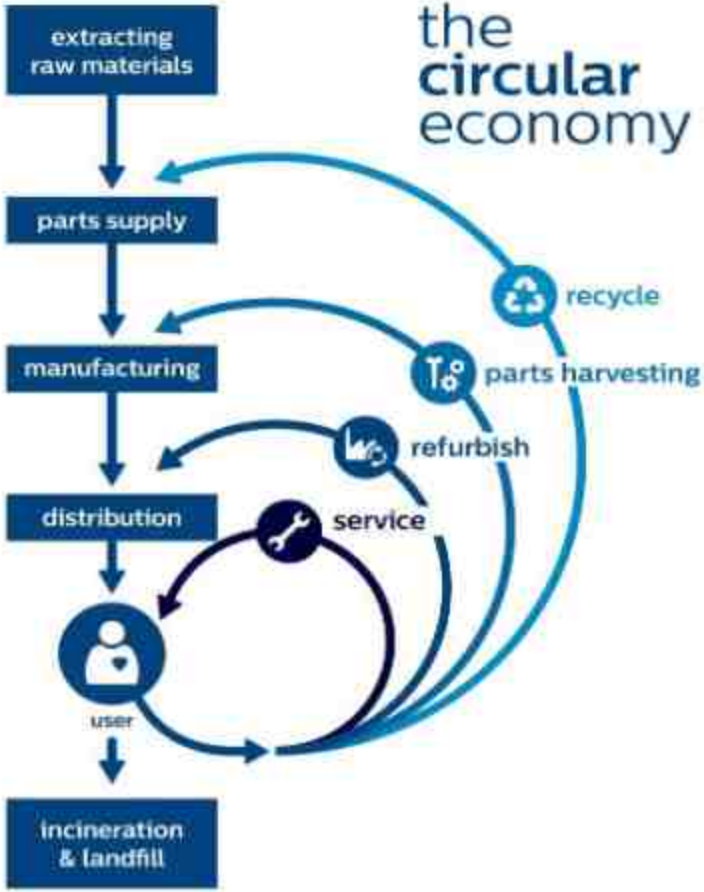
Industry 3.0 < : > Industry 4.0

Migration Path

Connect & Configure	Monitor & Visualize	Analyze & Predict	Cognitive
• Physical assets, IIoT etc. • Connect data sources • Collect, aggregate, explore	• Data visualization • Monitoring platform • Statistical analysis	• Model-based analysis • Machine/Deep learning • Prediction/recommendation	• Complex & unpredicted behaviors • Sensing & reasoning • Decision-making etc

UN Sustainable Development Goals - SDGs

The new context: Circular Economy



Extraction	— Raw Materials
Material Supply Chain	+ Reduce material inputs + Replace with renewable materials
Design & Manufacture	+ Design for quality, durability and longevity + Use safe chemistry and healthy materials
Distribution & Use	○ Reuse ○ Repair ○ Rent & resell
End of first file	○ Remanufacture ○ Recycle
Disposal	— Waste to landfill

Source http://www.zerowastemontenegro.me/circular-economy

Source: WMF Report 2021

The emergence of Product Embedded Information Devices

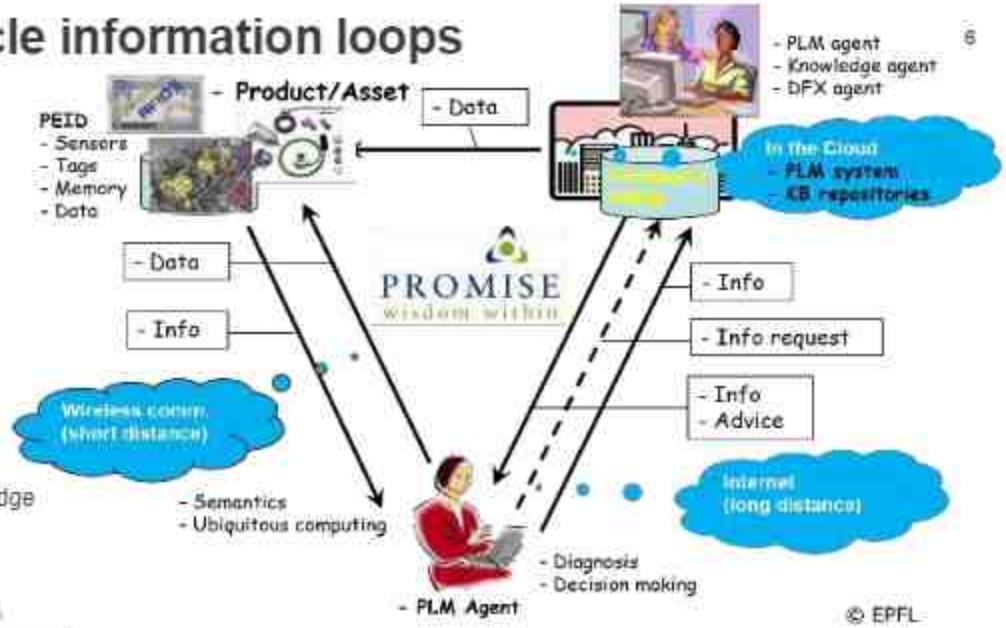
- Sensors (sensing)

- Memory chips (memory)

- Micro-processors + Software (logic)
- Barcodes, RFID, … (identity)

- Bluetooth, WiFi, IoT, … (communication)

PROMISE: Closing the lifecycle information loops



Product lifecycle data/information/knowledge

(1) Horizontally closed

BOL | MOL | EOL

(2) Vertically closed

Business applications

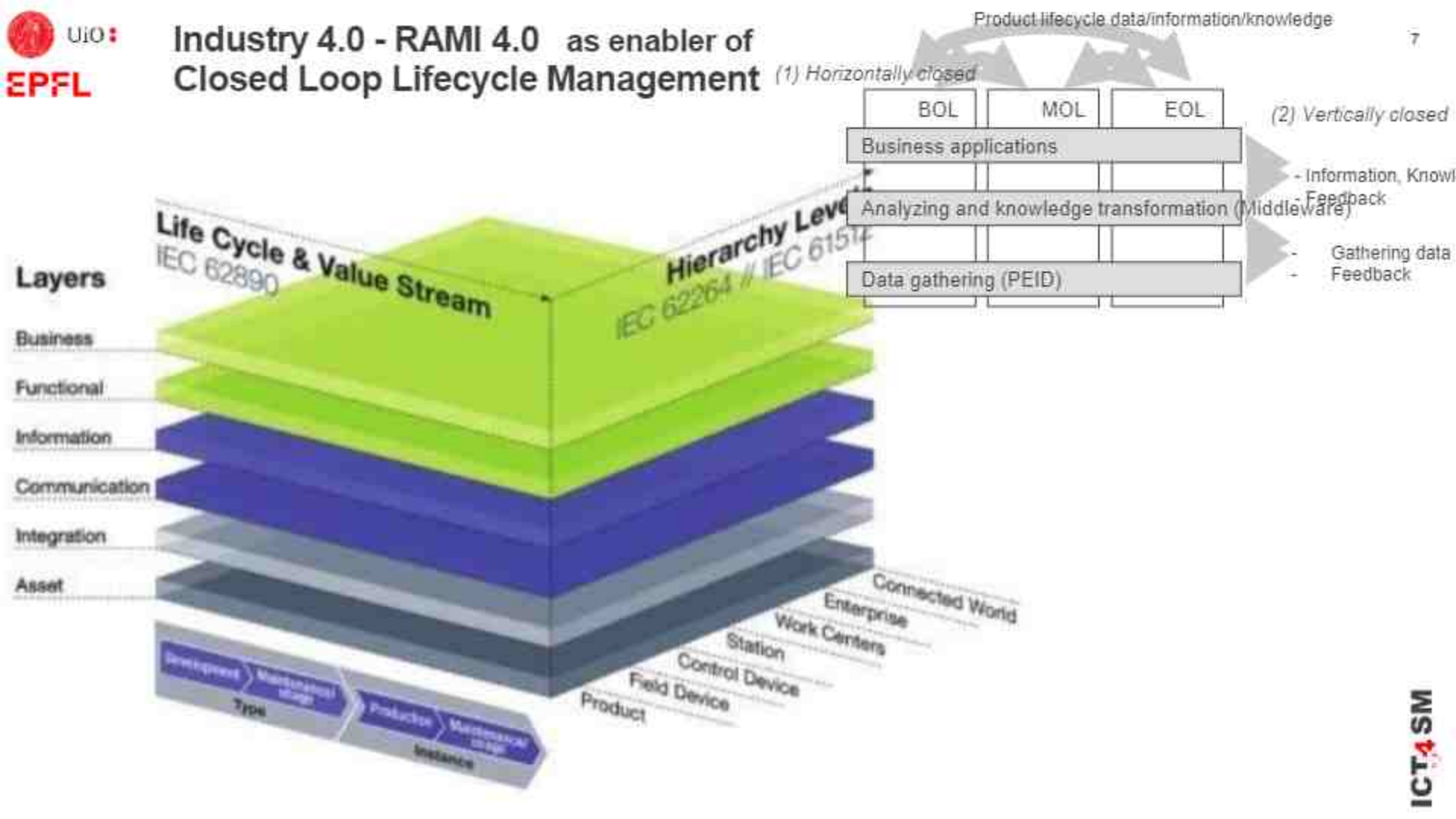
- Information, Knowledge
- Feedback

Analyzing and knowledge transformation (Middleware)

- Gathering data
- Feedback

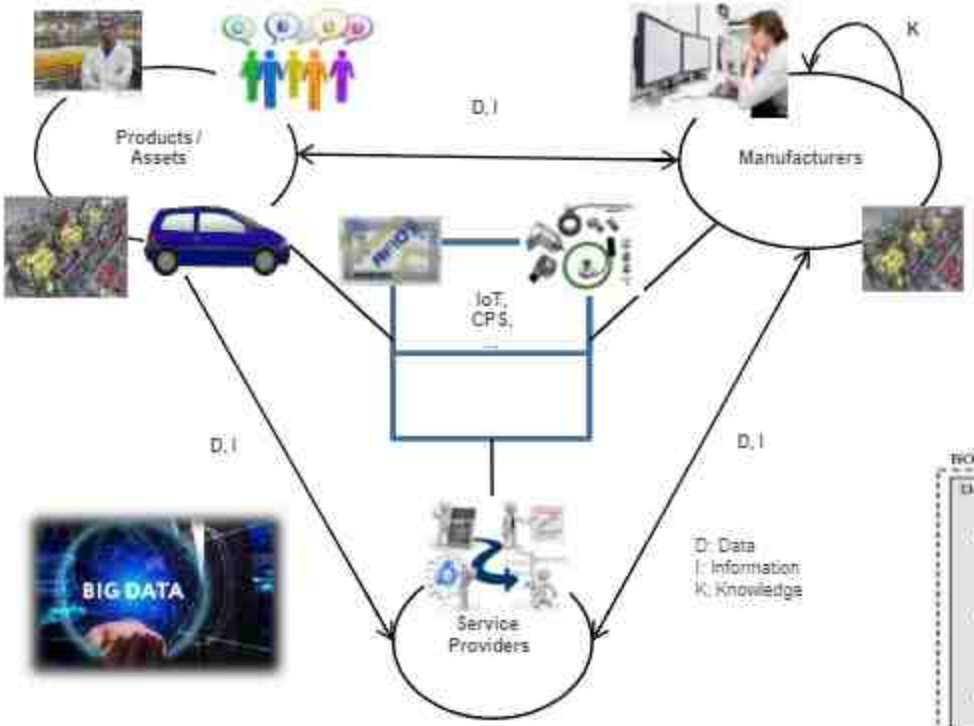
Data gathering (PEID)

Industry 4.0 - RAMI 4.0 as enabler of Closed Loop Lifecycle Management

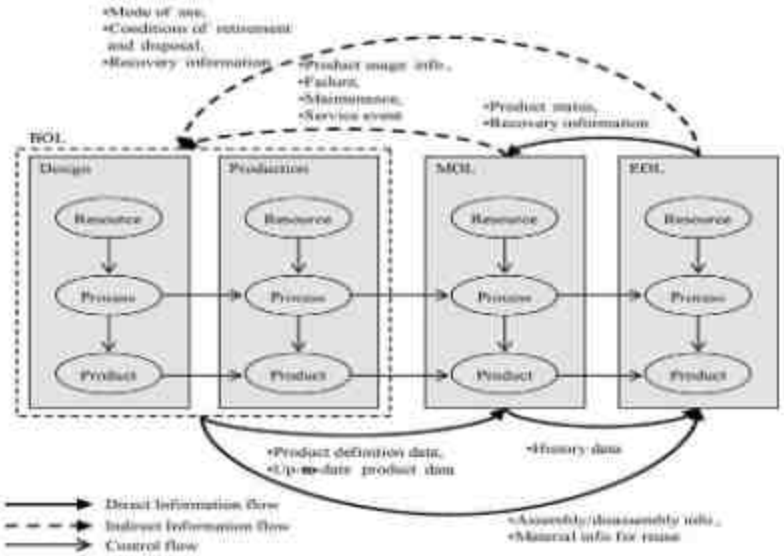


ICT4SM

It is all about Big Life Cycle Data Transformations



- Closed-Loop Life cycle
  - Data-Information-Knowledge Transformations
- Semantic Model-Based Systems Engineering for Industrial Data Analytics



LinkedDesign ZFactOr ZBre4k Boost 4.0 QUALITY

WORLD ECONOMIC FORUM

COMMITTED TO IMPROVING THE STATE OF THE WORLD

White Paper

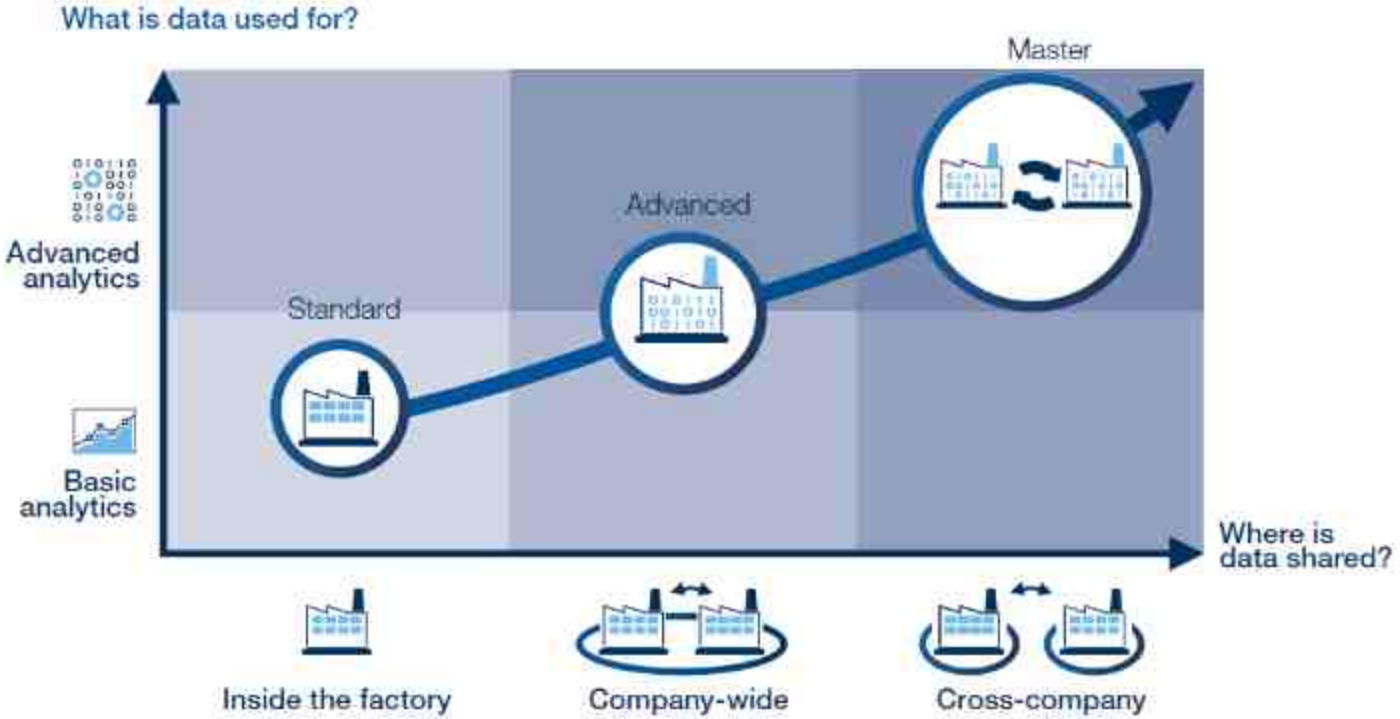
Share to Gain:
Unlocking Data Value in Manufacturing

In collaboration with Boston Consulting Group

January 2020

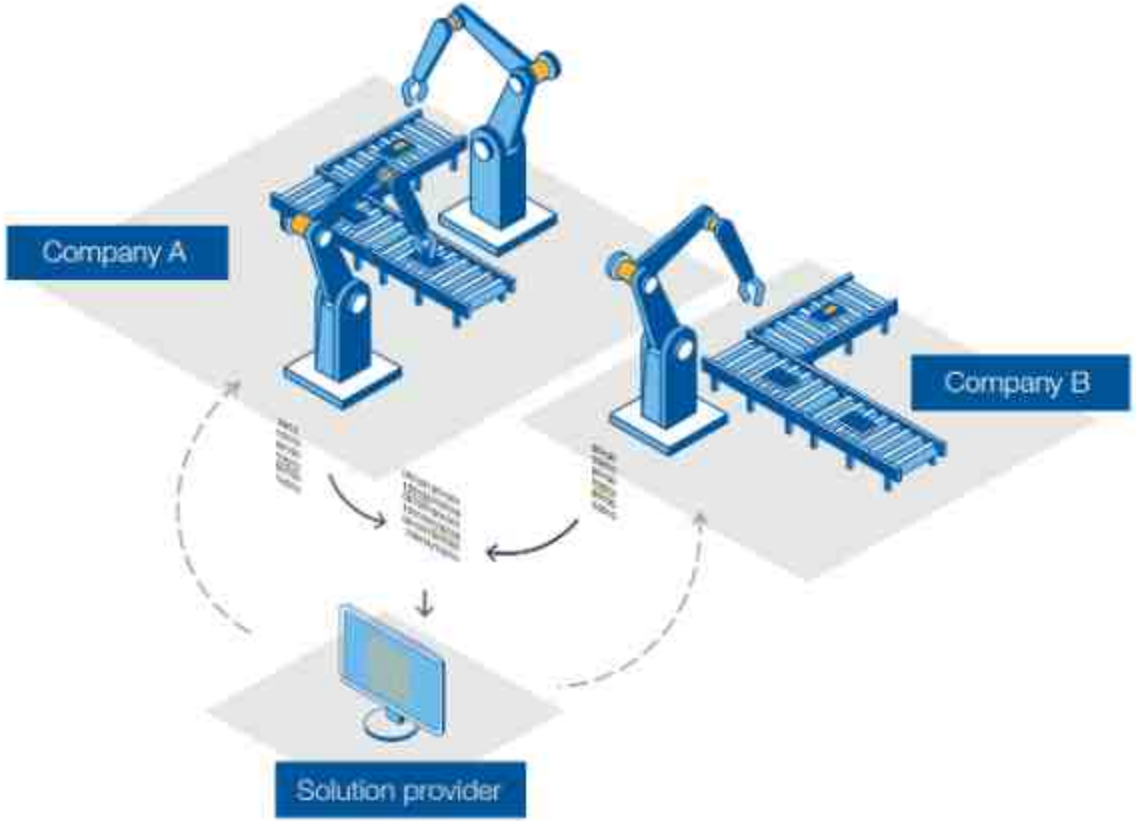
http://www3.weforum.org/docs/WEF_Share_to_Gain_Report.pdf

Data Sharing for Manufacturing



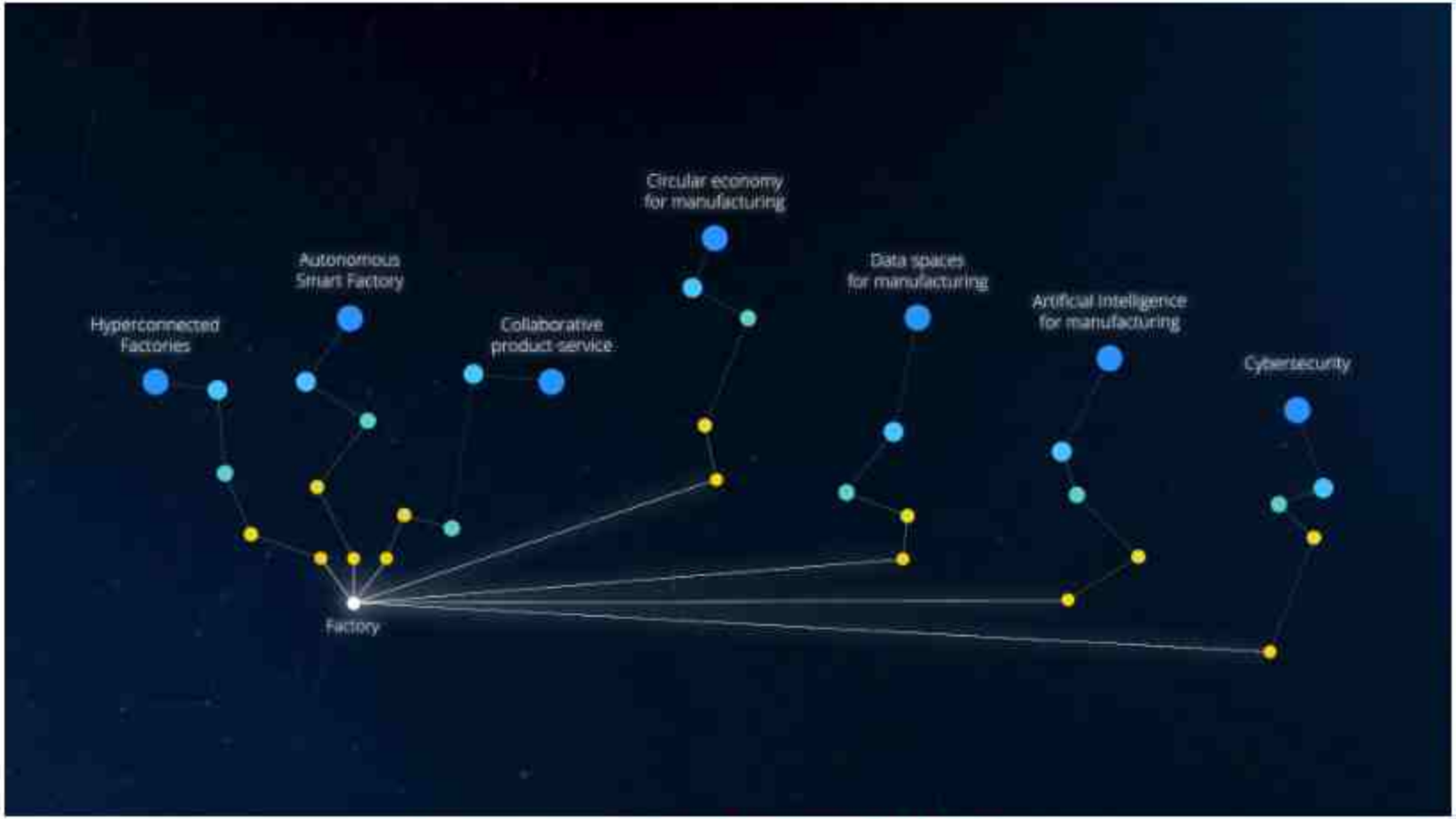
http://www3.weforum.org/docs/WEF_Share_to_Gain_Report.pdf

Enhance Asset Optimization



http://www3.weforum.org/docs/WEF_Share_to_Gain_Report.pdf

Connected Factories

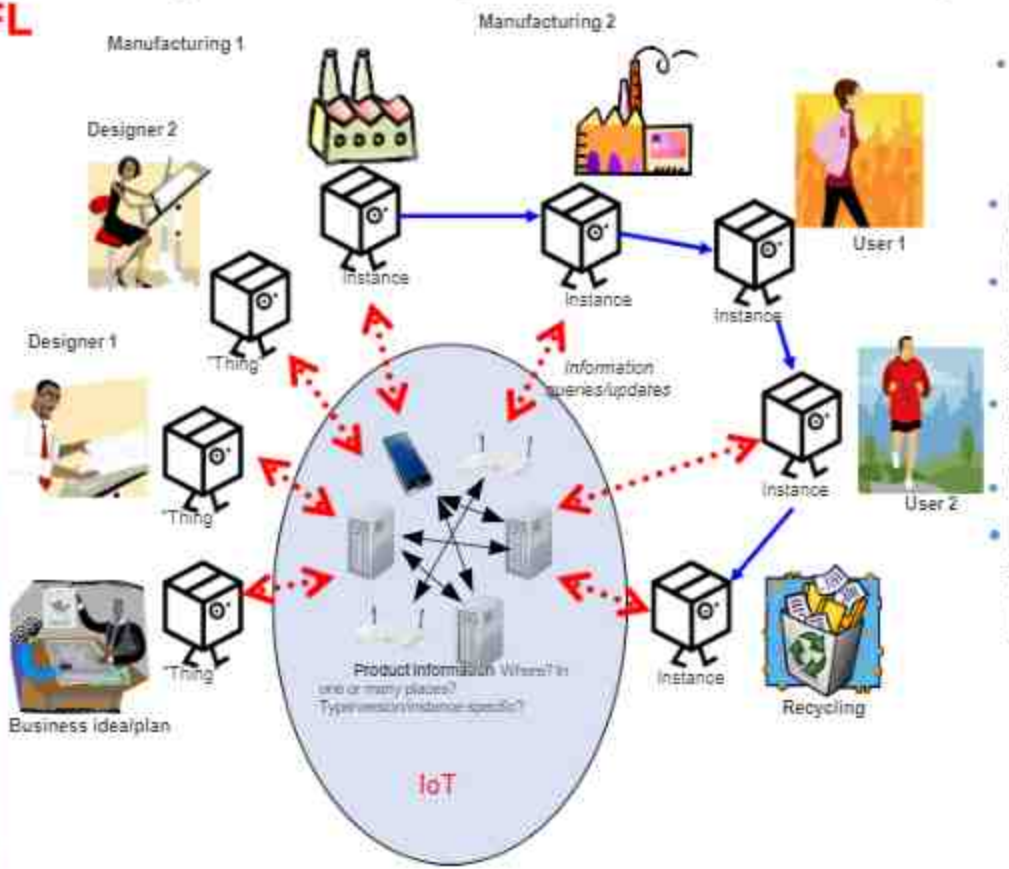


https://youtu.be/AT78aMMyS2s

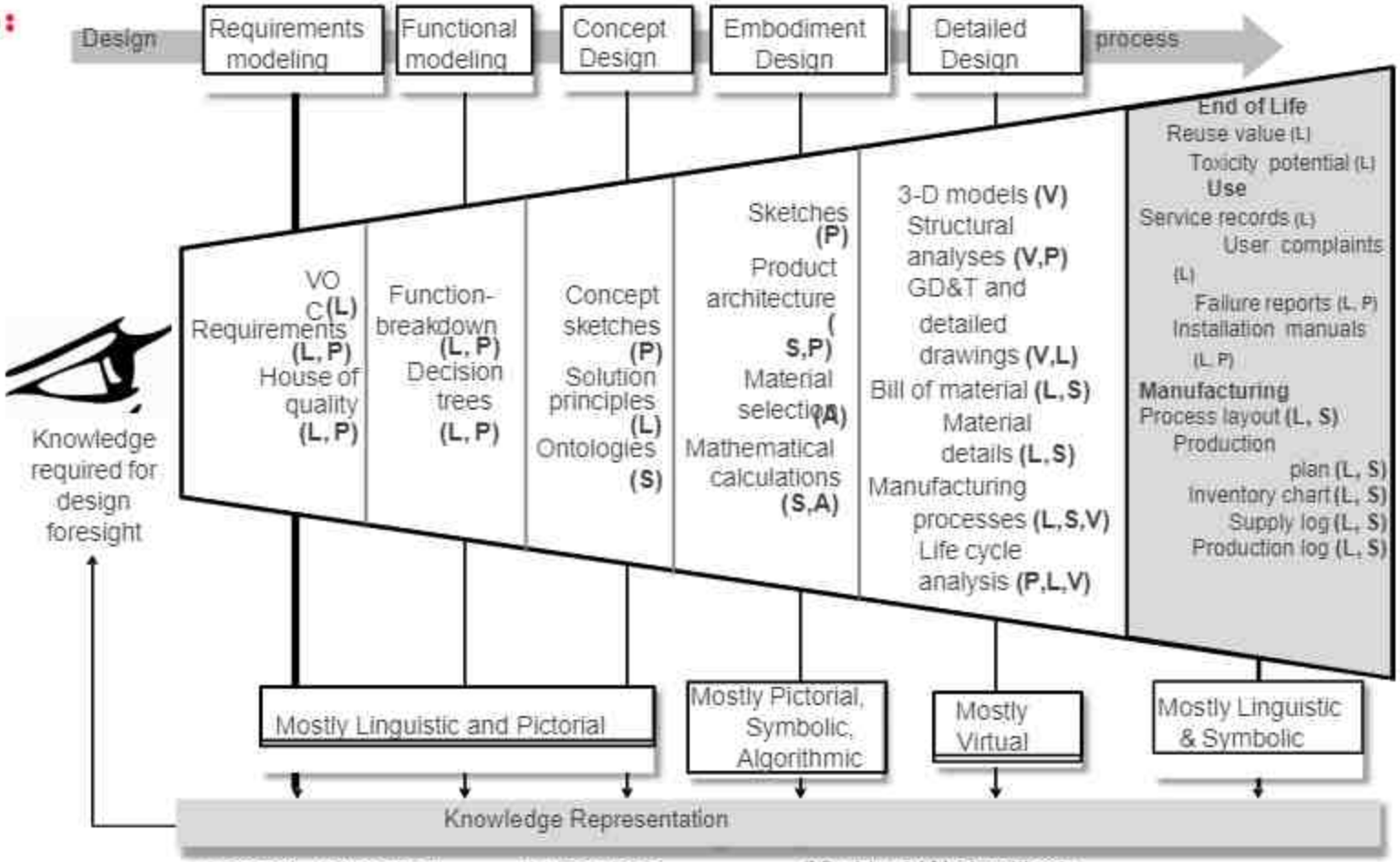
Agenda

- 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

Systems of Systems: Closed Loop Lifecycle Management



- **Lifecycle view**: IoT is about managing **all information** about **any Product/Thing**
- Information is **Distributed over Systems** (devices, servers, applications, ...)
- Information is **Distributed over Organizations** (companies, individuals, authorities, ...)
- Product (and its parts) are **unique instances**
- How to manage **identities**, **access rights**, ...?
- **IoT** should provide necessary capabilities for **Closed Loop Lifecycle Management**



Senthil Chandrasegaran, Karthik Ramani, Ram D. Sriram, Imre Horváth, Alain Bernard, Ramy Harik, Wei Gao. The evolution, challenges, and future of knowledge representation in product design systems. Computer Aided Design Volume 45, Issue 2, February 2013, Pages 204-228.

Characteristics of Data

Data Source

Value

Context

Transformation

Interpretation

Visualisation

The Meaning of Data

Body temperature

385 °C

Oven temperature

Ontologies allow the interpretation of the right meaning of data

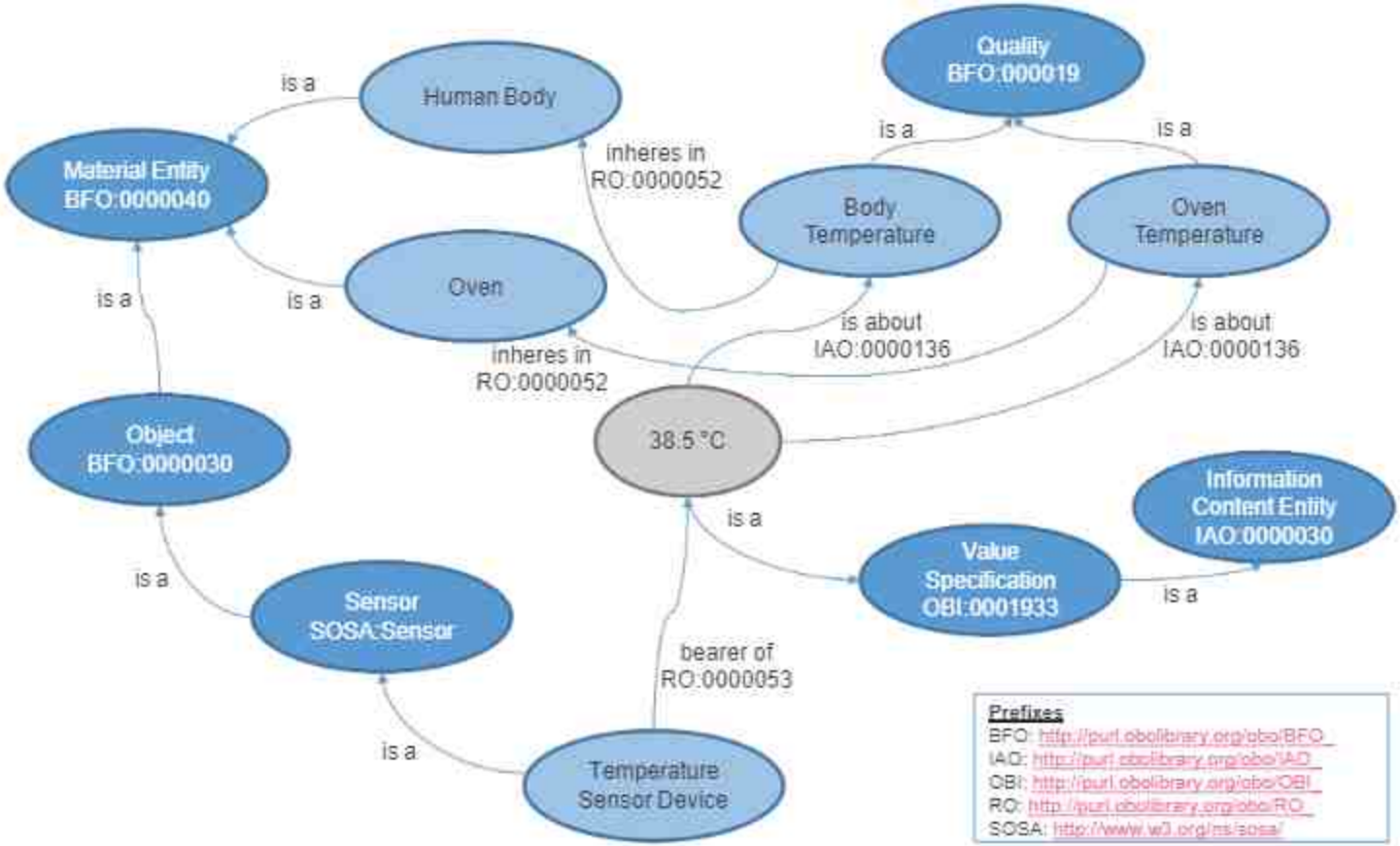
Reasoning

Domain disambiguation

Data Silos

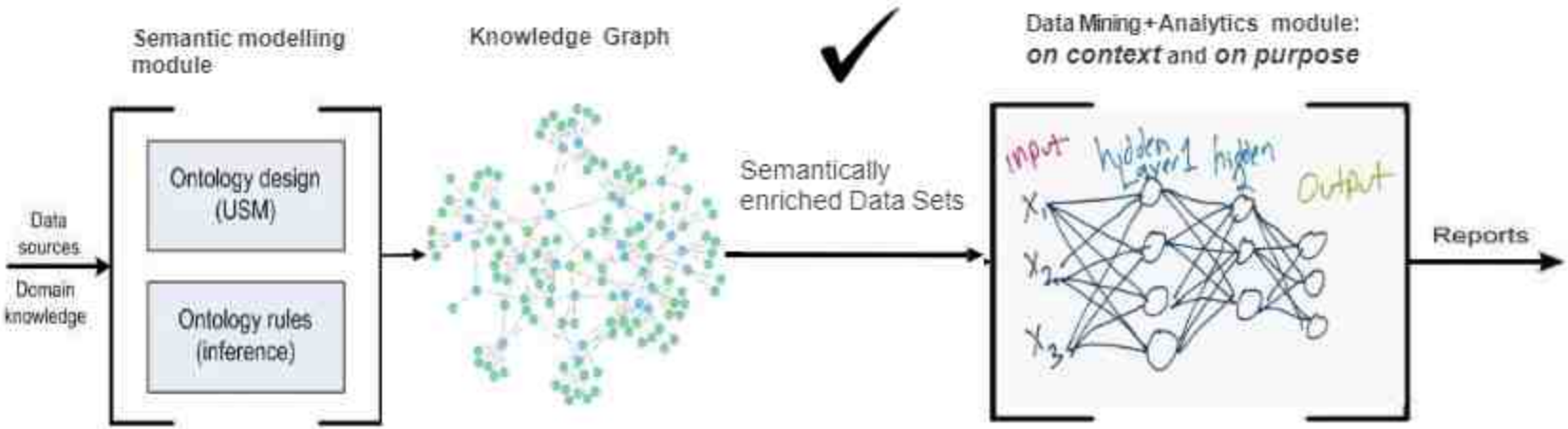
Essay by Verscheure & Kiritsis in 2018 WMF Report: https://www.worldmanufacturingforum.org/report/

The Meaning of Data



Ontologies & Big Data

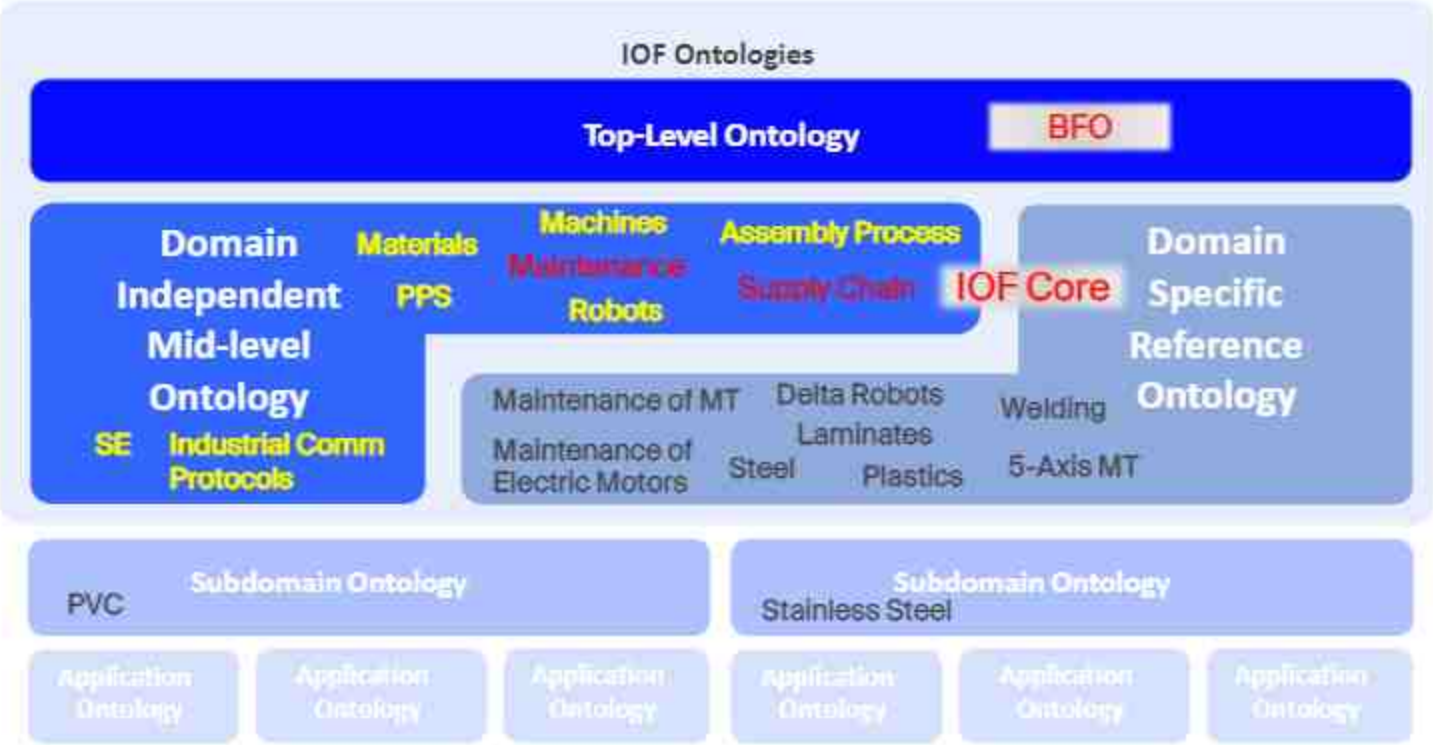
- **Challenges:**
  - Scattered data in several sources, systems and services
  - Different actors with multidisciplinary skills



Ontology - Industrial Ontologies Foundry (IOF)

https://www.industrialontologies.org/

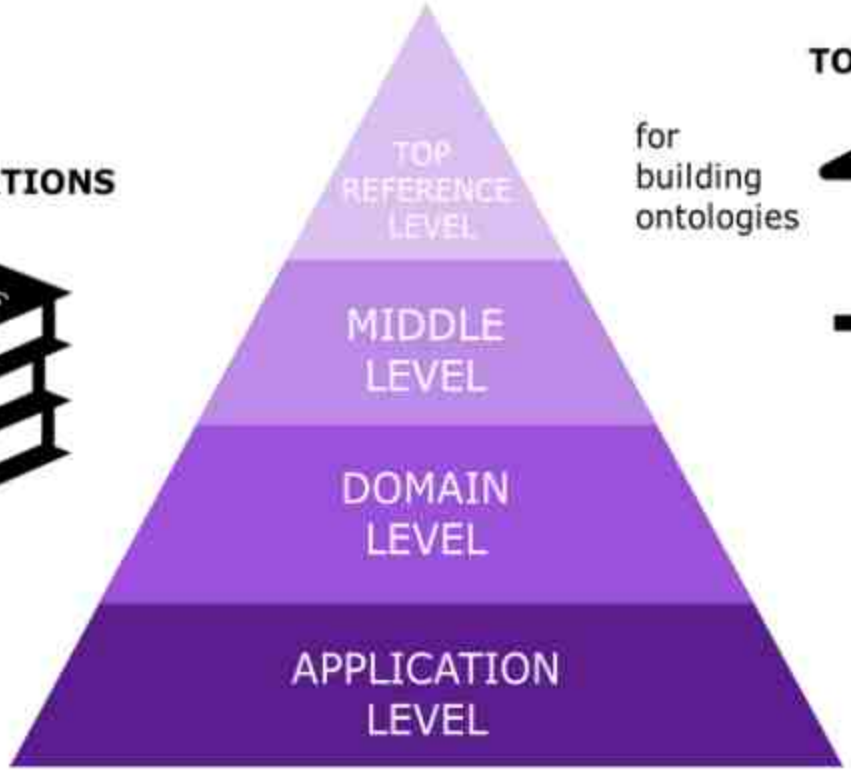
- aiming to create a set of open ontologies to support the manufacturing and engineering industry needs and advance data interoperability
- involves government, industry, academic and standards organizations



Ontology – OntoCommons EcoSystem

https://ontocommons.eu/

SPECIFICATIONS



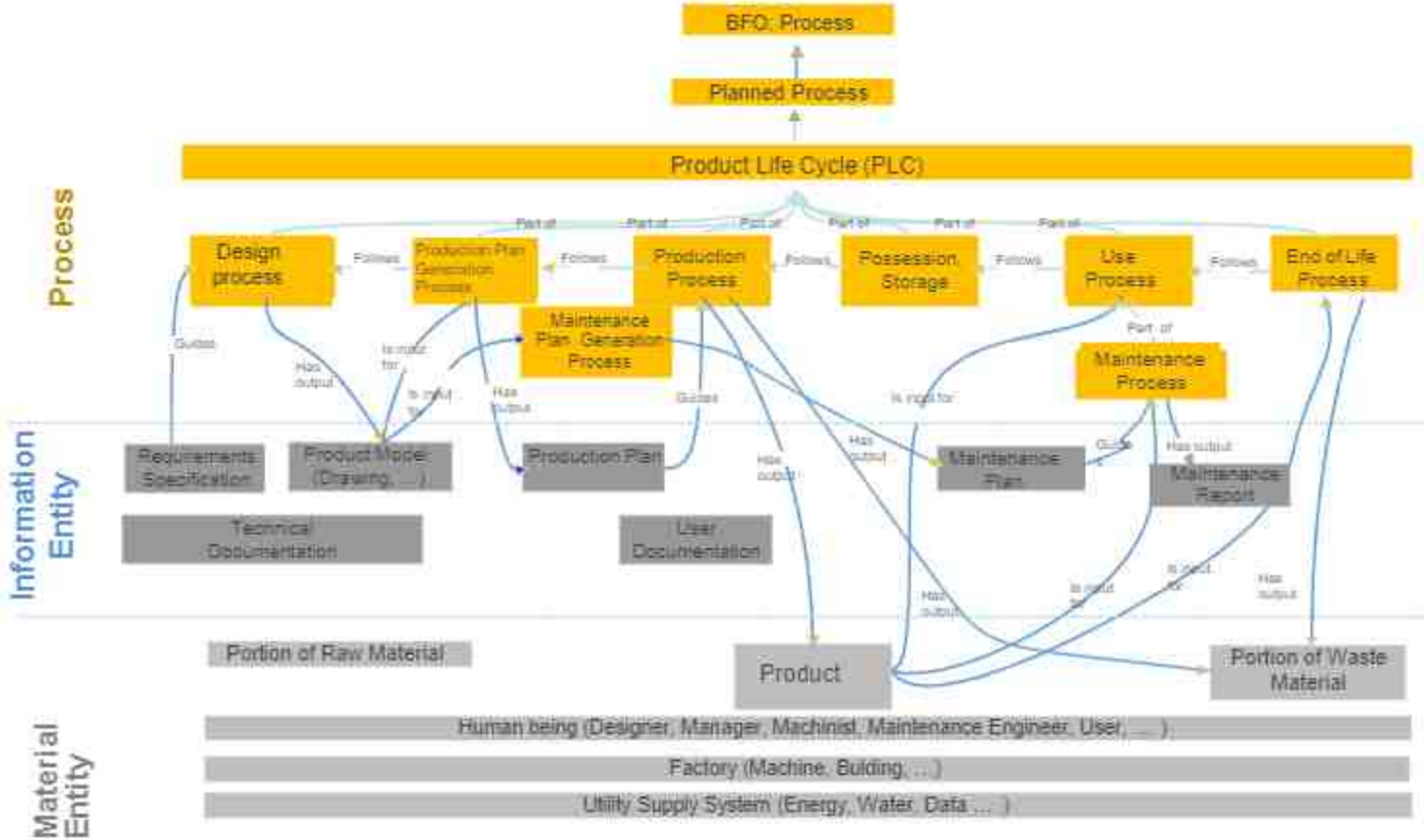
ONTOLOGIES

TOOLS

for building ontologies

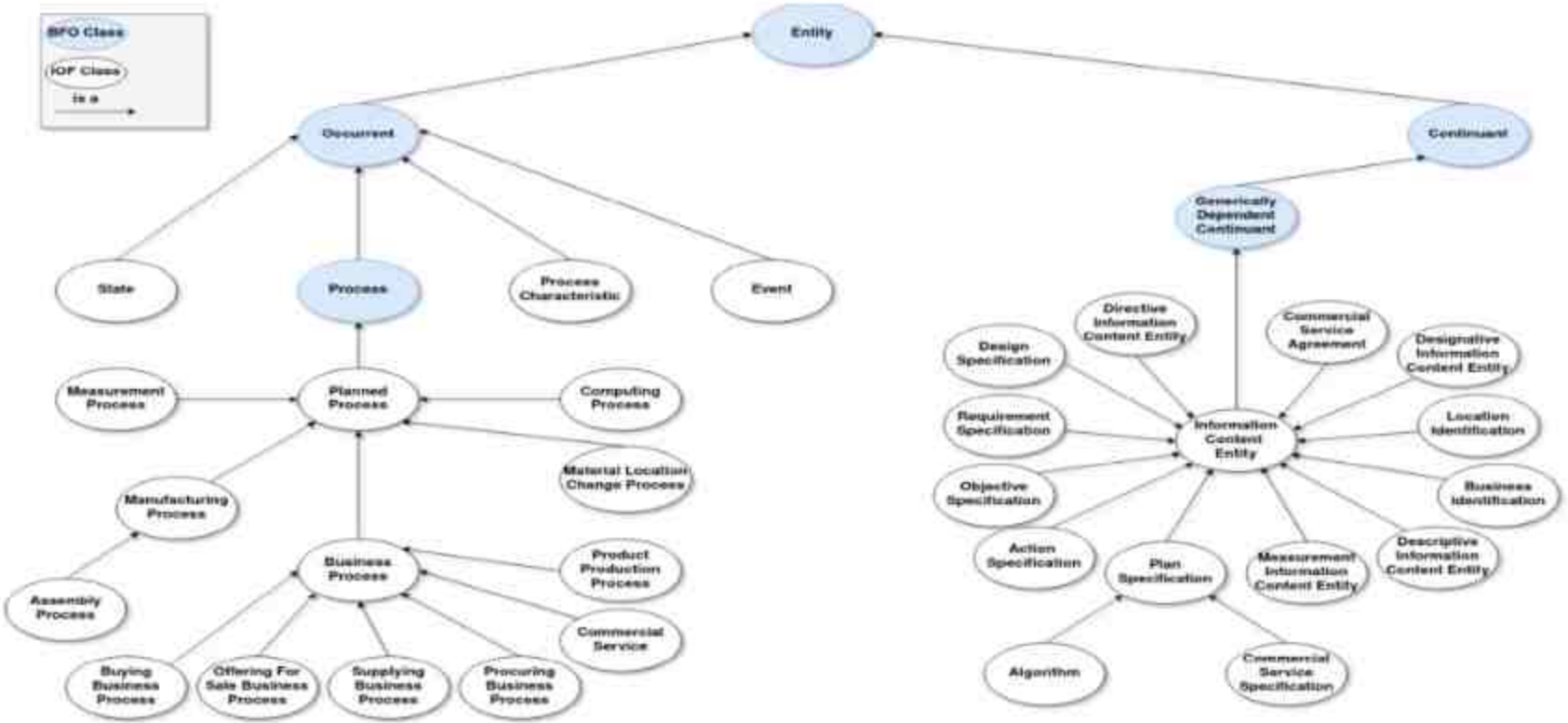
for data documentation

Sketch of a Product Life Cycle Ontology Framework



Barry Smith and Dimitris Kiritsis, 2016

IOF Core Ontology



IOF Supply Chain Ontology