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INDUSTRIAL SEMANTIC  
INTEROPERABILITY SUMMIT 2026  
Oslo, Norway  
9-11 June, 2026

# WHY INDUSTRIES SHOULD CARE ABOUT SEMANTIC INTEROPERABILITY

DANIELI

## Enabling efficient information integration DPP and LCA generation in the steel industry



**DANIELI AUTOMATION**

DANIELI / SINCE 1914  
PASSION TO INNOVATE  
AND PERFORM  
IN THE METAL INDUSTRY

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## INTRODUCTION OF INTEROPERABILITY IN THE STEELMAKING ICT LANDSCAPE

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01

## PRISMA PROJECT AT A GLANCE

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02

## DANIELI AUTOMATION USE CASE

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03

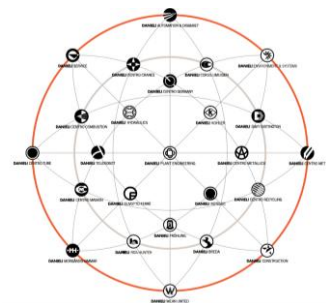
## CONCLUSIONS

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04



# WHY INDUSTRIES SHOULD CARE ABOUT SEMANTIC INTEROPERABILITY



## INTRODUCTION

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Direct Reduction Plant

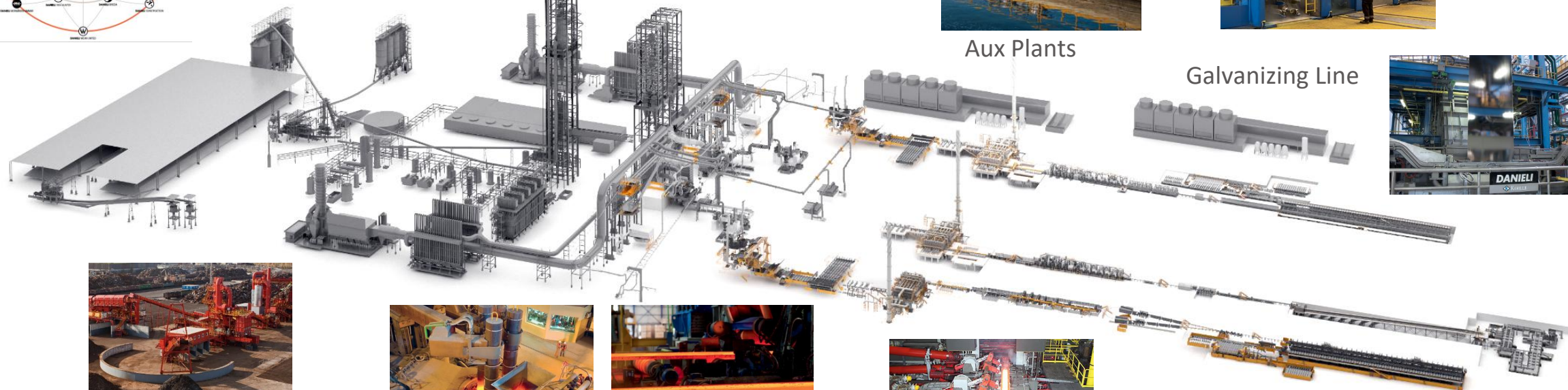


Aux Plants

Cold Rolling Mill



Galvanizing Line



Scrap processing



Primary & secondary Metallurgy



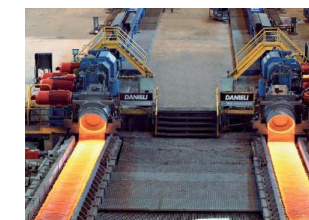
Continuous casting



Hot Rolling Mills



Plate Mills



Steel Wire Line



Fume Treat. Plant



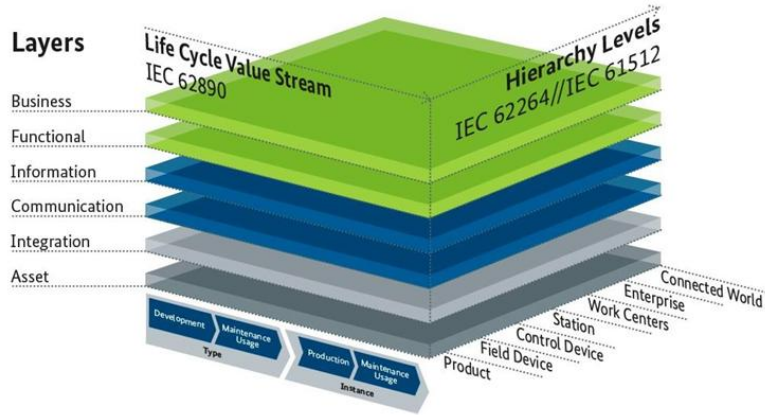


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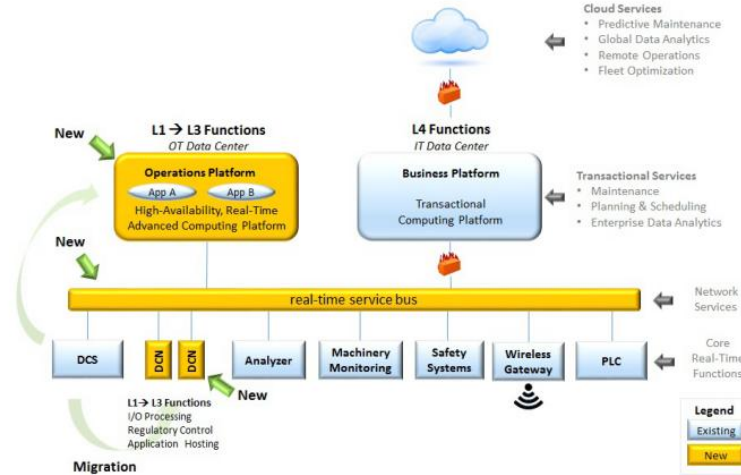
## STATE OF THE ART DIGITAL ARCHITECTURE

# DANIELI

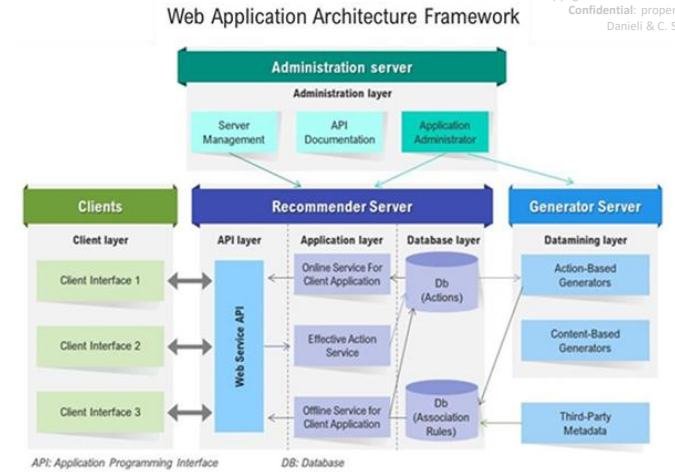
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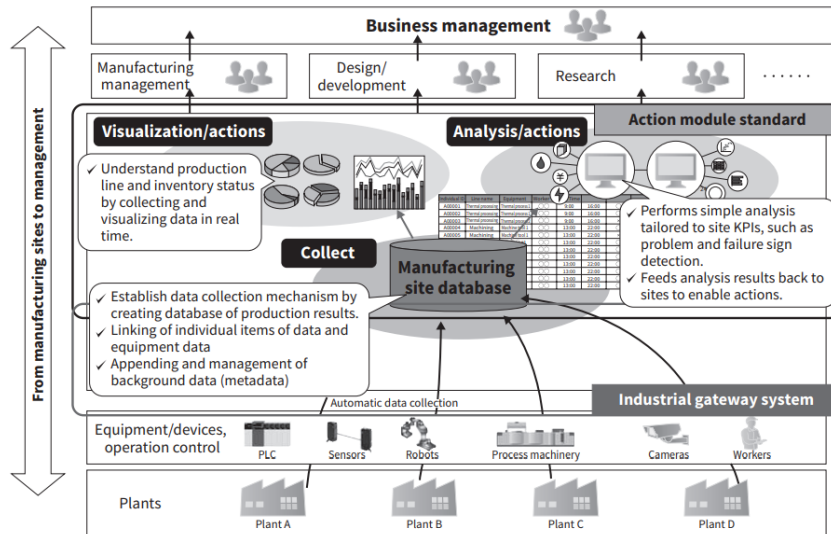
## Reference Architecture Model Industry 4.0 (RAMI 4.0)



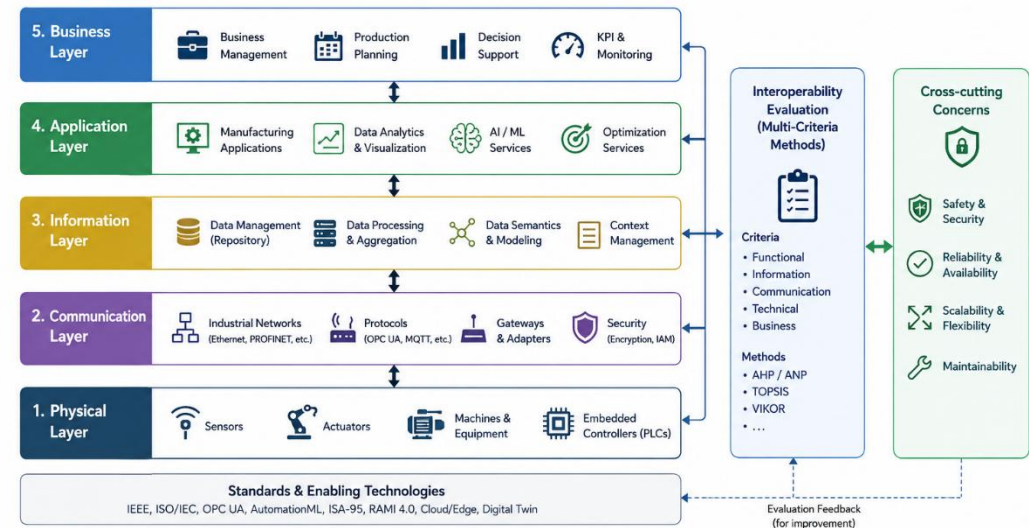
## OPA-S Architecture



### Framework Structure of a general Web Application Framework.



## Hitachi Digital Supply Chain/IoT (DSC/IoT) Platform



## Cyber-Physical System Architecture

References taken from the Position Paper n° 1: "CONTEXT, TECHNOLOGY AND SEMANTICS OF THE DIGITAL TRANSITION IN THE GLOBAL MARKETS THE STEEL SECTOR". The ESTEP Smart Factory Focus Group, September 2023 and *Saturno et al.* "Evaluation of interoperability between automation systems using multi-criteria methods" *Procedia Manufacturing* 11 ( 2017 ) 1837 – 1845

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# WHY INDUSTRIES SHOULD CARE ABOUT SEMANTIC INTEROPERABILITY

## STATE OF THE ART DIGITAL ARCHITECTURE

| Aspect               | RAMI 4.0                                                                          | OPA-S Architecture                                           | Web Application Framework                 | Hitachi DSC/IoT Platform                                  | Cyber-Physical Systems (CPS)                                  |
|----------------------|-----------------------------------------------------------------------------------|--------------------------------------------------------------|-------------------------------------------|-----------------------------------------------------------|---------------------------------------------------------------|
| Purpose              | Standard reference model for Industry 4.0                                         | Open, interoperable automation systems                       | Structure for building web applications   | Digital supply chain & IoT optimization                   | Integration of physical and digital systems                   |
| Scope                | Industrial systems across lifecycle and hierarchy                                 | Process automation in industrial plants                      | Software/system development (general use) | Enterprise/industrial IoT platforms                       | Cross-domain (manufacturing, robotics, healthcare)            |
| Key Concept          | 3D model (Layers, Lifecycle, Hierarchy)                                           | Modular, vendor-neutral architecture                         | Layered architecture (UI, logic, data)    | Data-driven optimization using IoT & analytics            | Real-time interaction between physical and digital components |
| Main Components      | Asset layer, Integration, Communication, Information, Functional, Business layers | Control nodes, communication infrastructure, open interfaces | Frontend, backend, APIs, database         | IoT devices, cloud platform, analytics, integration tools | Sensors, actuators, embedded systems, communication networks  |
| Interoperability     | High – standardization focus                                                      | Very high – vendor independence                              | Moderate – depends on standards used      | High – integrates multiple systems                        | High – relies on communication protocols                      |
| Flexibility          | Medium – structured model                                                         | High – modular and scalable                                  | High – adaptable to many applications     | High – scalable cloud-based platform                      | High – adaptable to dynamic environments                      |
| Industry Focus       | Manufacturing & Industry 4.0                                                      | Process industries (oil, gas, chemicals)                     | All sectors using web applications        | Industrial supply chain & IoT ecosystems                  | Broad (smart factories, smart cities, etc.)                   |
| Technology Focus     | Standardization & modeling                                                        | Open automation systems                                      | Software engineering principles           | IoT, big data, cloud computing                            | Embedded systems, networking, control systems                 |
| Role in Industry 4.0 | Foundational reference model                                                      | Enables modern industrial control systems                    | Supports digital services & interfaces    | Enables digital transformation & optimization             | Core enabling technology                                      |

# WHY INDUSTRIES SHOULD CARE ABOUT SEMANTIC INTEROPERABILITY

## ICT LANDSCAPE CONCEPT

### GOALS



Automation of product grading and non-conformance management



Prompt detection and correction of quality issues



Causal correlation with quality outcome to optimize process setup



Flexibility to adapt to market requests of new product characteristics

### CHALLENGES



Integration of different data sources for product data traceability



Efficient management of live streaming and historical data



Team collaboration and knowledge sharing for continuous improvement



AI and ML integration for predictive quality control (applications)

### SOLUTION



A platform-based quality control and analytics solution to support decision-making.

Embedded DANIELI plant-making experience and process know-how

## WHY INDUSTRIES SHOULD CARE ABOUT SEMANTIC INTEROPERABILITY

### PRISMA PROJECT AT A GLANCE



**PRISMA** is pioneering sustainable practices in the European steel industry, aligning with the Green Deal and Twin Transition objectives. Central to PRISMA is to develop a Unified Environmental Data Model (UEDM), streamlining environmental reporting and analysis across the steel value chain.

Leveraging modern **digital infrastructure** and **platforms**, PRISMA aims to quantify and mitigate steel production's carbon footprint through, for example, **dynamic life cycle assessments (LCAs)** and **digital product passports (DPPs)**.



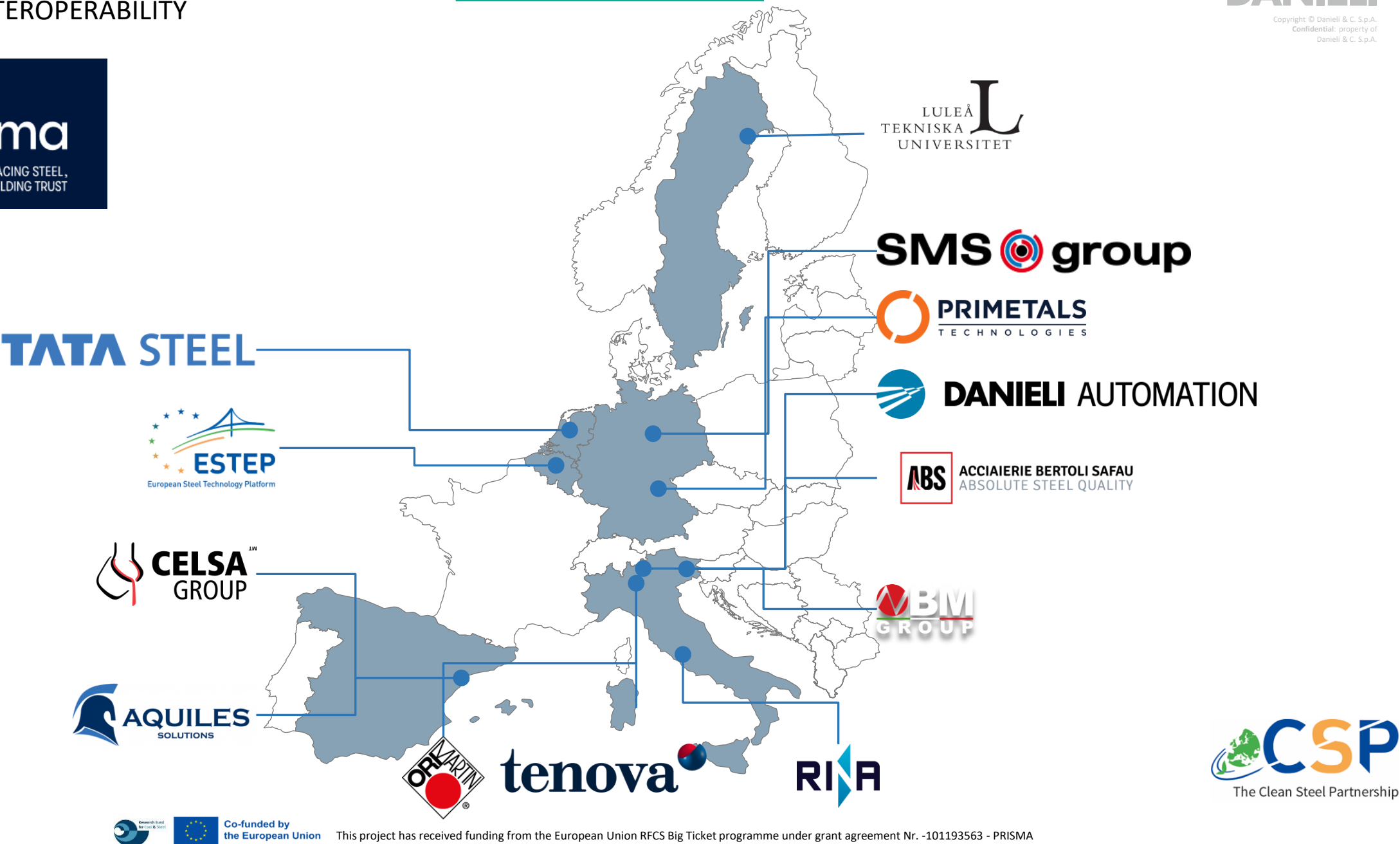
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PRISMA PROJECT AT A GLANCE



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- An interoperable digital architecture for designing a monitoring and managing systems of the environmental scenario isn't just about plugging sensors into a dashboard
- Key aim of an interoperable digital architectures is to be the basis of an environmental evolutive Environmental Management System able to make "understandable" the environmental scenario of a steelmaking factory by catching the step-by-step picture and its dynamics over time.
- Interoperability is the basic capability to ensure a seamless data flow and systems in which data, systems, and institutions can reliably understand and use them over time.
- In consequence, the main requirements fall into technical, semantic, organizational, and governance layers.
- Interoperability to make processes monitorable, controllable and manageable in function of a given viewpoint isn't just a technical convenience
- It fundamentally changes how industrial, environmental, or infrastructure systems perform, scale, and evolve.



- The PRISMA project is a digital demonstrator aimed at developing a Unified Environmental Data System supported by an interoperable Environmental Management System designed for making each process layers monitorable, controllable and manageable in function of accelerating the steelmaking decarbonization.
- In this sense, the implementation of its outcomes it is not just a technical convenience but a step ahead Towards the Green Deal.

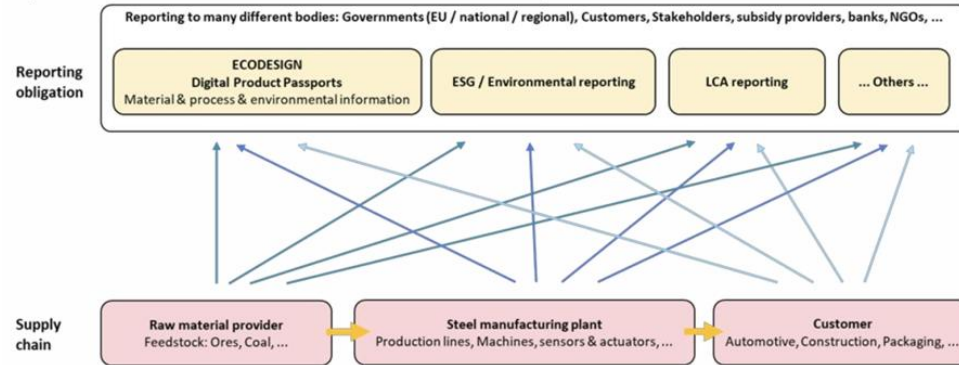


# WHY INDUSTRIES SHOULD CARE ABOUT SEMANTIC INTEROPERABILITY

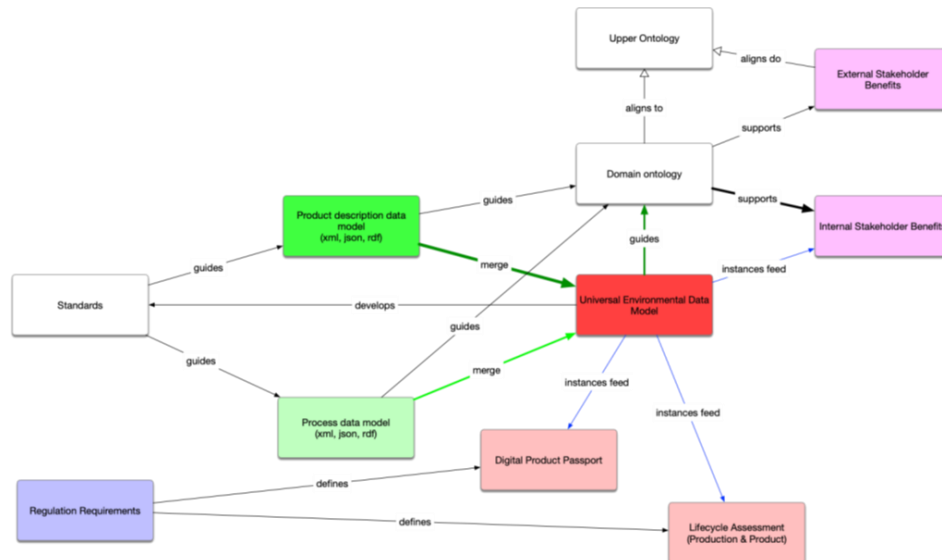
## ONTOLOGIES AND PERSONA BASED APPROACH

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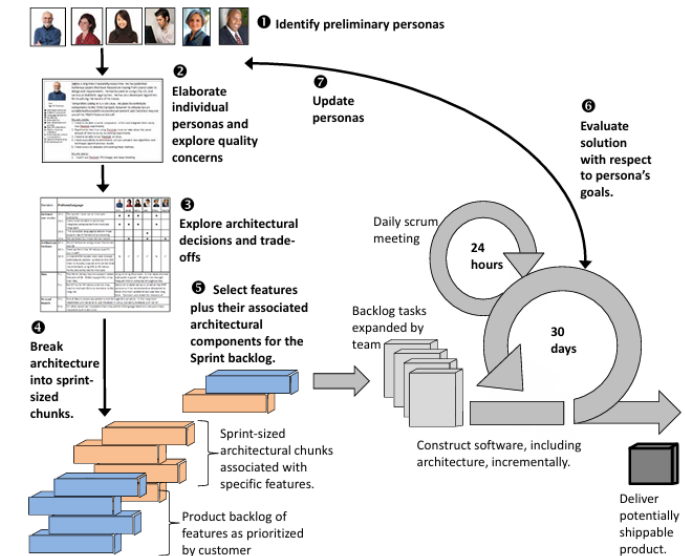
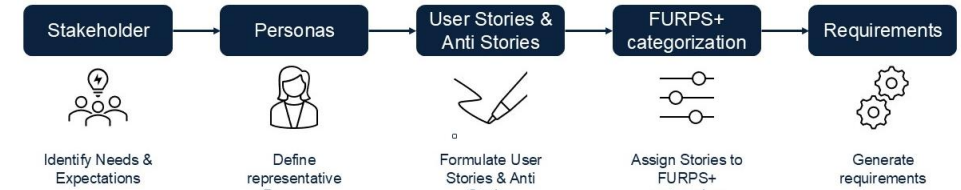
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UEDM alignment context: **common Ontology**  
alignment based on a bottom-up approach



## Persona Based Approach – FURP+ Methodology



Cleland-Huang J. et al. "A Persona-Based Approach for Exploring Architecturally Significant Requirements in Agile Projects" [J. Doerr and A.L. Opdahl (Eds.): REFSQ 2013, LNCS 7830, pp. 18–33, 2013.]



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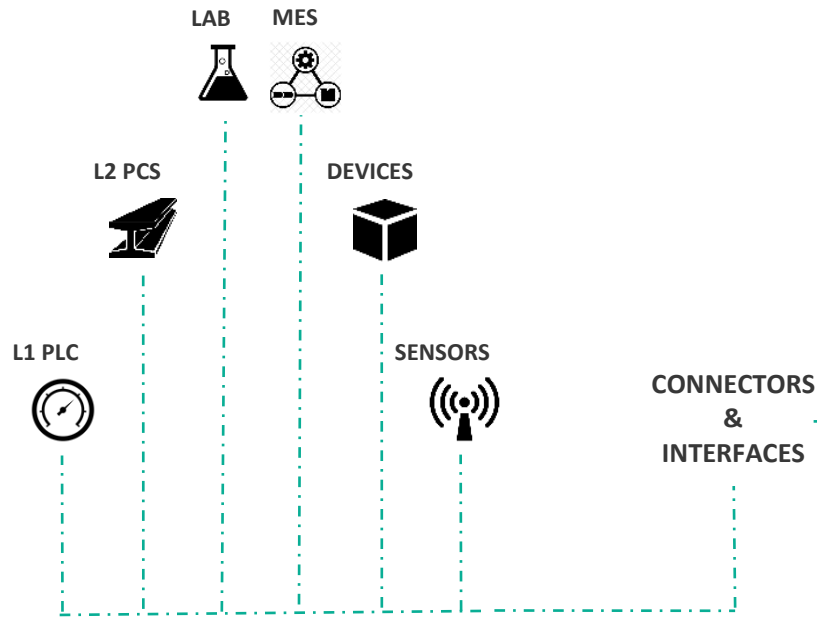
# WHY INDUSTRIES SHOULD CARE ABOUT SEMANTIC INTEROPERABILITY

## DIGITAL INFRASTRUCTURE - PRISMA SUGGESTION

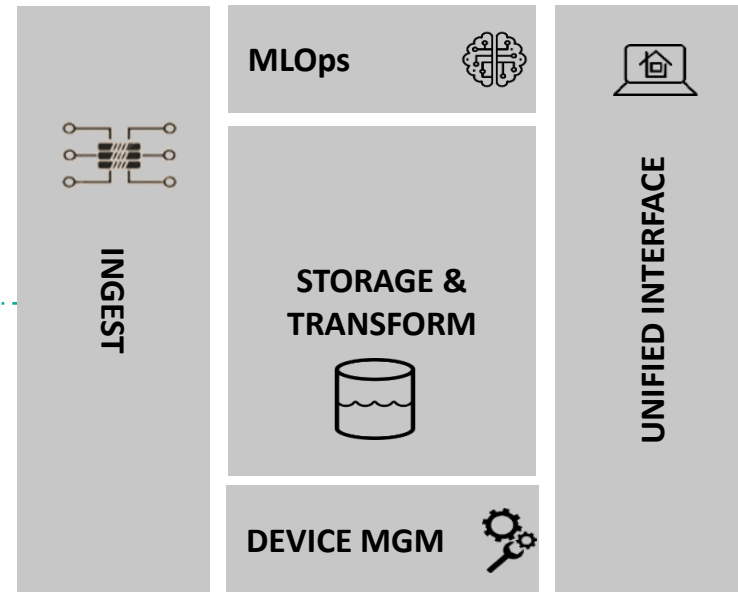
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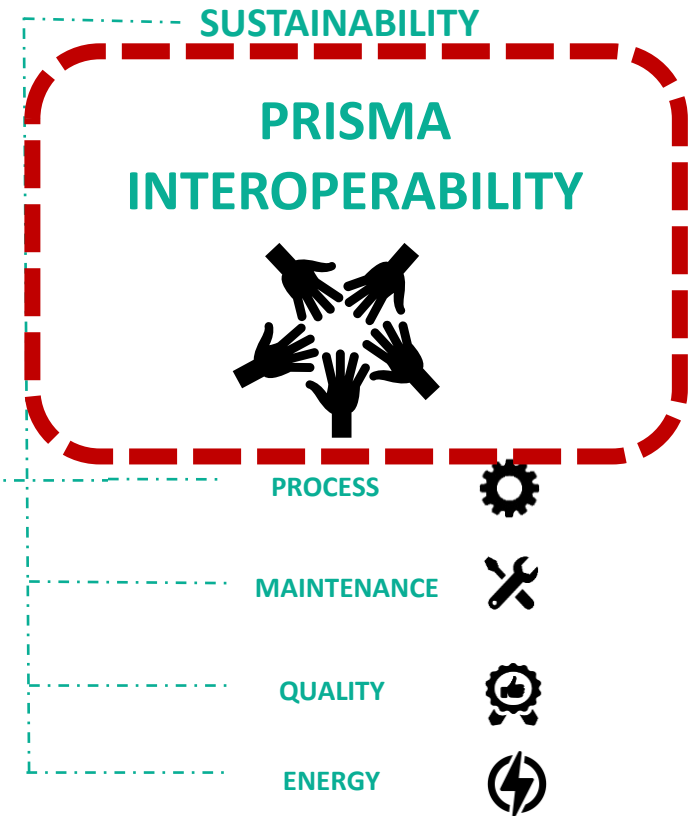
### Data sources



### Data Services



### Data Usage & Restitution



ON PREMISE



HYBRID



CLOUD

### COLLECT

### INGEST & MODEL

### ANALYZE & PREDICT



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# WHY INDUSTRIES SHOULD CARE ABOUT SEMANTIC INTEROPERABILITY

## DIGITAL INFRASTRUCTURE – PROPOSAL

This framework suggests a structured approach to managing and utilizing data efficiently, commonly used in industrial automation, IoT, and digital transformation initiatives.

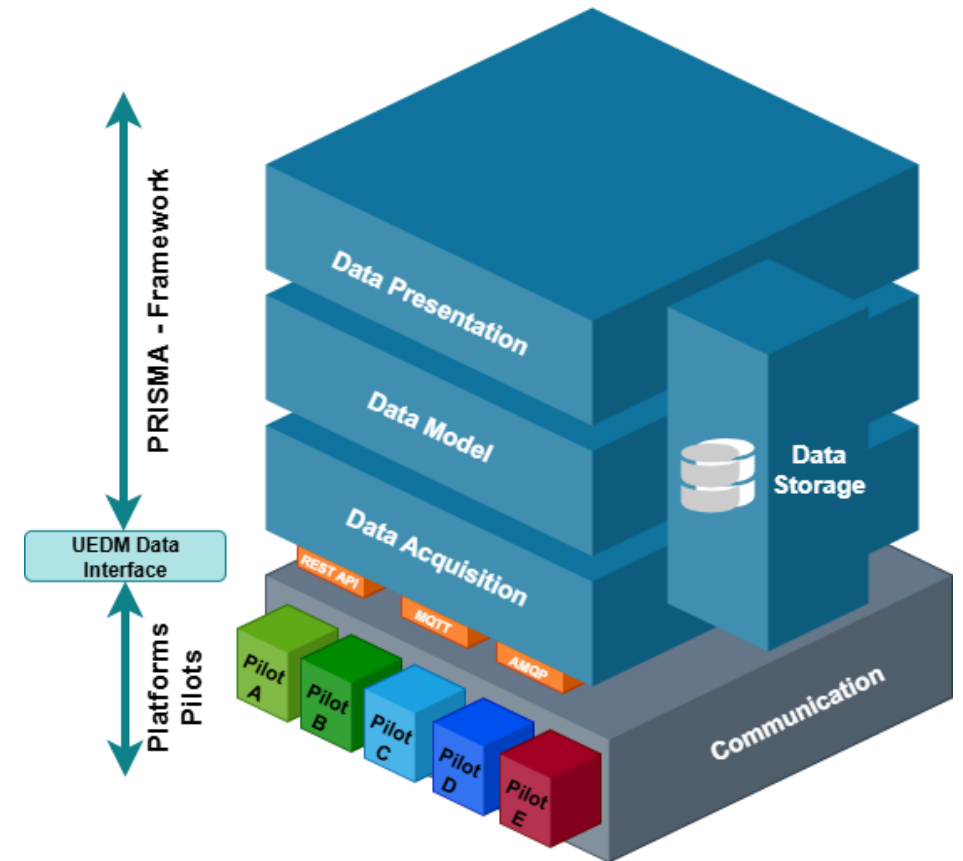
**Data Presentation** – The topmost layer displays and visualizes data to end users.

**Data Model** – The intermediary layer that structures and processes data, ensuring consistency and logical representation for applications.

**Data Acquisition** – This layer is responsible for collecting data from various sources. It integrates different communication protocols.

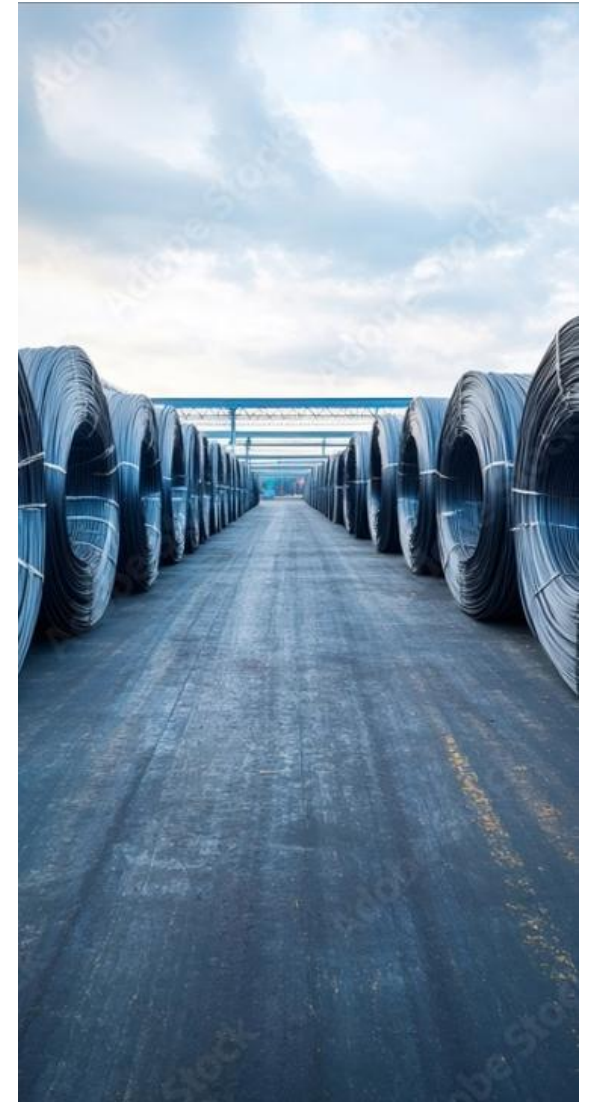
**Communication Layer** – The foundation enables data exchange between components and external sources.

**Pilots (A to E)** – Representing different data sources, test cases, or subsystems contributing data to the platform.



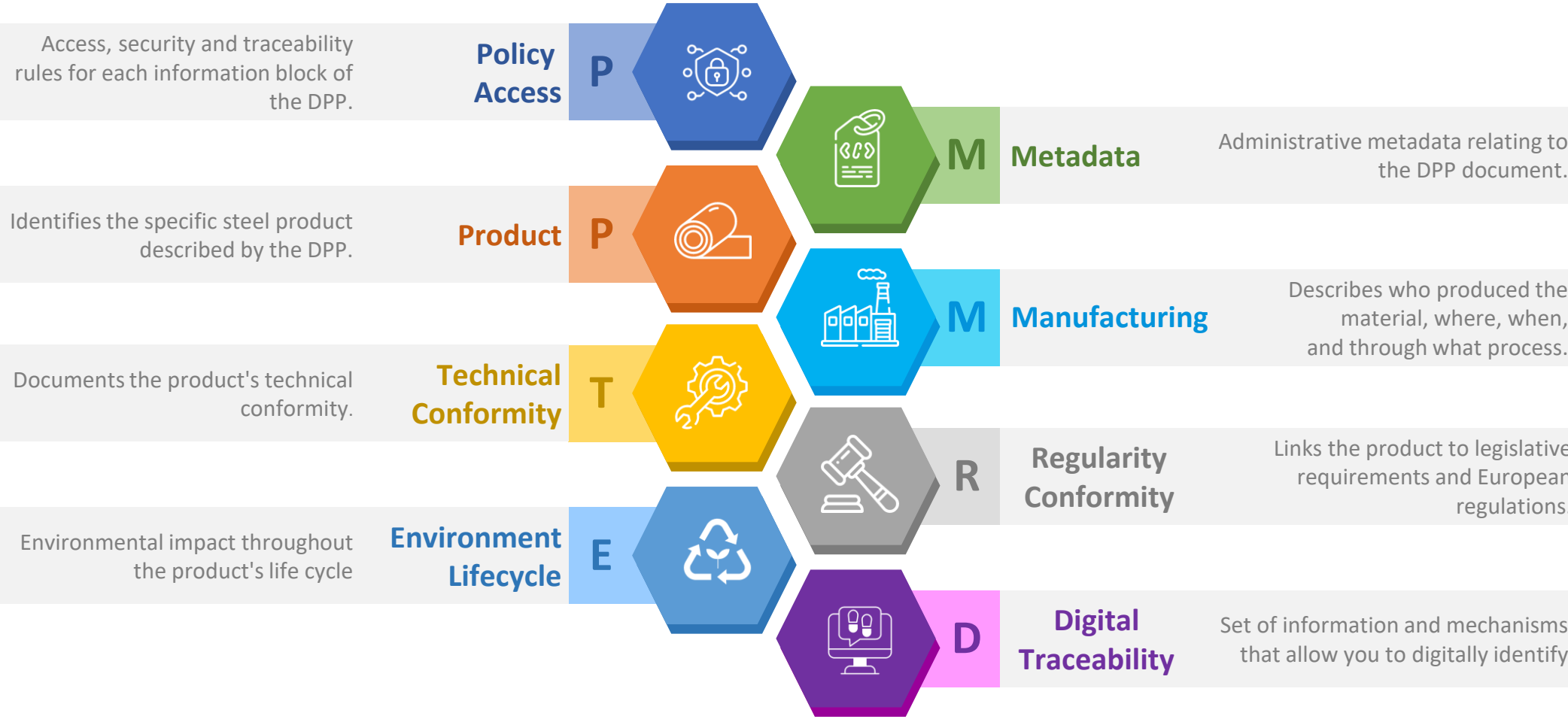
# Enabling transparency, traceability, sustainability, and circularity

The DPP is a digital document that collects and makes accessible essential information about a product throughout its life cycle. It is a tool promoted by the European Union as part of the **Green Deal** and the **Ecodesign for Sustainable Products** (ESPR) Regulation.



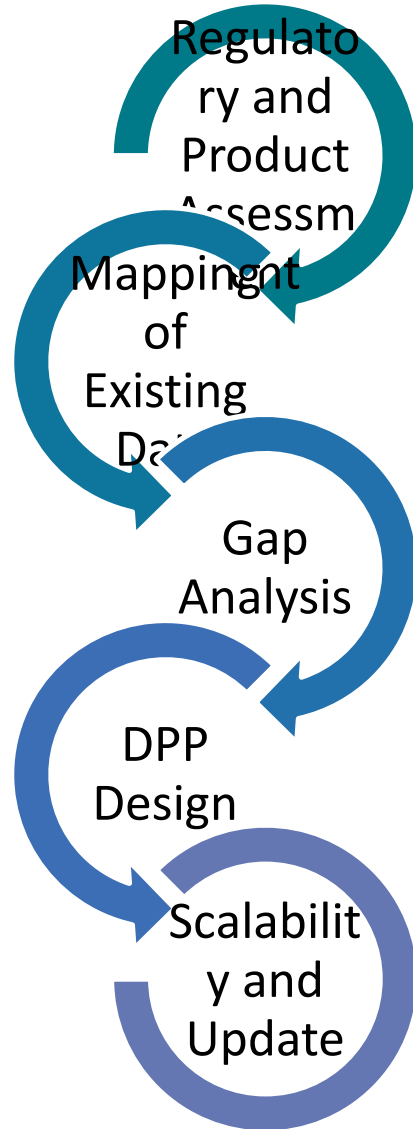
# WHY INDUSTRIES SHOULD CARE ABOUT SEMANTIC INTEROPERABILITY

## DIGITAL PRODUCT PASSPORT



## WHY INDUSTRIES SHOULD CARE ABOUT SEMANTIC INTEROPERABILITY

### DIGITAL PRODUCT PASSPORT



- PRISMA as DPP Provider
- Guarantee a safe, secure and sharable access for all the stakeholders.
- Guarantee Data Management, Integrity and Security.
- Guarantee Assurance & Governance due to Traceability.

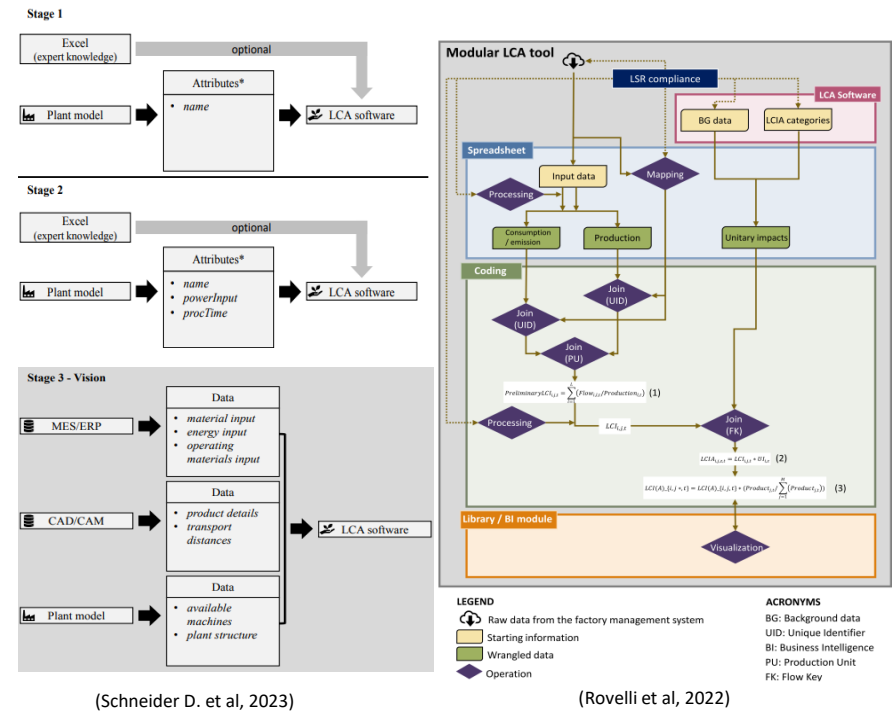




# WHY INDUSTRIES SHOULD CARE ABOUT SEMANTIC INTEROPERABILITY

## DYNAMIC LIFE CYCLE ASSESSMENT

### Literature studies

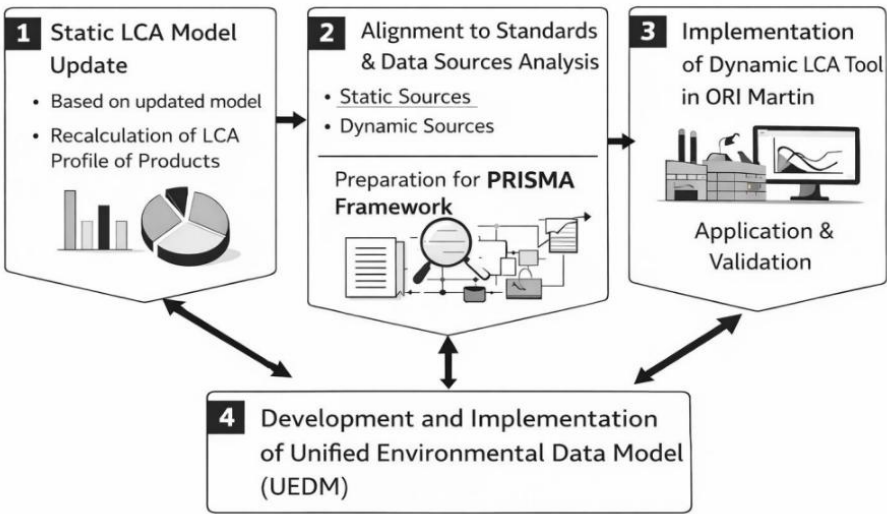


### Standard studies

**ISO 14000 family standards** define how companies and organizations manage their environmental responsibilities

**ISO 14001: Environmental Management System** defines the criteria Environmental Management Systems have to comply with. It ensures that environmental impacts are being measured and improved.

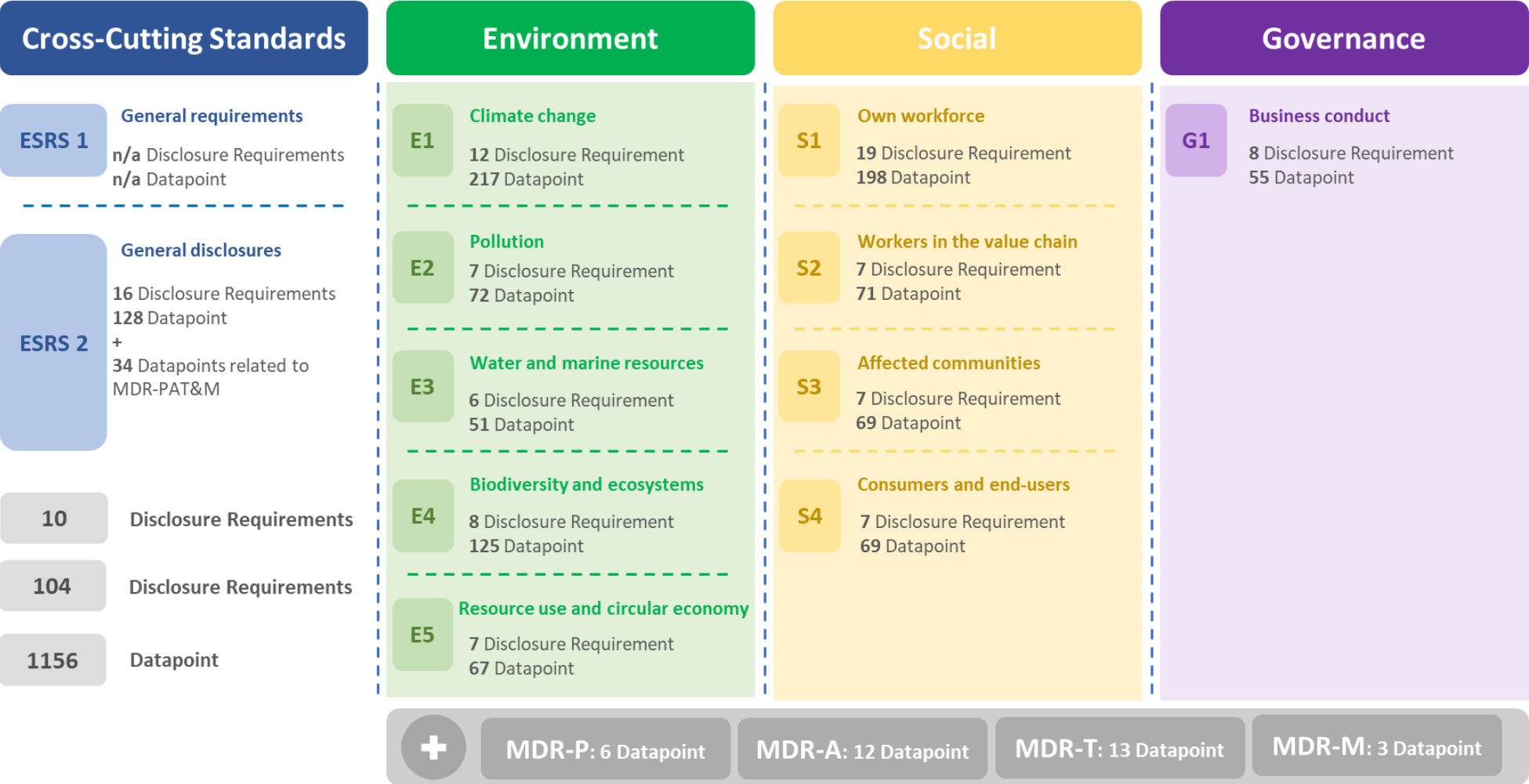
- **ISO 14021: Environmental Claims and Labels** defines how specific environmental claims have to be and how they have to be formulated and documented
- **ISO 14040:2006 Life Cycle Assessment Framework** defines the principles and framework of a Life Cycle Assessment
- **ISO 14044: LCA update** replacing earlier version of ISO 14041-14043
- **ISO 14067 Quantifying Carbon Footprint** defines how the carbon footprint of a products is quantified during a LCA.
- **ISO 50001 Efficient Energy Management** defines the Energy management Systems.



# WHY INDUSTRIES SHOULD CARE ABOUT SEMANTIC INTEROPERABILITY

## ANNUAL SUSTAINABILITY REPORT

A structured approach aligned with the **European Sustainability Reporting Standards**, integrating governance, environmental, and social analyses to identify impacts, risks, opportunities, and actions supporting transparent, consistent, and comparable sustainability reporting.



# THE TRADITIONAL APPROACH

- Test campaigns on product samples

Quality information available only at the end of production  
and not easily traceable between process phases

- Offline-only implementation of corrective plans

Limited adaptation to changing conditions  
and evolving requirements



# THE **DIGITAL** APPROACH

- Statistical techniques applied to data collection
- Real-time data processing and predictive models
  - Detect potential issues before their occurrence
- Online remedial actions
  - Manage non-conformities

## WHY INDUSTRIES SHOULD CARE ABOUT SEMANTIC INTEROPERABILITY

## WHY SHOULD WE USE Q3-PLATFORM?



to collect and harmonize in one ecosystem every data coming from various sources



to analyse and correlate information from various domains and enhance your business



to have a unified user experience relying on Danieli's process knowledge in the metal industry



to rely on a decision-driven solution optimizing production process



to have a collaborative environment for process knowledge sharing inside your company



## Cloud and hybrid architecture

Having part of Q3-Platform's architecture in the cloud can be highly beneficial from a variety of standpoints



### SCALABILITY

Adapt anytime the computational resources to fit your plant's needs



### DISASTER RECOVERY

Secure backup storage in case of failure or disaster recovery



### SECURITY

Secure architecture inside a private network with unique cloud identification server

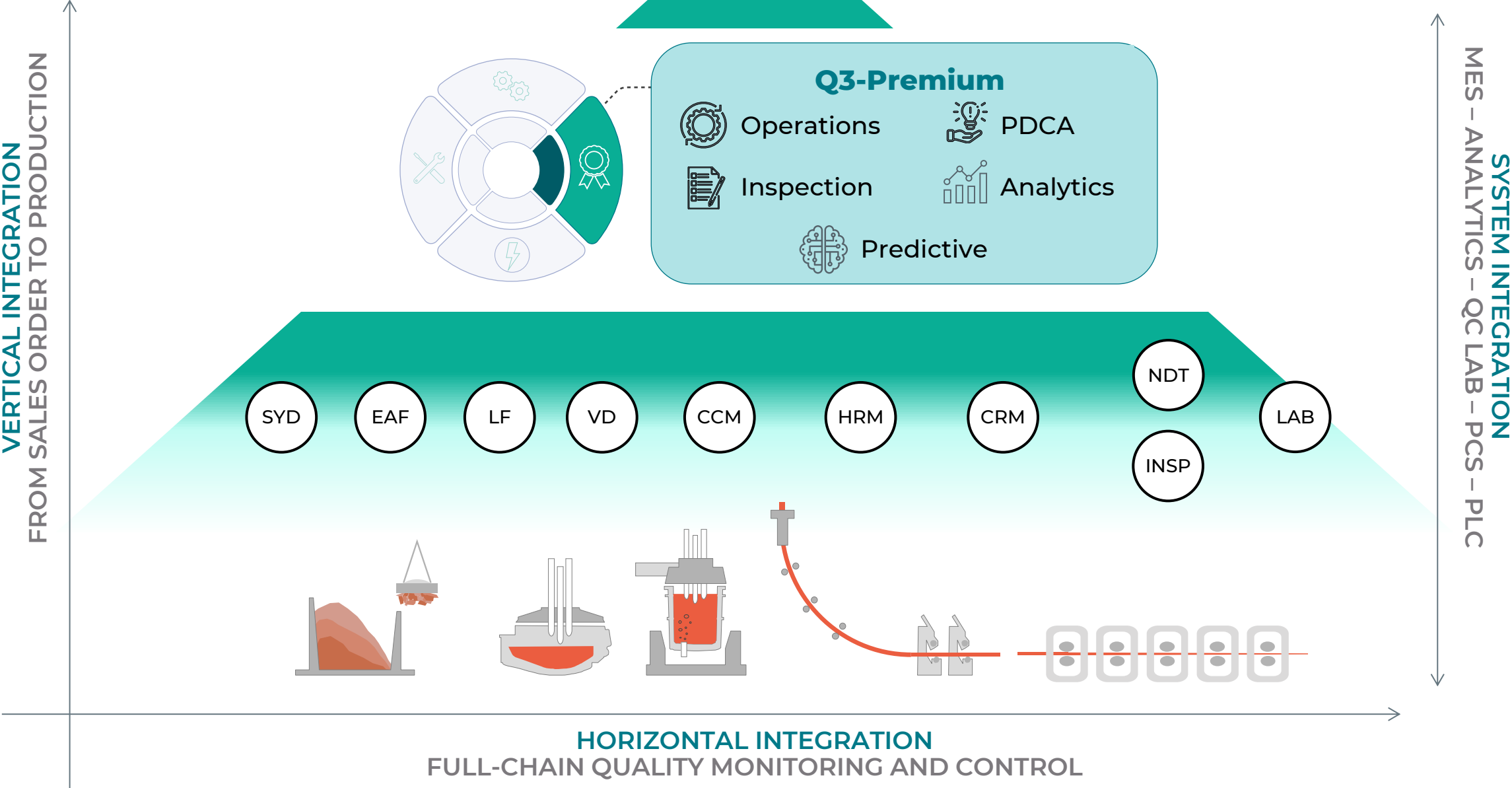


### SAVINGS

"Pay only for what you use" formula helps to cut unnecessary costs



WHY INDUSTRIES SHOULD CARE ABOUT  
SEMANTIC INTEROPERABILITY



- Reduction in non-conformance ratio
- Improvement in production yield
- Higher process repeatability
- Fast and precise response to customer claims
- Driver to knowledge sharing and continuous improvement
- Smart working and team collaboration enabler



### TODAY'S CHALLENGES AND OPPORTUNITIES

- Industrial devices produce huge quantities of raw data
- Connect data coming from both legacy and IoT devices
- Gather, enrich, and track data to unveil their business value
- Maximize process improvements with a thorough data analysis
- Avoid process-specific know-how losses with changes in personnel



# Enabling efficient information integration DPP and LCA generation in the steel industry

Thank you



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