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D 5.2
Organisation of 1st European workshop and associated report

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[1] PU: Public, CO: Confidential, only for members of the consortium (including the Commission Services)
[2] RE: Report, OT: Other; ORDP: Open Research Data Pilot

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 873086.

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Abbreviations and acronyms

TERMS, ABBREVIATIONS AND ACRONYMS	
DoA	Description of Action
CE	Circular Economy
D	Deliverable
WP	Work package

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1 Introduction

The ConnectedFactories2 workshop '**Pathways to the digitalisation of manufacturing and associated use cases'** was organised on the 24th of March 2021.

One of the main topics that have been discussed was the ConnectedFactories2 pathways about Data Spaces and Circular Economy (CE). Pathways are explaining how to achieve an advanced digitalisation level in manufacturing through an evolutionary step-by-step transition. Use cases and demonstrators are playing an active role to understand how the transition to a high level of digitalisation in manufacturing is taking place. They offer in fact Success Stories and Best Practices for Digital Transformation.

The online workshop mainly focused on 2 specific pathways: The Circular Economy pathway and the Data Spaces for manufacturing pathways underling at the same time the importance of cross-cutting aspects and key enablers.

This report reflects on the aim and content of the workshop. Considering the advanced level of information that is available about the ongoing work on data spaces and their implementation within manufacturing, this report provides more details on the data spaces perspective. The data spaces pathways is also a quite fundamental pathway to other more specific transformations, including also the transition to circular economy.

2 Agenda of the workshop

9:15 -9:30 Connecting to the online meeting

9:30 – 9:45 General introduction (Chris Decubber, EFFRA)

9:45 – 11:15 **Data space pathway and cases**

- Introduction/purpose of the session (Sergio Gusmeroli, 10')
- Main cases (5x10')
  - Data Spaces implementations for Didactic Factories and Testing and Experimental Facilities in AI REGIO project by Alissa Zaccaria INTELLIMECH (SME)
  - Implementing Data Spaces via Asset Administration Shell in CANVAAS and DIMOFAC projects by Saadia Dhouib, CEA
  - Data Sharing Spaces in White Goods spare parts management in AI.SOV project by Pierluigi Petrali, WHIRLPOOL- Strong association with Hyperconnected Factories Pathway
  - Data Spaces for Digital Product Passport from sheep to shop in BOOST4.0 project, by Alessandro Canepa, Piacenza Cashmere (SME) – strong association with Collaborative Product-Service Pathway
  - Data Spaces for Additive Manufacturing Machinery in QU4LITY project, by Gaetano Patrimia, PRIMA Industrie – strong association with Smart Autonomous Factories Pathway

Panel discussion and interaction with participants (30')

11:15 –12:25 **Circular Economy (CE) pathway and cases**

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- Introduction/purpose of the session (Katri Valkokari, VTT 10')
- Main cases (3x10')
  - DigiPrimeuse case, cross-industry synergies of material flows (pilot case between textiles and automotive, Marcello Colledani, Polimi
  - EFPF use case, Alexandros Nizamis, ITI
  - KYKLOS 4.0 use case, ProMedi carepilot, Luca Rizzi, CETMA
  - (Optional) VTT use case

Panel discussion and interaction with participants (about 30')

12:25 - 12:45 **Conclusion – outlook to next steps (more detailed structured description of cases)**

Presentations and recordings are available via the following public links:

- Presentations - here
- Recordings - here

Please note that we have edited the recording of each presentation to facilitate their viewing.

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3 The aim and essential content the workshop

The ConnectedFactories2 workshop that was organised on 24 March aimed specifically at:

- Offering an update on the work on the pathways and the association of cases, in particular the circular economy pathway and the data spaces for manufacturing pathway.
- Obtaining the latest information regarding the work on use case and demonstrators that are relevant for the two pathways, situate these cases within the pathways and lay the foundations of future interactions with these and similar projects for further information sharing and analysis
- Providing an overview of the importance of cross cutting aspects.
- Introduction of the new pathway on Artificial Intelligence.

The workshop was organised before the big dissemination event named "Digitalisation of manufacturing: pathways, key enablers and skills" on 22 April 2021. The idea was to keep this webinar smaller for achieving a great level of interaction with the participants via digital murals.

3.1 Circular Economy Pathways

Before the workshop, an introduction material of CE pathway was provided to the representatives of the three projects (DigiPrime, EFPF and KYKLOS4.0). This material included a preliminary matrix (Figure 1developed by VTT and Polimi. It is developed as a complementary framework for the CE pathway (Saari et al. 2021)[3]. The matrix aims to identify how in different levels of circular economy pathway, CE provides opportunities to turn the inefficiencies of linear value chains into business value. The identified five inefficiencies are: unsustainable materials, underutilized capacities, pre-mature product lives, wasted end-

CE maturity levels/ manufacturing value chain	**Linearity**	**Industrial CE Piloting**	**Systemic Materials Management**	**CE Thinking**	**Full Circularity**
Product design					
Sourcing					
Production					
Logistics					
Marketing and sales					
Product use					
End of life disposal					

Figure 1. The matrix bridging together of CE maturity levels and value chain phases

[3] Leila Saari, Vafa Järnefelt, Katri Valkokari, Jorge Tiago Martins and Federica Acerbi (2021) Towards sustainable manufacturing industry via collaborative circular economy strategies. A conference paper accepted to PROVE2021

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of-life value, and unexploited customer engagement. (Figure 1). Through the matrix, it was possible to deeper investigate the distinctive levels at which the embracement of CE can be put in practice to overcome the inefficiencies experienced along the manufacturing value chain.

The introductory material enabled the project representatives to consider their position at the CE pathway and the practical examples they could bring to the CE pathway. All three projects presented engrossing use cases linked to different levels of CE pathway.

The first stage of "Linearity" represents the permanence of the traditional principles and practices of make-take-dispose. So, across the value chain there are no identified solutions. Rather there are acknowledgements of the challenges cutting across the insufficiencies of product design, the sourcing strategy that is generally disengaged from material and energy consumption strategies, the insufficient attention paid to R-cycles, the non-existent plans to optimise logistics, the absence of a sustainability vision from marketing activities, and neglect of opportunities for reuse or repair products during their lifecycle.

At the stage of "Industrial CE piloting", where a level of experimentation is observable both internally and in collaboration with external industrial actors, there are nascent strategies and solutions aimed at resource sufficiency, with a particular emphasis on the production and logistics stages of the value chain. Exemplary solutions related to production have been identified at manufacturing quality pilots focused on the reduction of unnecessary scrap material, as well on the use of development of demos for the application of augmented reality to support the maintenance of PRIMA Industrie's additive manufacturing systems (currently being explored in the QU4LITY project). Further observed solutions focused on logistics address the need to increase traceability, visibility and transparency in CE supply chains and are exemplified by the piloting of blockchain traceability through a mobile delivery application currently being developed by the European Factory Platform.

A more integrated concern with the opportunities to reuse, refurbish, recycle and remanufacture materials is what characterises the "Systemic material management" stage, where the identified solutions are focused on extending the adoption of CE to the different steps of the value chain in order to grasp more value-generating opportunities. Exemplary solutions related to product design have been identified in the Kyklos project's approach to product personalisation, more specifically through developing a fully automatised process where users can configure wheelchairs through web modelling tools according to individual specifications, where unique components of the wheelchair are 3D printed, and where augmented reality manuals are available to users.

Further solutions with a more specific focus on production reflect companies' efforts to actively monitor the environmental impacts of production and are observable in the TRICK's project use of block chain to build a shared tamper-proof ledger that tracks "from sheep to shop" how fabric is manufactured for high-end textile supply chain. Concerning logistics, participating firms highlighted the importance of ensuring the existence of core buffers in the reverse chain, to enhance transparency and control.

When considering marketing and logistics, the concept and practice of a digital marketplace has been exemplified by the European Factory Platform's development of a matchmaking and online bidding service and federated search service that enables automated B2B matchmaking and new market opportunities. Finally, participating companies' more holistic view of production and demand in the context of product use are exemplified by the use of AI-based systems such as the one deployed by Whirlpool in the AI.SOV project

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that forecasts production for spare part optimisation and reduction of overproduction of machine components.

Moving further in the stages of CE maturity, “CE Thinking” signals manufacturing firms’ commitment to an industrial symbiosis network, where the ultimate goal is to leverage a closed-loop supply chain. Participating firms’ solutions concerning production challenges revolved around the synergistic opportunities of coupling remanufacturing and manufacturing of new products in the same assembly line. Similarly, and taking advantage of the affordances of factory connectivity and real time data analytics, there are examples of smart waste management (monitoring and alerting) as illustrated in the European Factory Platform Pilot, which simultaneously reflects an active concern with the end of life disposal of manufactured products.

Considering logistics, participating firms highlight the range of solutions offered by digital platform integration, which enable the interaction among value chain actors. This is observable in the European Factory Platform’s use of a block chain-based information exchange approach that supports secure and reliable information exchange in collaborative networks and enables traceability to improve closed loop supply chains. At the level of marketing and sales, concrete example of the synergies between manufacturing-as-a-service and product-as-a-service business models is exemplified by Kyklos’ web-based tool where users can configure wheelchairs through web modelling tools according to individual specifications and acquire knowledge on product properties and maintenance needs, effectively operating as a digital twin of the product’s footprint. Further, at the level of product use, participating firms’ solutions are related to leveraging industrial IoT embedded in products, such as Whirpool’s predictive maintenance, whereby sensor-based data on the performance of clothes dryer drums is shared with equipment supplier.

Finally, the stage of “Full Circularity” represents as an aspirational standard towards which manufacturing companies can progress, should this be consistent with their core business and product typology, i.e. it should not be expected that the descriptors of full circularity across the value chain are suitable or even the ultimate end goal for the operations of every type of manufacturing firm. Given the developmental nature of the trajectory towards this stage, the dominant features here reflect a broad understanding of value flows and co-creation of new value circles within manufacturing networks.

Thus, these above described practical case examples of CE business (Figure 2) showed that changes are needed concurrently in several value chain phases. Similarly, the use cases indicated that the above described solutions developed within the cases, can be reflected to have links to several levels of pathway. The connection to the level three (systematic material management) was the mostly mentioned. The use cases represented different industrial contexts and showed how the challenges are both similar as well as different based on different value chain structures, product life cycles etc.

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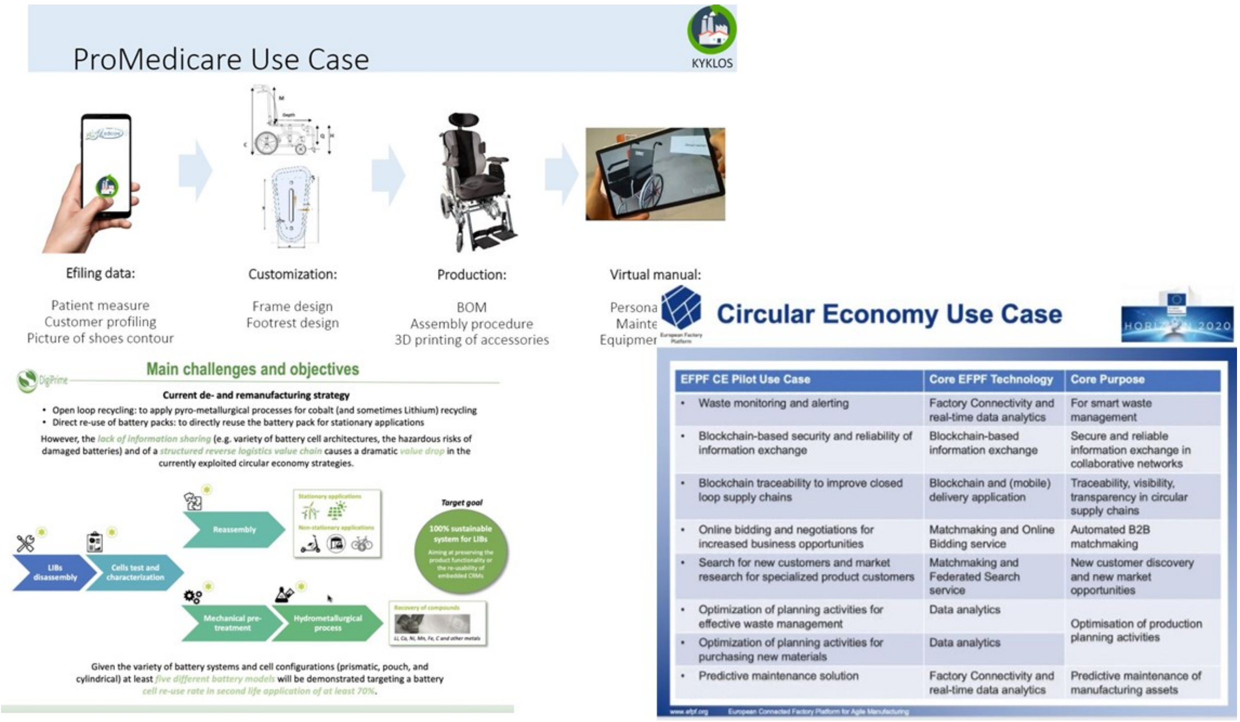

Figure 2 . Examples of practical use cases for CE pathway presented at the workshop

After the use case presentations, the interaction between the participants was facilitated at the Miro board: https://miro.com/welcomeonboard/ToawEI0HckCudj3q53lacYK82U8BwTYeW7TmZ7AWZGWgAcqMwMml42jHHECbjKtl. During the workshop, features, solutions and challenges of CE maturity levels on each manufacturing value chain phase were collected via the matrix (Figure 3).

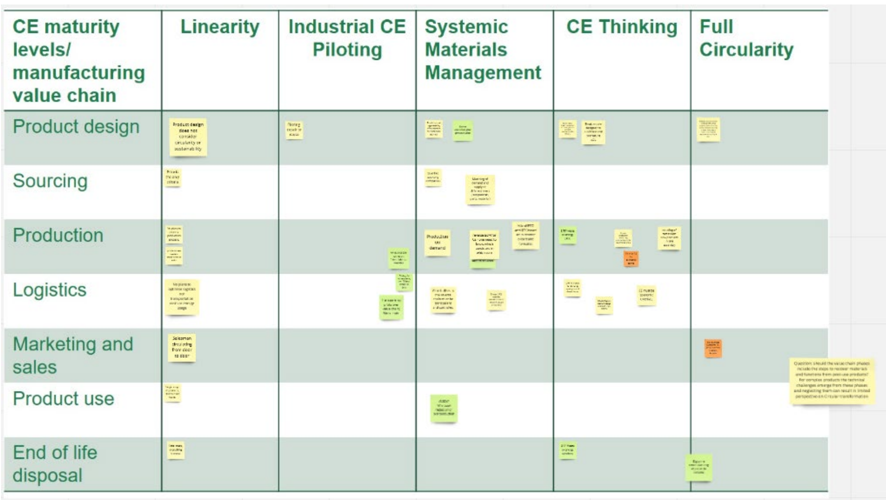

Figure 3 The results of workshop: identified challenges and solutions

The participants provided good insights on practical solutions and the comments will be utilised within the future development work. For instance, traceability and transparency of value chains was mentioned often and digital platforms for sharing the data of product manufacturing as well as product use was mentioned as an important enabler. Based on the results of the workshop, the preliminary matrix was completed in order to summarize the key development needs in each of the maturity levels (Figure 4).

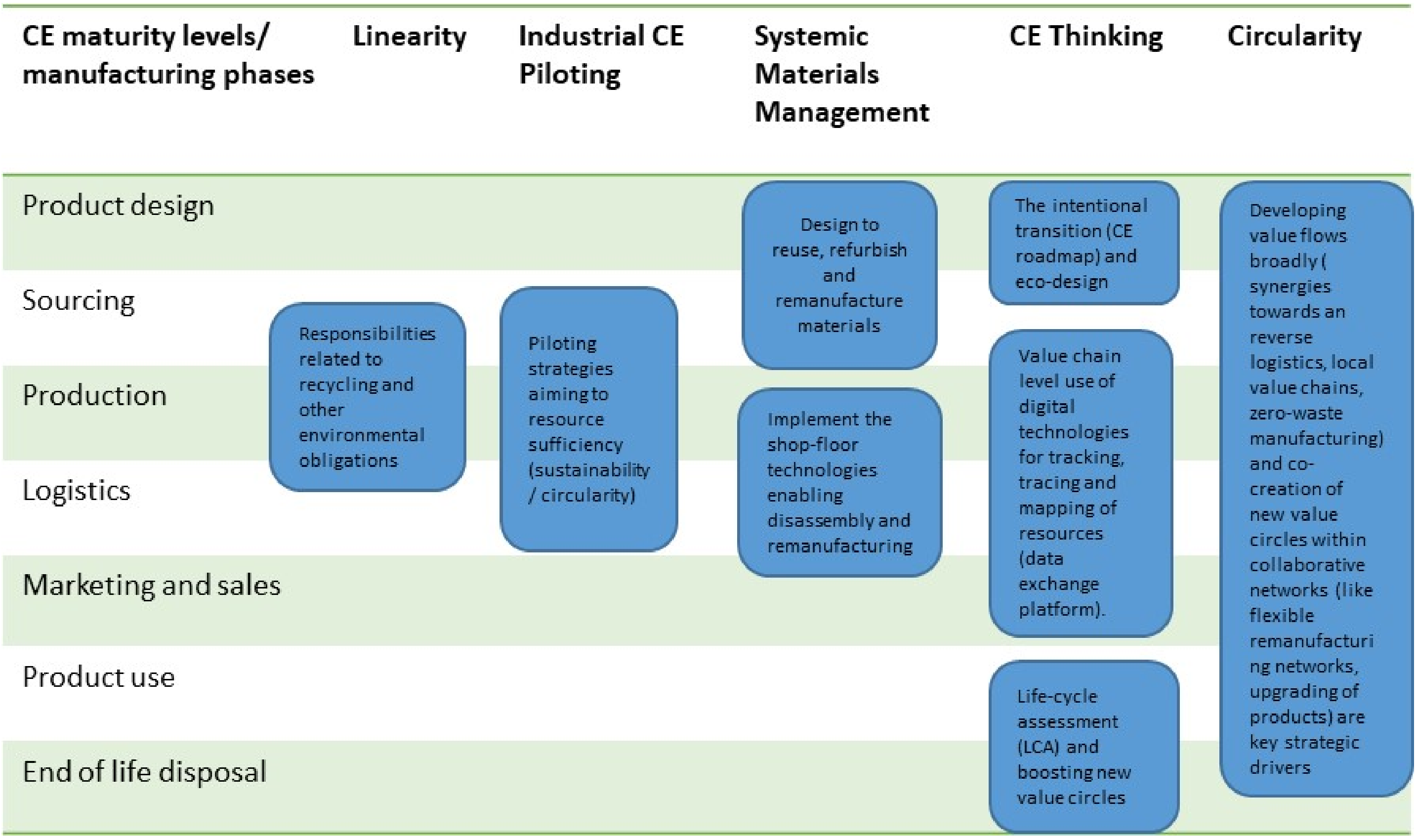

Figure 4. Key actions at different levels of CE pathway

At the first level, linearity, the focus of companies and their value changes is typically on environmental obligations and responsibilities related to the recycling. Then, companies launch different piloting strategies aiming to resource sufficiency within sourcing, production or logistics enhancing sustainability or circularity. Through systemic materials management industrial companies and their value chains consider already at product design phase the different R strategies and/or implement at shop-floor technologies enabling remanufacturing and other R strategies. The CE thinking level is concretised in a CE roadmap, aiming to intentional transition and boosting identification of new value circles. At the value chain level, companies use digital tools (data exchange platforms) for mapping the resources and life-cycle assessment is considered at value chain level. Finally, the circularity level, value chains are developing value flows broadly (synergies towards an reverse logistics, local value chains, zero-waste manufacturing) and co-creation of new value circles within collaborative networks (like flexible remanufacturing networks, upgrading of products) are key strategic drivers.

3.2 Data Space Pathway Discussion and Interactive session

The first hour and half of the webinar was dedicated to discuss about Data Spaces, with the objective to explain **what a data space is**, presenting firstly the main European initiatives developed around the topic and then identifying a number of embryonic cases of real implementations in manufacturing.

The introductory part was conceived to provide an overview of the European activities and strategies running to support the implementation of Data Spaces. It's worth to mention, for instance,

- the **European Data Strategy** published in February 2020 that supports the creation of European Data Spaces as key enabler toward a digital transformation for Europe. Four pillars have been considered and one of them is the deployment of Data Spaces in crucial economic sectors and domains of public interest. The Data Space for Manufacturing call will be soon published by the European Commission in the Digital Europe Programme (DEP). During the webinar, challenges identified by the European Commission (DG CNECT) for the new DEP programme were presented and analysed.

Figure 1 Four pillars of the European Data Strategy

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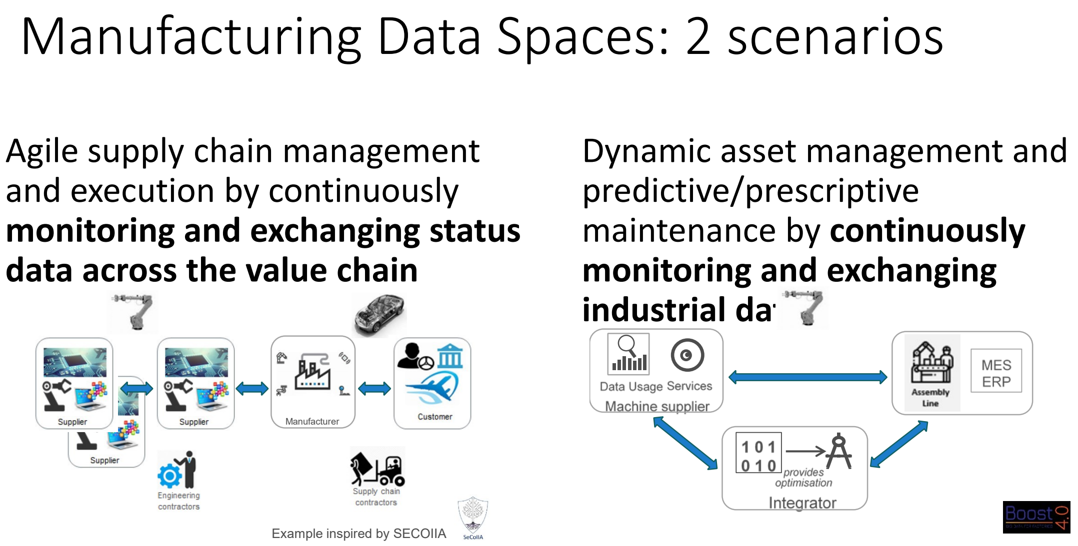

Figure 2 Two scenarios for manufacturing Data Spaces

- The **BDVA** (Big Data Value Association) **Reference Model for Data Governance**, that assigns to “Data Sharing platforms” a key role, encompassing and boosting all data dimension (visualization and UI, analytics, processing architecture, protection and management, plus data sharing). These are the dimensions of analysis through which the pathway will be developed

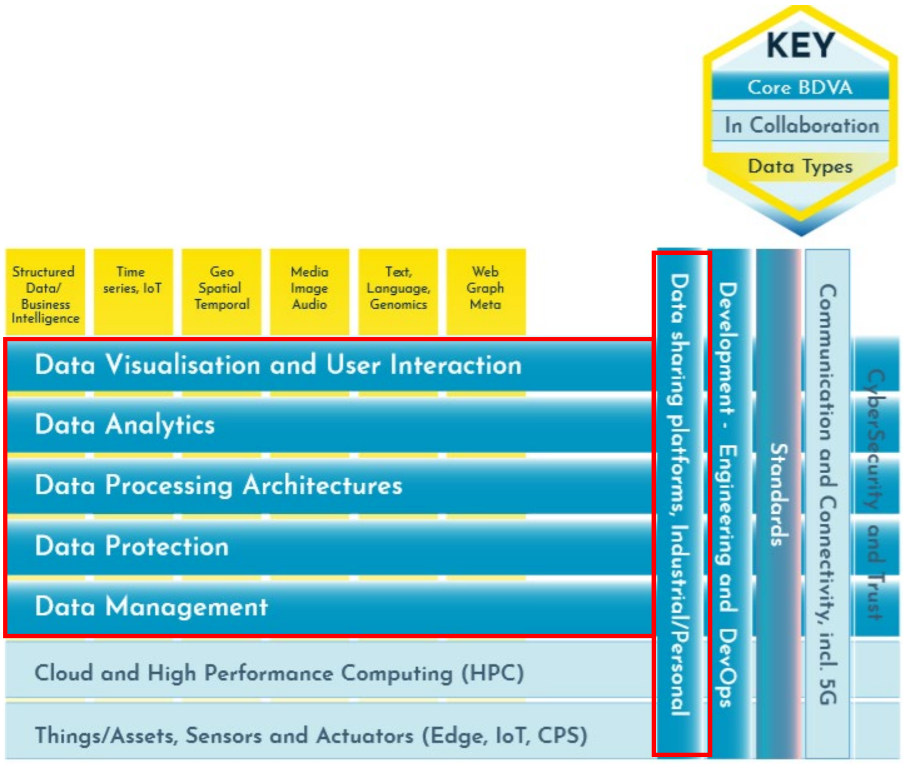

Figure 3 BDVA dimensions of analysis for Data Governance

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- The **Connected Factories Data Space pathway**, as a reference framework for manufacturing industry to identify their position in term of data exploitation and valorisation. Level One No Data Control (data are generated by Industry 4.0 CPPS but companies are unaware of them); Level Two Data Silos (data are locked in silos managed by ICT solutions vendors); Level Three Data Bridges (ad-hoc bridges between proprietary formats and data models, vendors' lock-in); Level Four Data Interoperability (common standard data models and ontologies for seamless semantic data integration); Level Five Data Valorisation (FAIR high value Data Sets to be shared in a trusted network).

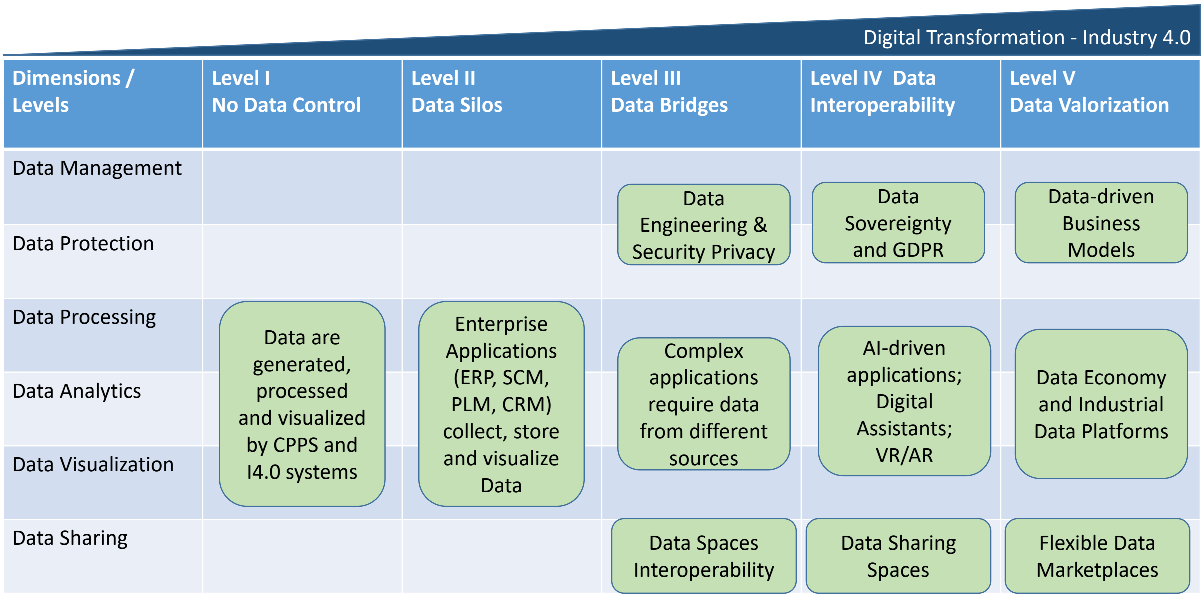

Figure 4 The Connected Factories Data Space Pathway

During the webinar **five different use cases were presented**, to provide concrete evidence of Data Spaces implementation and possible facets, and to highlight main obstacles and barriers to be overcome, positioning the use cases along the Connected Factories Pathways (Hyperconnected, Collaborative Product-Service, Autonomous Smart Factories Pathways and, of course, Data Space Pathway).

In next paragraphs, the five presentations are briefly summarized.

3.2.1 Data Spaces implementations for Didactic Factories and Testing and Experimental Facilities

The first presentation was run by INTELLIMECH and it dealt with the implementation of Data Spaces inside **Didactic Factories** (DF) and **Testing and Experimental Facilities** (TEF), describing the experiences of AI REGIO project. Since INTELLIMECH is involved also in Qu4lity project (supporting Whirlpool pilot where a digital platform for data management is developed) a second use case is presented, in order to provide a further example of Data Space application.

DATA SPACE FOR DF AND TEF USE CASE IN AI REGIO PROJECT

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This use case is led by INTELLIMECH and will be implemented within the AI REGIO[4] project with the collaboration of a large industrial cranes manufacturer member of the INTELLIMECH ecosystem.

The experiment at issue will **exploit Natural Language Processing (NLP) algorithms** to achieve a troubleshooting system featuring an advanced human-machine interaction based on free text or speech dialogue, enabling the system to accommodate mistakes and adapt to the competencies of the specific user. Moreover, the system is intended to be integrated with a self-learning mechanism that will automatically enrich its knowledge over time by processing the ongoing issues. This structured data collection can enable enterprises to identify unconsidered faults as well as new associations between system malfunctions and component failures and, on this basis, optimize the assets design and integrate the maintenance manuals.

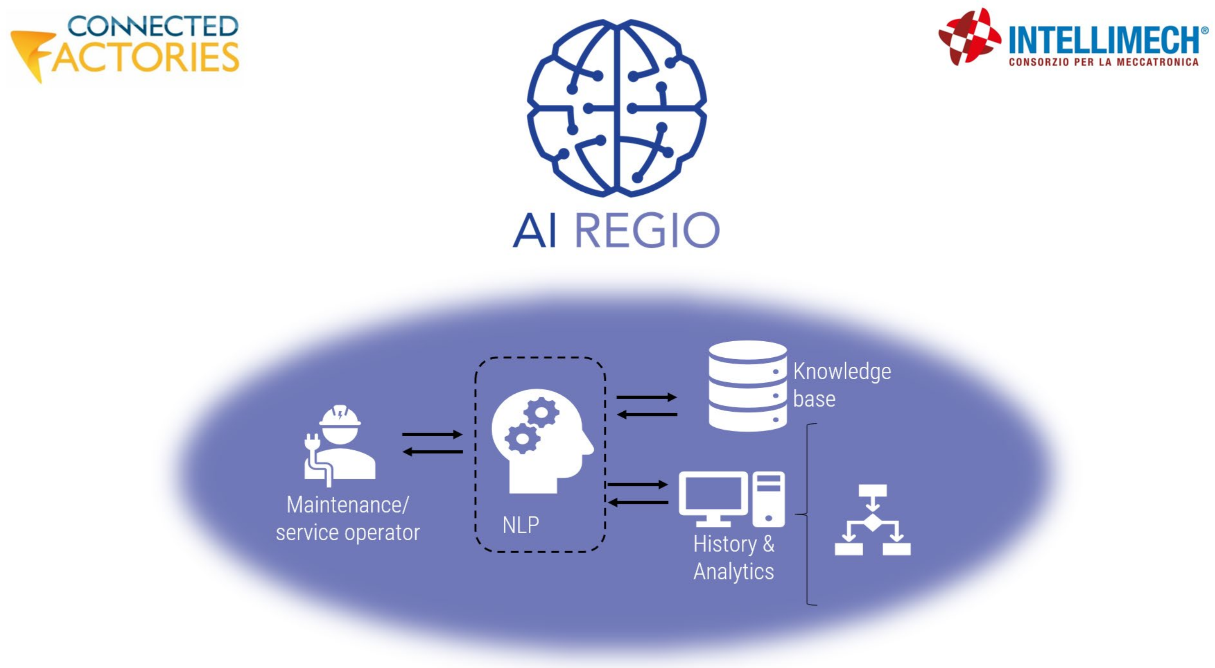

Figure 5 Schema for the AI REGIO use case

The experiment can be inscribed in the "**Collaborative Product-Service Factories**" pathway. In particular, given the interaction with the end-users and the feedback acquirable by these entities, this pilot can be related with the Service-enabled Product Design scenario.

[4] The objective of the 36 partners from 8 European countries which joined the AI REGIO project is to support European SMEs on the road to AI-based digitization by further integrating the pan-European network of regional Digital Innovation Hubs (DIHs)

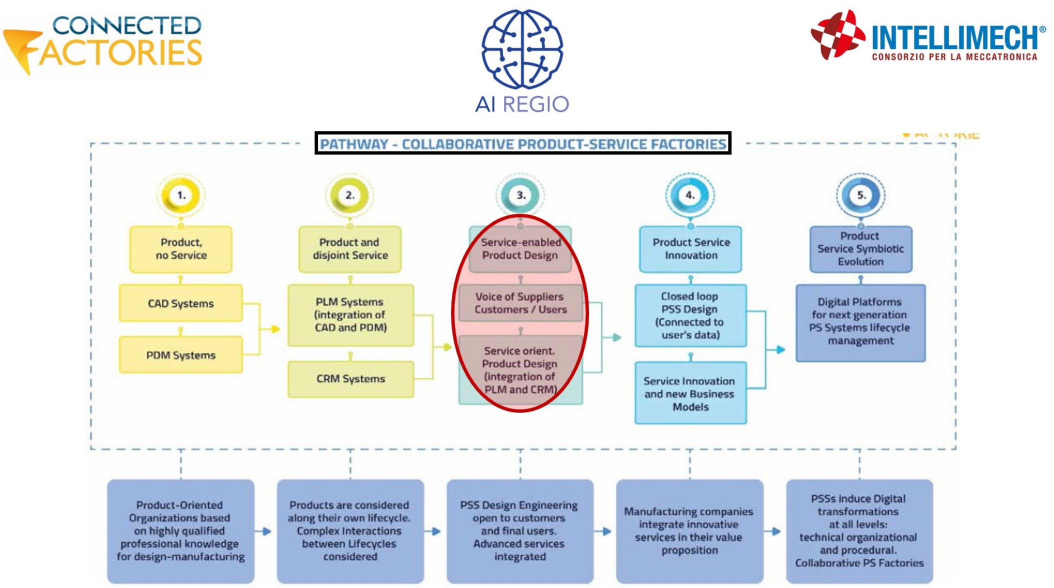

Figure 6 The position of AI REGIO use case in the Collaborative Product-Service Factories Pathway

This use case can be mapped **between the second and the third level of maturity** according to the DS pathway. Indeed, data can be acquired from different sources and stored in interconnected databases. However, no multisource analytics is planned.

Digital Transformation - Industry 4.0

Dimensions / Levels	Level I No Data Control	Level II Data Silos	Level III Data Bridges	Level IV Data Interoperability	Level V Data Valorization
Data Management			Data stored in ad-hoc interconnected databases		
Data Protection				Standard protection mechanisms are used	
Data Processing		From unstructured data (text, vocal recording) format to semi-structured information (fault cathegorization)			
Data Analytics		Database interconnected but no multisource analytics pipeline			
Data Visualization			Data from different sources can be extracted and visualized at corporate level		
Data Sharing	No needs for data sharing with customer		Extracted knowledge shared with supplier		

Figure 7 The position of AI REGIO use case in the Data Space Pathway

WHIRLPOOL USE CASE IN QU4LITY PROJECT

This use case is led by Whirlpool with the participation of INTELLIMECH in the framework of the Qu4lity project. Qu4lity is the largest European project dedicated to Autonomous Qu4lity (AQ) and Zero-Defect

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Manufacturing (ZDM) in Industry 4.0. It aims to demonstrate, in a realistic, measurable and replicable way, an open, certifiable and highly standardized ZDM product and service model, suitable for SMEs and based on shared data for Industry 4.0 across 14 pilot lines.

The pilot at issue will be based on **a digital platform which implement the Materials, Processes, Functions and Quality (MPFQ) model** to reach a holistic view of the Quality system. According to this approach, every material, production process and product function/feature can be described by its technical characteristics and a collection of measured data.

Some indicators related to quality will be monitored to assess the quality process control. The AQ approach will allow to automatically detect anomaly in these indicators and generate an “alarm” to allow to fix the corrections in the production process.

All the information collected and analysed by the system will be part of dedicated reporting and monitoring tool that can be used by different departments inside the organisation for different purposes.

Figure 8 The data lifecycle for WHIRLPOOL use case

The experiment can be inscribed in the “Autonomous Smart Factories” pathway, particularly addressing real-time optimization.

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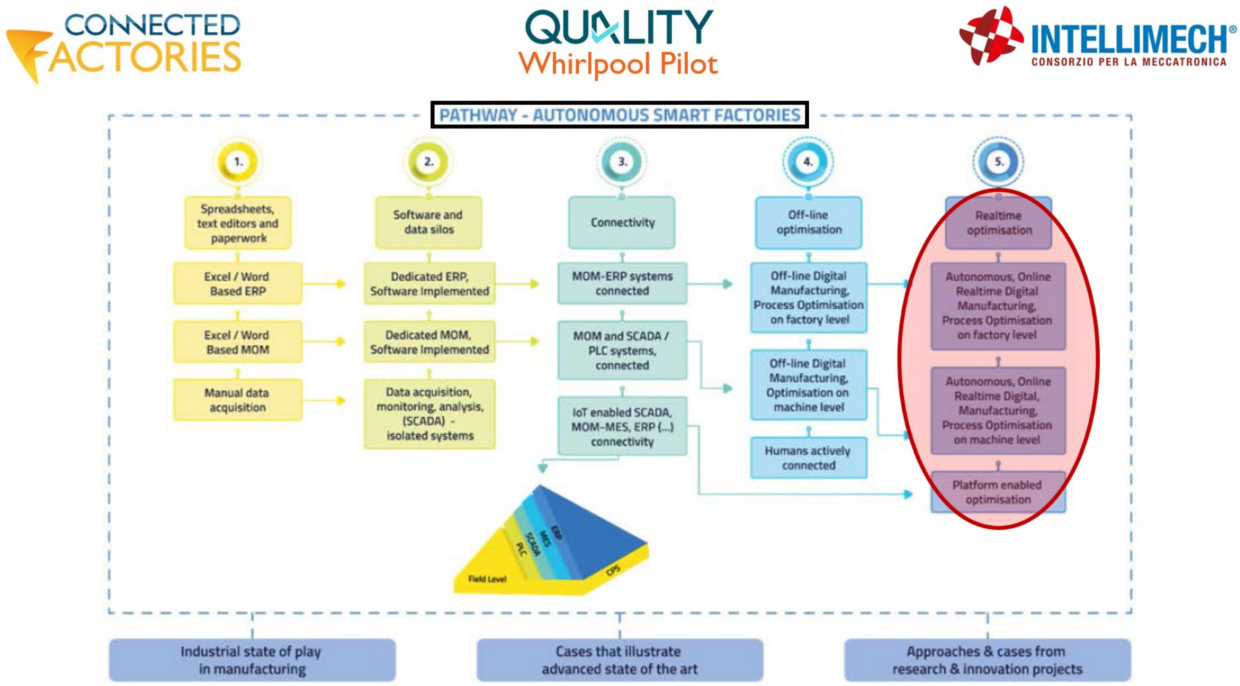

Figure 9 The position of WHIRLPOOL use case in the Autonomous Smart Factories Pathway

Moreover, the use case can be mapped in an **intermediate level of maturity** according to the DS pathway. Indeed, for optimization purposes, data from different sources need to be integrated.

CONNECTED FACTORIES — QUALITY Whirlpool Pilot — INTELLIMECH CONSORZIO PER LA MECCATRONICA

Digital Transformation - Industry 4.0

Dimensions / Levels	Level I No Data Control	Level II Data Silos	Level III Data Bridges	Level IV Data Interoperability	Level V Data Valorization
Data Management			Data stored in ad-hoc interconnected databases		
Data Protection				Standard protection mechanisms are used	
Data Processing			Ad-hoc applications for data sharing among IT systems		
Data Analytics			Different analytic tools based on the specific application		
Data Visualization			KPI trend cockpits are developed to show quality indexes		
Data Sharing		Extracted knowledge shared within the Whirpool ecosystem			

Figure 10 The position of WHIRLPOOL use case in the Data Space Pathway

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The main barriers identified in these two pilots can be summarized as follows:

- AI REGIO pilot
  - NLP platform maturity
  - Resources for maintaining the system
  - System integration
- Qu4lity pilot:
  - Data quality
  - Data integration
  - Traceability

3.2.2 Implementing Data Spaces via Asset Administration Shell in CANVAAS and DIMOFAC

The second presentation was run by CEA and it dealt with the implementation of Data Spaces using Asset Administration Shell (AAS) as interoperability standard.

Interoperability of industrial equipment is a key issue of Industry 4.0, a requirement to answer to the challenges of mass customization and flexibility. The Asset Administration Shell (AAS) is a promising standard to address interoperability of production assets. Interoperability enables production equipment to intercommunicate seamlessly, providing new levels of automation and productivity yields. Manufacturing companies must grasp the opportunity on AAS as a main enabler for Inustry4.0, but there is a lack today of user-friendly tools with a guided methodology for training workers in factories to deploy AAS for increased interoperability. The CanvAAS **EIT MANUFACTURING project** is developing such methodology and tools to encourage adoption of AAS.

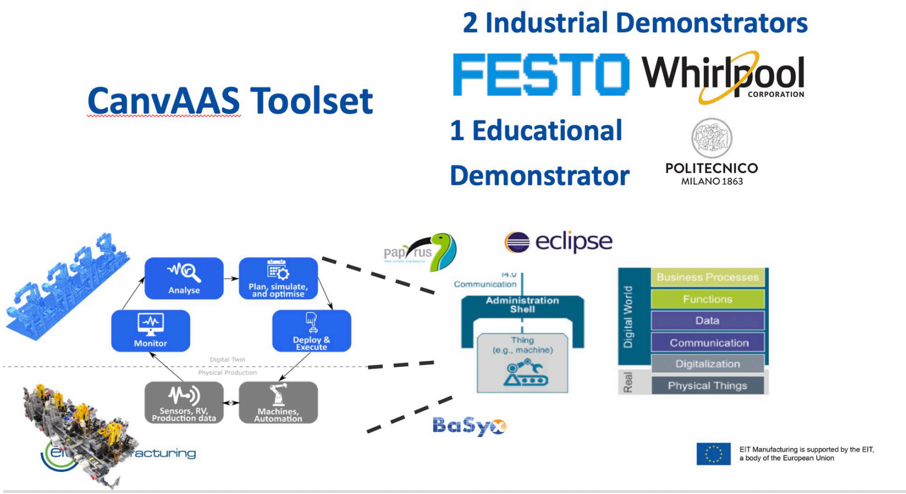

Figure 11 Overview of CanvAAS's Toolset and partners

Three demonstrators are developed in CanVAAS:

- **Demonstration in Didactic Factories** and Training course MooC: A demonstration of the CanvAAS tool as an additional feature of Festo Didactic's learning systems for Industry 4.0.
- **Demonstration in an industrial scenario**: Distributed automation at Whirlpool EMEA.
- **Demonstrator in Teaching factory** at Industry 4.0 Lab Polimi

In each demonstrator, AAS data spaces are built to ensure interoperability between the Industry 4.0 assets (elements of a plant, products, subsystems, systems, semifinished parts, etc) .

The three demonstrators are mapped into the DS Pathway evolutionary matrix as shown in the figure below. They are **situated in the Data Sharing dimension** since the AAS standard is targeting data exchange from one value chain partner to another. Whirlpool and POLIMI demonstrators are situated in Level III “Data Bridges” since AAS models are not running in a specific infrastructure, whilst FESTO demonstrator is considered in Level IV “Data Interoperability” since AAS models are deployed and running using the Basyx middleware and OPC-UA communication protocol.

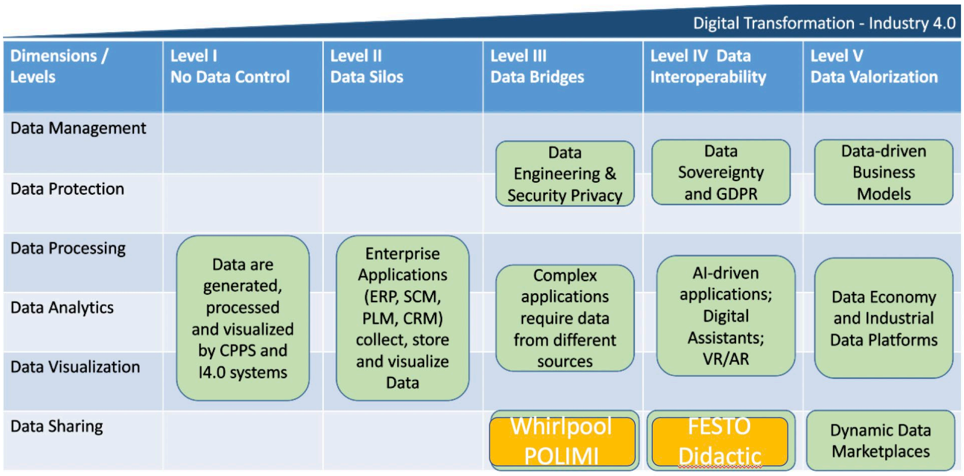

Figure 12 The position of CanvAAS use cases in the Data Space Pathway

3.2.3 Data Sharing Spaces in White Goods spare parts management in AI.SOV project

The third presentation was run by WHIRLPOOL and it dealt with the building of a Data Space to manage spare parts along the production supply chain, implementing an architecture based on IDSA (International Data Space Association) principles. The AI.SOV project, has been presented during the workshop. it is a one year project funded under EIT Manufacturing, led by Whirlpool EMEA with the participation of Politecnico di Milano, Cefriel, Inesctec, Sonae and Sonae Arauco.

AI.SOV, stands for Artificial Intelligence enabled data SOVereignity and aims at creating a real reusable, sustainable industrial **data space** ecosystem based on industrial platforms that are **supporting the European industries to faster exchange AI results**. This objective will be achieved through the design, development, setup, and deployment of a platform able to support and foster data exchange between trusted parties based on self-defined data usage policies by considering data sovereignty principles.

The project will demonstrate in two industrial use cases: Whirlpool will exchange results of predictions in machine maintenance and in spare parts with some of its suppliers; SONAE Arauco will share product recommendation inside its network of professionals. Both the use cases have specific requirements in ruling user access and modality to use data: a specific architecture based on IDSA will be designed and implemented through a platform.

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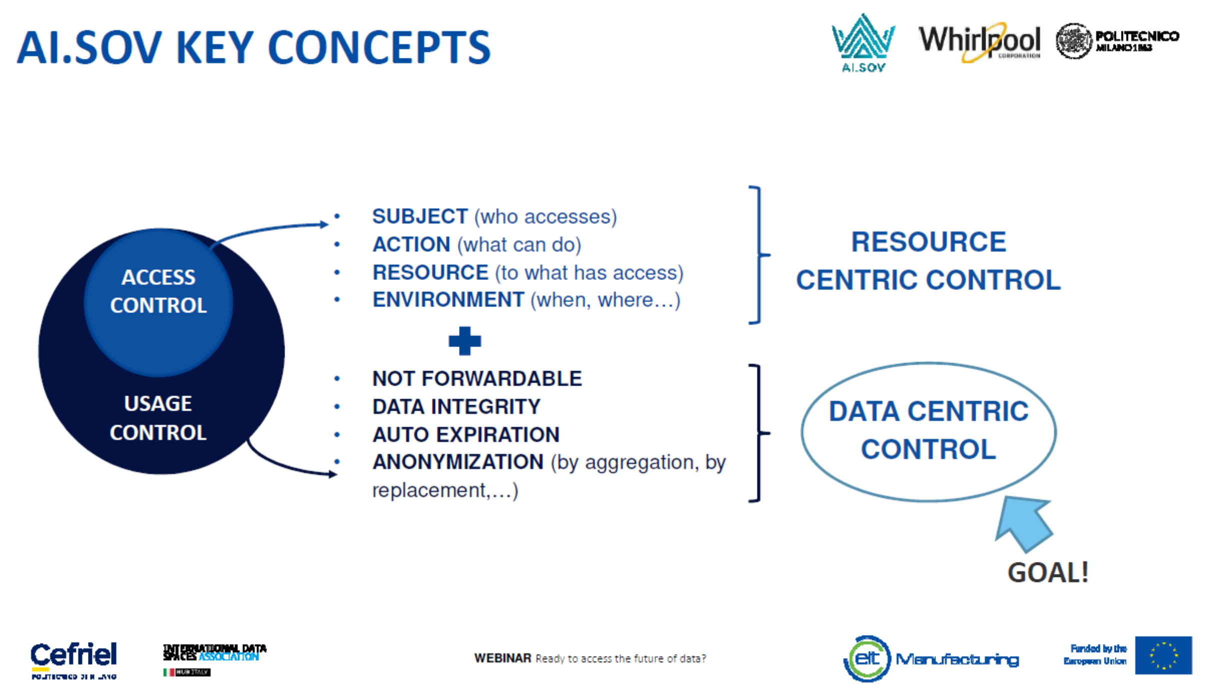

Figure 13 AI.SOV Key Concepts

In the workshop mapping of Ai.SOV into the CF pathways was addressed: being a typical example of data interconnection, AI.SOV fits into the Hyperconnected factories

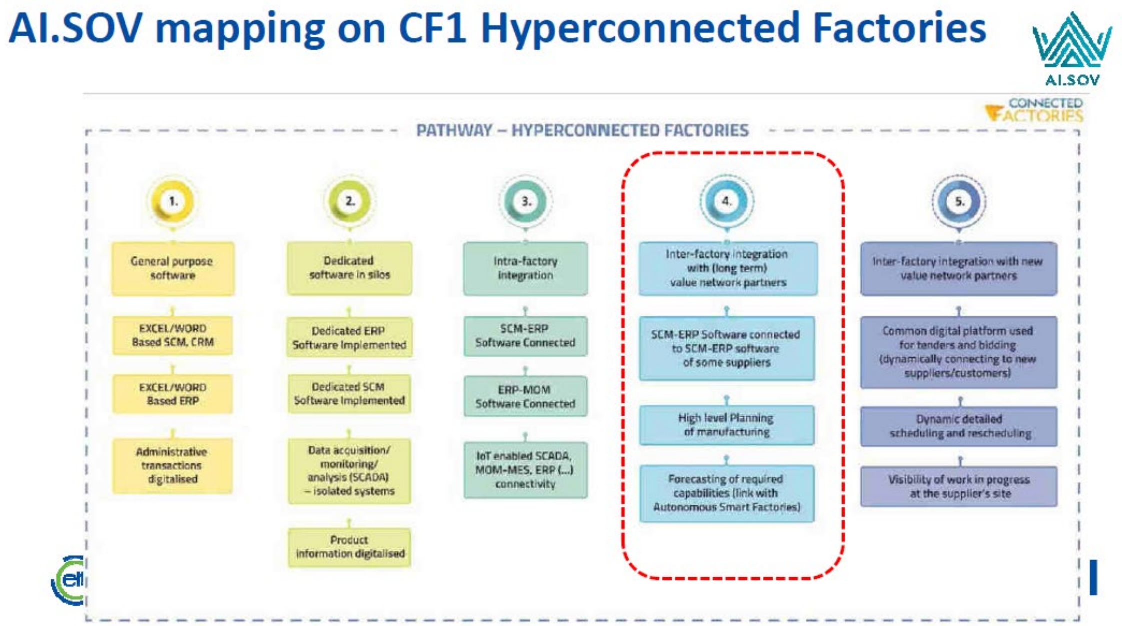

Figure 14 The position of AI.SOV use cases in the Hyperconnected Factories Pathway

Moreover, Ai.SOV is also fitting the new DS Pathway very well, placing it in the u**pper level of maturity stage,** covering completely Data Interoperability and hitting some of the topics of Data Valorization.

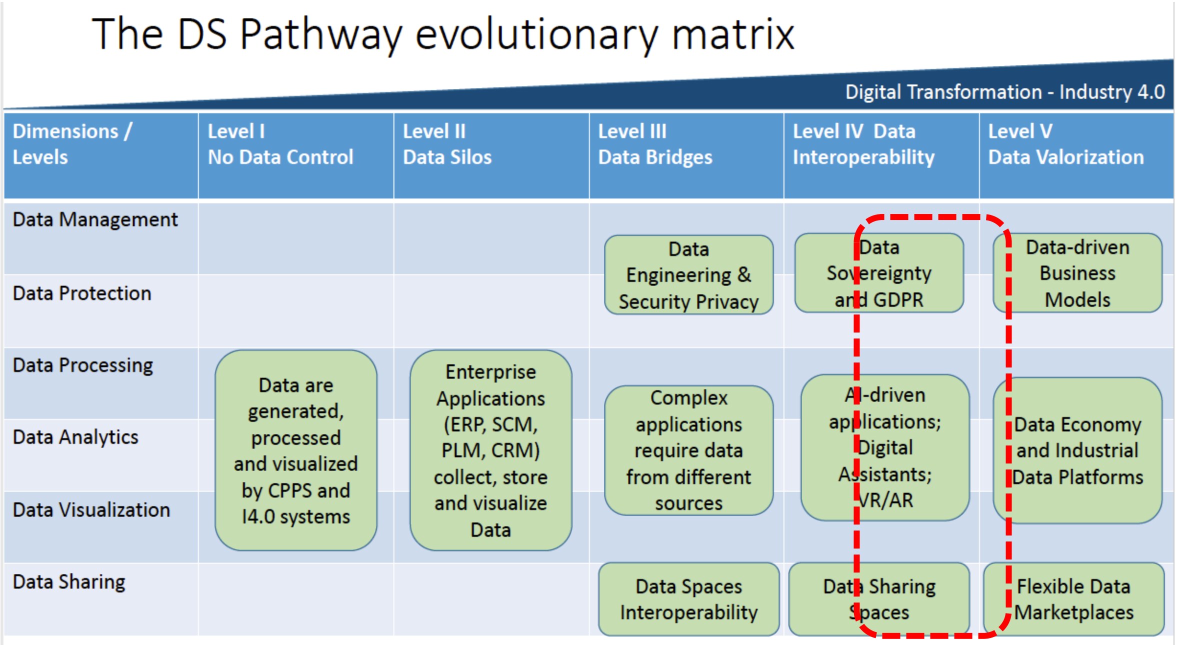

Figure 15 The position of AI.SOV use cases in the Data Space Pathway

Achieving the transformation in a company like Whirlpool is not straightforward: firstly because not all the internal company functions are at the same degree of maturity and, as a consequence, in suppliers/customer interactions real Data Share mechanisms (e.g. IDSA, AAS) are not fully exploited. Although a standard and aligned approach is yet to come in Whirlpool, a good set of research and innovation projects to explore and experiment the topic (BOOST4.0, NIMBLE, QU4LITY, I4Q, CANVAAS) provided a consistent foundation of knowledge and experience that will pave the path toward a successful evolution.

To achieve the transformation, it is required to align many internal stakeholders (different businesses, IT, Security Policies in a mixed governance (Regional vs. Global) environment) and to ensure Data Availability (that, even if it is not a real challenge according to CF, for Whirlpool is not easily achievable since it requires investments, with long-term returns). It is also important to maximize return of investment on Data Sharing projects, to invent (and implement!) new business models.
Last but fundamental step is to accelerate the digital upskilling and consolidation of new roles (Data Scientist, Data Architect, CDO, Data UX Architect etc.).

3.2.4 Data Spaces for Digital Product Passport from sheep to shop in BOOST4.0 project

The fourth presentation was run by Piacenza Cashmere and it dealt with the implementation of Data Spaces to support a blockchain system for Digital Product Passport.

In Boost 4.0 the textile pilot has carried out the experimentation on the data collection and analytics on textile industrial environment in Piacenza. It has carried out the design and implementation of the collection of the data necessary for **full fabric production traceability and the issue of the Preferential Certification of Origin in a secured way by exploitation of Blockchain technology**.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 873086.

The solution was implemented by three partners collaborating together: Piacenza has been in charge of the data providing and input for the simulations and analysis of the business impact; Domina was responsible for the implementation of the collection of data, engineering process definition and implementation of wrappers required for data injection; IBM designed, developed and deployed a blockchain based solution for track and trace of high-end fabric from raw material to buyers.

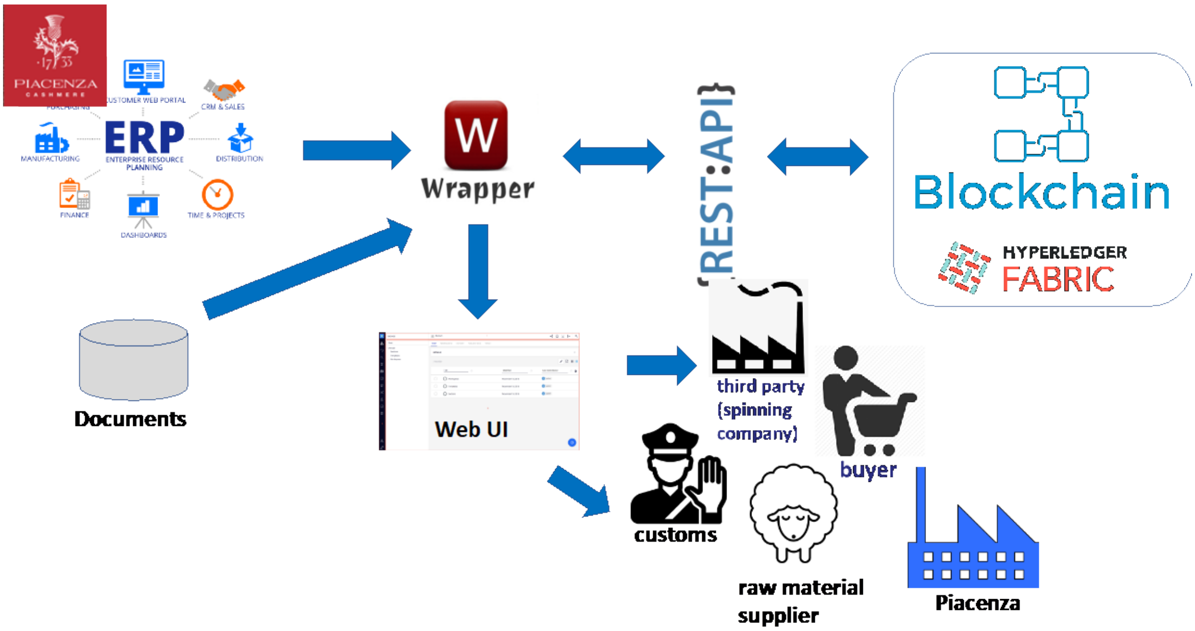

Figure 16 High level overview of Piacenza solution

The blockchain solution includes the backend and a user interface for the different players in the network (raw material suppliers, fabric manufacturers, fabric buyers, and customs) to query the data on chain.

The main data source will be Piacenza's ERP production system, to be stored on the chain. The provided solution enabled full traceability of items in the supply chain at any time anywhere along with location of the original documents that accompany the production of the fabric. Customs has immediate (and trusted) access to the Preferential Certification of Origin and by that, savings will be achieved by reducing storage time and place of goods. IBM leverages on Hyperledger Fabric permissioned blockchain, suitable for enterprise business networks as the blockchain infrastructure.

The experiment can be inscribed in the "Collaborative Product-Service Factories" pathway. In particular, given the innovation that the solution brings to the entire supply chain, this pilot can be related with the Product-Service Innovation pathway level.

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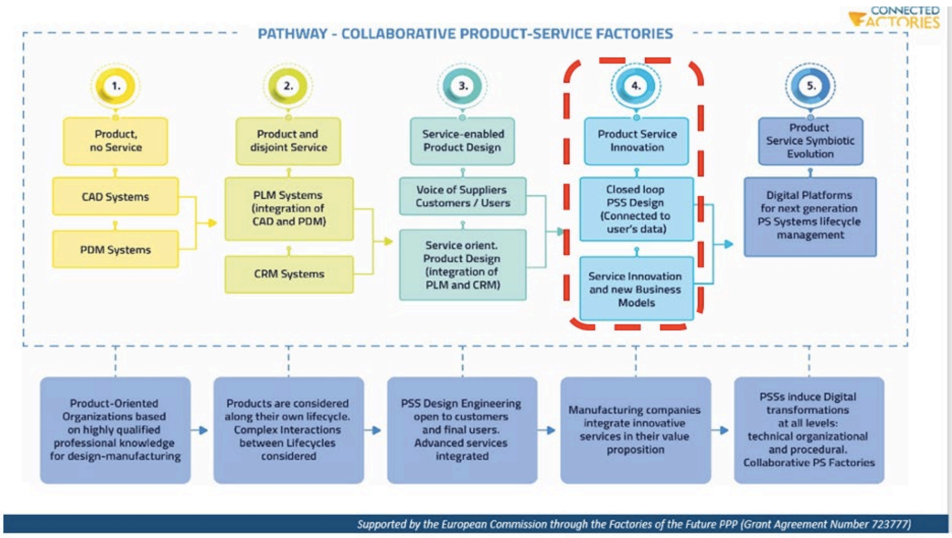

Figure 17 The position of Piacenza use case in the Collaborative Product-service Factories Pathway

In the DS Pathway, Piacenza is very well positioned: high value Data Sets to be shared in a trusted network.

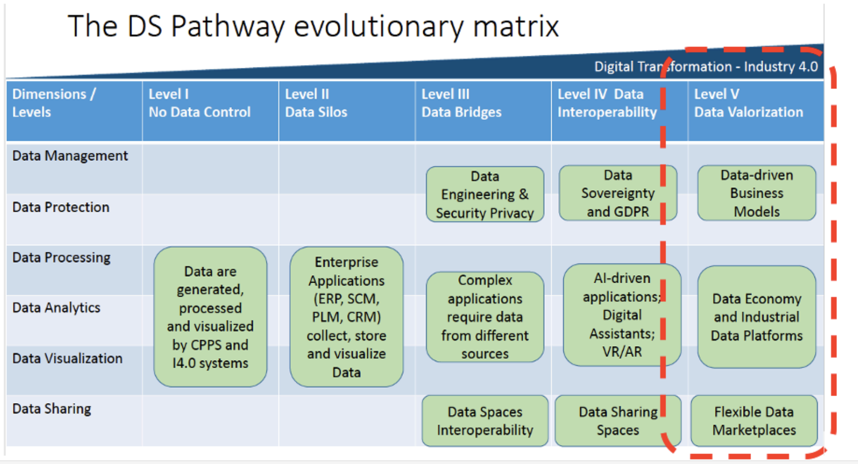

Figure 18 The position of Piacenza use case in the Data Space Pathway

3.2.5 Data Spaces for Additive Manufacturing Machinery in QU4LITY project

The fifth presentation was run by PRIMA Industrie and it dealt with the implementation of a Data Space for additive manufacturing data management.

As anticipated by the first presenter, QU4LITY objective is (among others) to demonstrate how European industry can build unique and highly tailored **ZDM strategies** and competitive advantages **through an orchestrated open platform ecosystem**, ZDM atomized components and digital enablers across all phases of product and process lifecycle.

All the achievements and the main results of the project will be demonstrated trough several industrial pilot cases divided in 2 main areas: ZDM for Lighthouse large scale and ZDM Equipment enhancement.

In the area of ZDM Equipment enhancement, Prima Industrie presented the **Additive Manufacturing pilot** for collecting, tracking and analysis of data to enhance process robustness.

In this pilot, additive manufacturing machines for Powder Bed have been considered to enhance process control for producing metal components. New concepts of machines will be considered to test new edge devices for process control, towards a ZDM result, and to work on data management and analytics to implement the whole manufacturing process by a platform approach. In this scenario it is possible to work on:

- Modular edge device for real-time AI - data analysis and metrics exploitation
- AR visualization and open platform
- Simulation framework
- Edge computing
- Industrial data space
- ZDM strategy at machine level

In this trial the main technologies adopted are:

- Sensors system for process monitoring
- Graphic visualization tool
- Digital twin time estimation
- Data analytics tool
- Decision support system
- Augmented reality
- Blockchain Secure updates

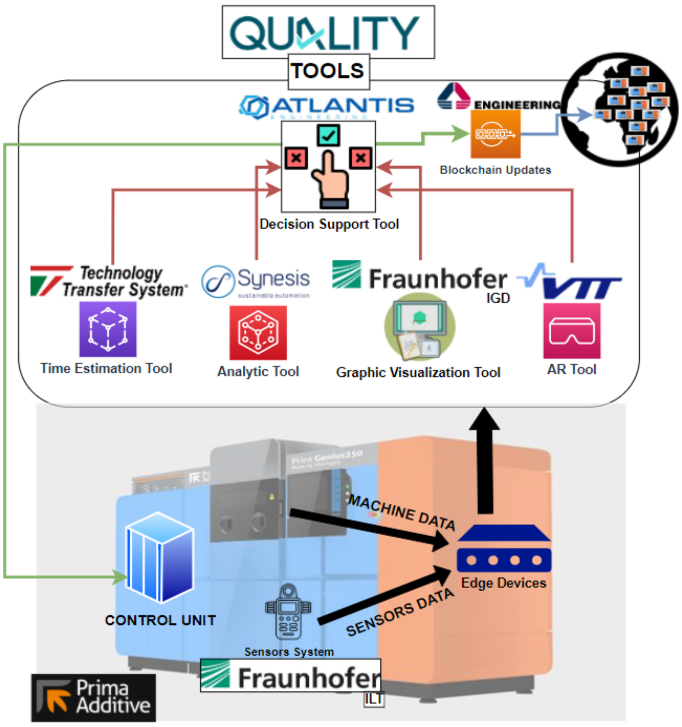

Figure 19 Schema for PRIMA Industrie use case

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Real-time data update and sufficient data resolution is problematic for current background technology and that's why **more sensors systems** must be installed. Another important obstacle is **lack of skills and experts management**, outside the European projects: far from the research environment, finding and managing skills and competencies needed for this implementation could be very difficult. In fact, several skills were required for this pilot (e.g. graphic expert, sensors expert, data analysis expert, AR expert, blockchain expert, smart and AI applications developer) and it is not trivial to gather such expertise without the support of a strong ecosystem.

The implementation developed within QU4LITY project will be useful for a fast reaction at machine level, but in any cases the human will still be there and so some aspects has to be considered.

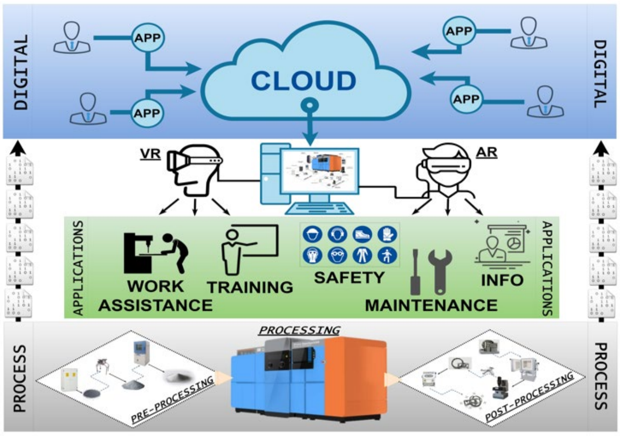

Figure 20 The human role in PRIMA Industrie pilot solution

In the next steps new data sources will be exploited for the development of following services: Work Assistance, Training, Safety and Maintenance. This pilot case is related to Smart autonomous Factory, in particular for application at machine level.

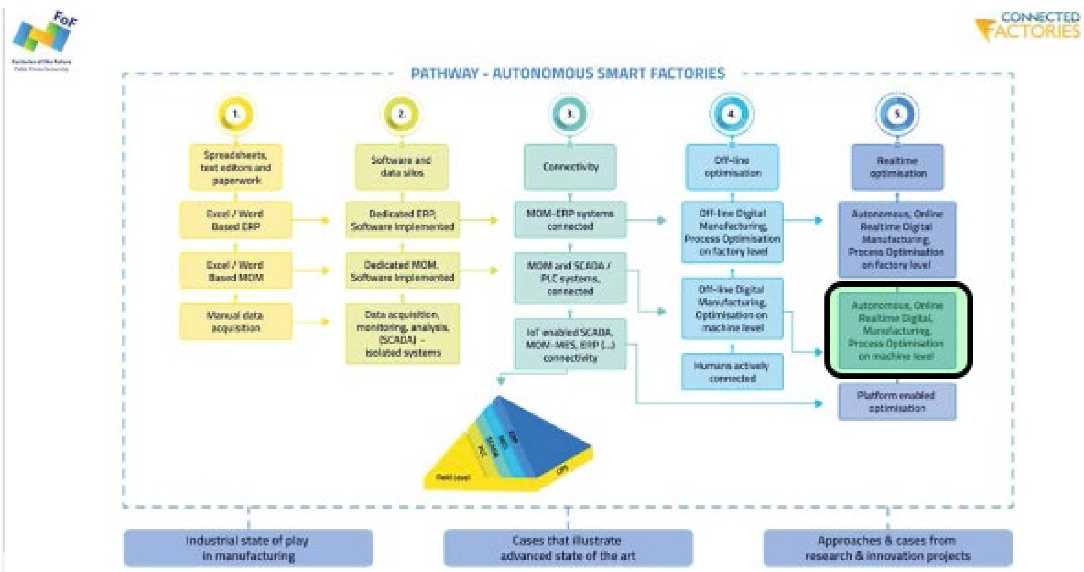

Figure 21 The position of PRIMA Industrie use case in the Autonomous Smart Factories Pathway

In the DS Pathway, Prime Industrie is very well positioned: the new data approach allowed to move from Level II (Data Silos) to Level IV (**Data Interoperability**).

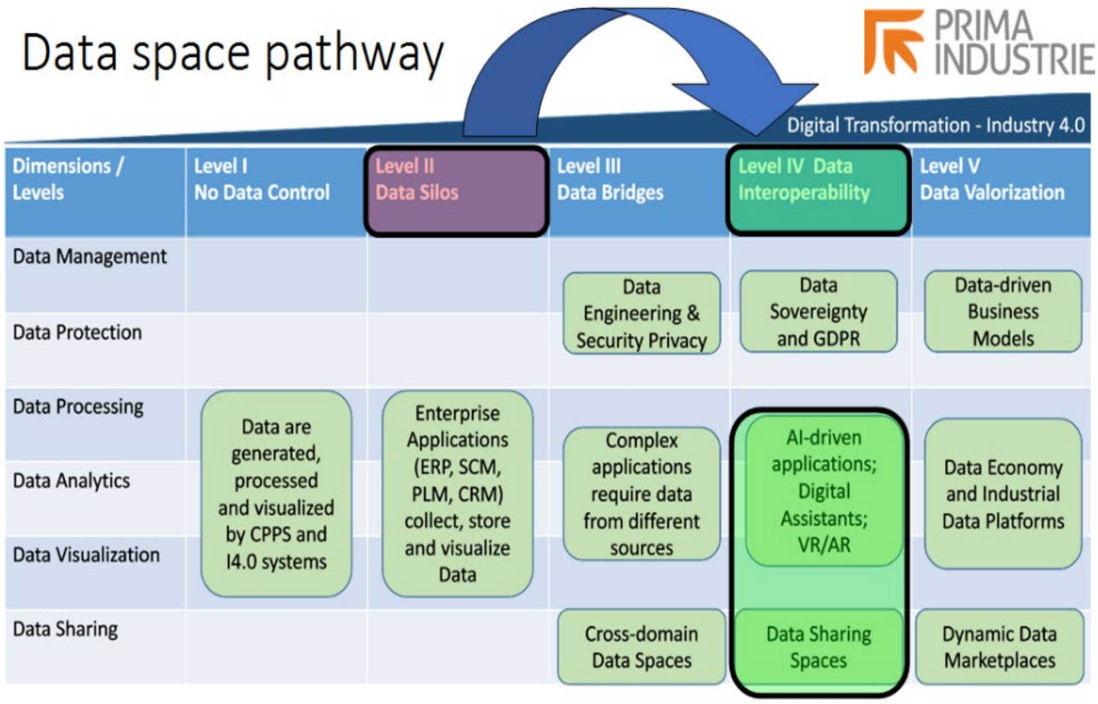

Figure 22 The position of PRIMA Industrie use case in the Data Space Pathway

4 Conclusion

The workshop provided the next level of insight into the use cases and demonstrators that are associated to the CE and DS pathways and particular cross-cutting aspects and key enablers, such as for instance the Asset Administration Shell concept. These use cases and demonstrators serve as excellent building blocks for the catalogue of demonstrators (Deliverable 3.2), for identifying recommendations (Deliverable 3.3) and for developing future dissemination activities (such as the big dissemination event that followed on 22 April and reported in Deliverable 6.3).

Although there should still be a lot of ground covered in terms of associating cases to different elements of the Data Space Pathway and the Circular Economy Pathway, the workshop has confirmed that both pathways offer a good reference for situating the developments of use case demonstrators.

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