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Creating Growth : Improving Society

AI for CIRCULARITY



AI challenges and opportunities for green manufacturing

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INDEX

- **AI evolution**, new methods are available.
- Recent AI advances have the potential to improve performance in Manufacturing. Propose some examples. What have you been working on?
European Research Projects.
- There are several **challenges** ahead. (Complexity of AI tools? Modeling of the process? Time consuming process?...)
- There are **barriers**. (Need to simplify the technology? Need to prove it in several cases to see how to use it efficiently? ...)
- Proposed **way forward**.

MAS4AI

CIRMET

DigiPrime

Circular
TwAI

tecnal:a

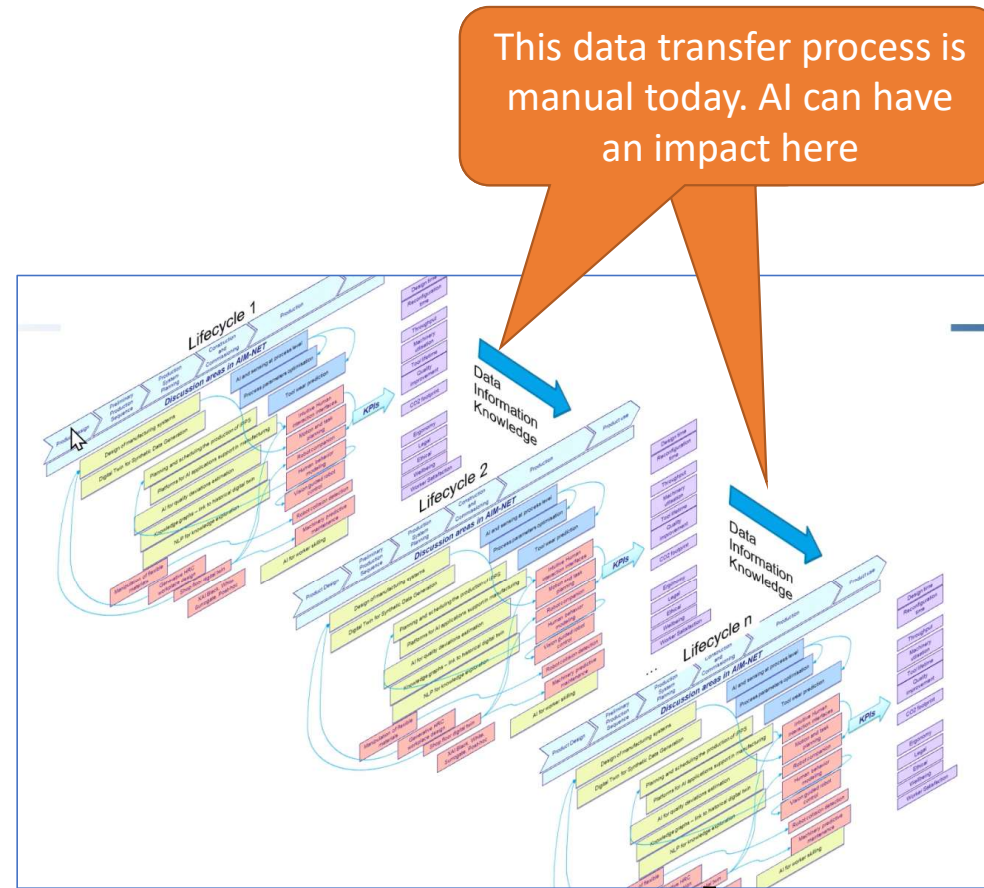
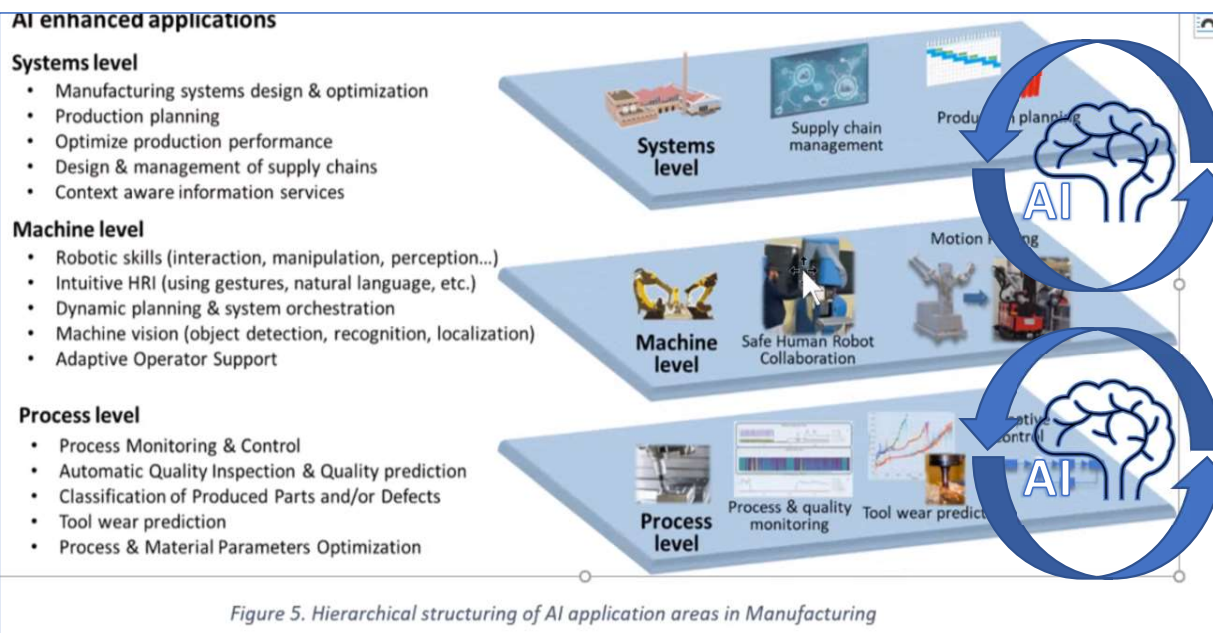
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These projects have received funding from the European Union's Horizon 2020 research and innovation programme under grant agreements No 957204, 820670, 873111, 101058585.

AI evolution



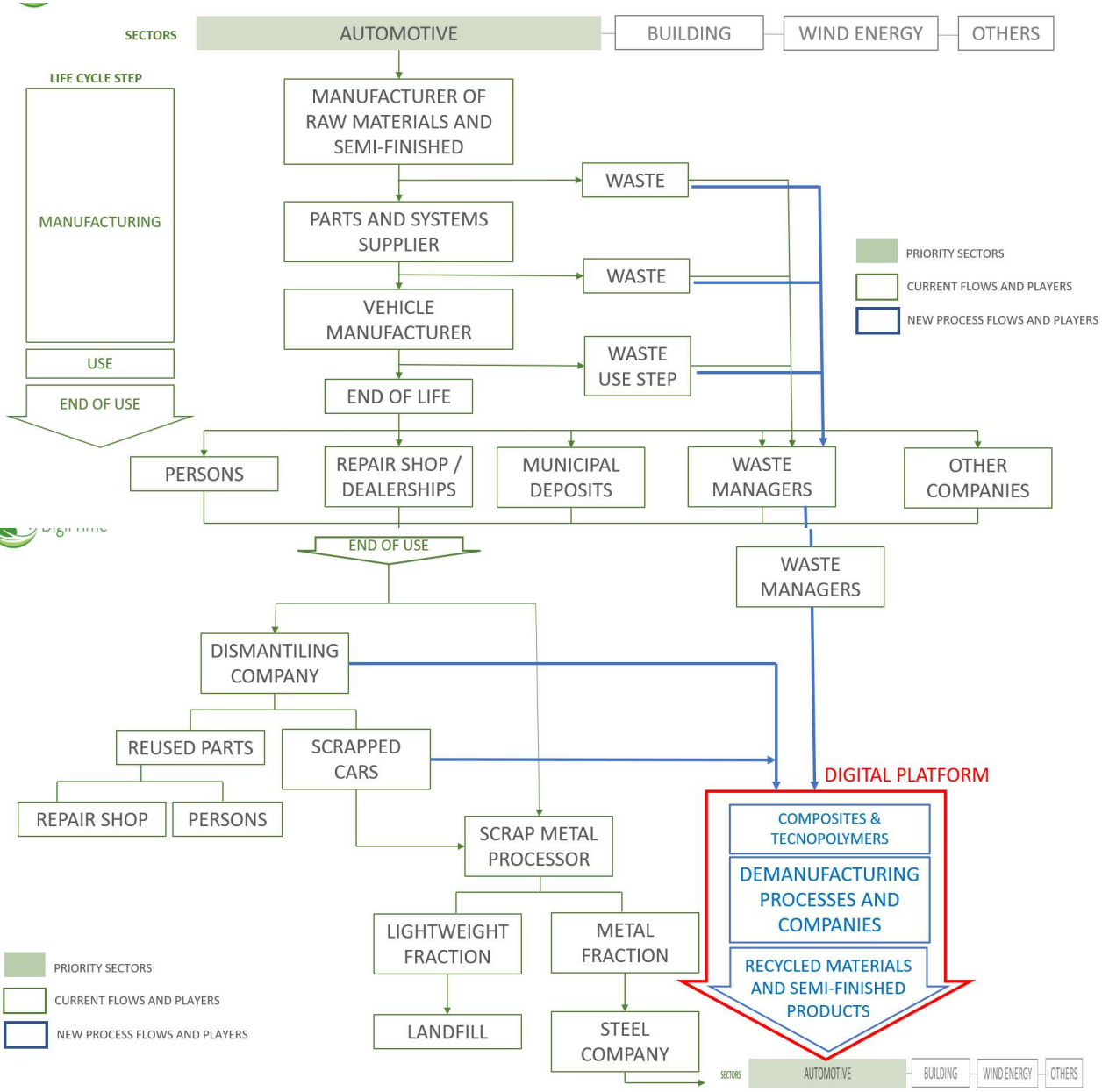
AI Challenges and Barriers



The background is a gradient of orange and red tones. It features several concentric circles of varying thicknesses, some appearing as glowing outlines. Scattered throughout are small white and orange dots, some in pairs and some in small groups, creating a sense of depth and movement.

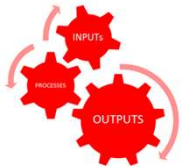
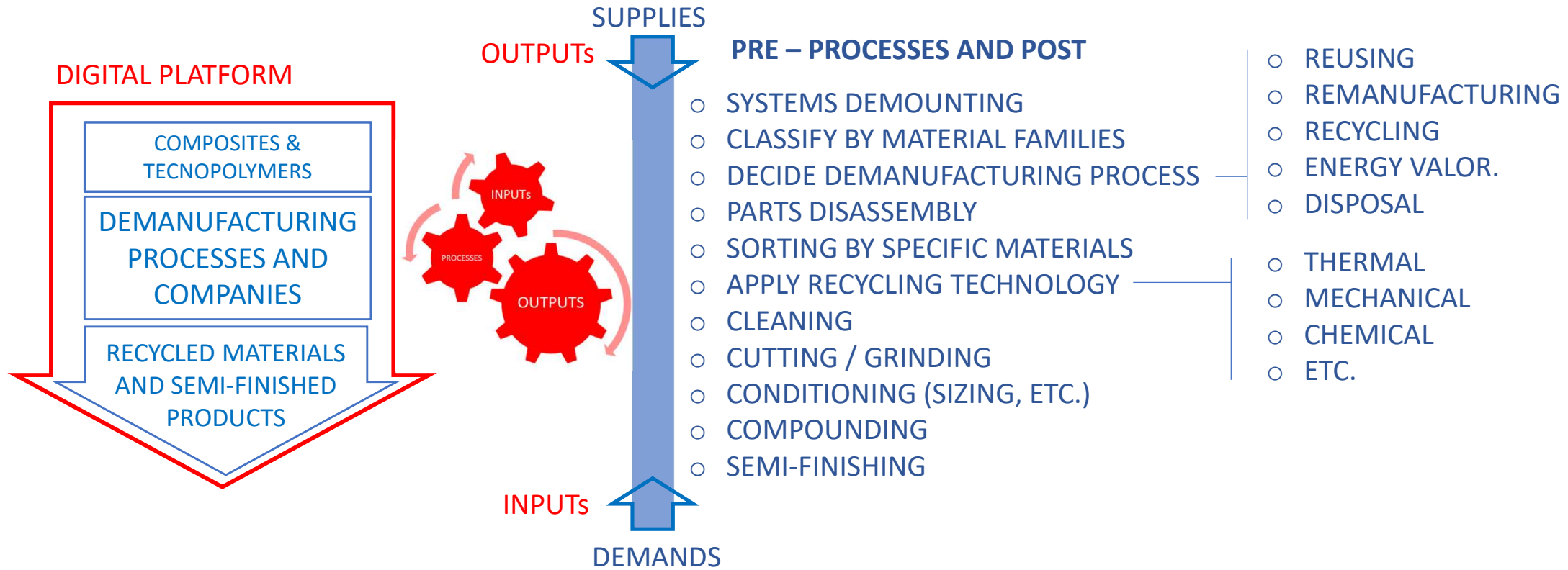
Circularity





CURRENT RESTRICTIONS

1. Insufficient technical and batch **uniformity** guarantees
2. Some critical activities (disassembly, separation and classification) are not **economically feasible**
3. **Technical and industrial limitations** of some demanufacturing processes
4. **Lack of information** between stackholders regarding present needs and opportunities
5. **Lack of knowledge** about new valorization opportunities



1. Decision support tools ↔ Match Making Tools
2. Digital Twins and optimization processes for recycling
3. Innovation Services
4. Information (Legal, technological and Market)

Data & Next steps



AAS for processes (i.e. battery remanufacturing)

DPP for product (i.e. battery)

- Connect different remanufacturing processes to a **circular Data Space**
- **Implement IDS RA** for AAS integration. Provision of Data Space services required for MVP (Broker, Identity services)
- **Connect to processes and sensors** via AAS connection
 - Power sensors (MQTT)
 - PLC automation (OPC UA)
 - External systems (HTTPS)
- **Re-use AAS submodel templates** for circularity information
- Calculate **Carbon Footprint** based on sensors / systems and store in Process / Product AAS

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A screenshot of a software interface showing a tree view of AAS (Asset Administration Shell) submodels. The tree is expanded to show the "CarbonFootprint" submodel under the "BatteryRemanufacturingAAS" AAS. The "CarbonFootprint" submodel contains three "ProductCarbonFootprint" submodels (SMC), each with six elements. The "ProductCarbonFootprint1" submodel is further expanded to show five properties (Prop): "PCFCalculationMethod", "PCFCO2eq", "PCFReferenceValueForCalculation", "PCFQuantityOfMeasureForCalculation", and "PCFLiveCyclePhase" (set to "A1 - raw material supply (and upstream production)"). Below this, the "PCFGoodsAddressHandover" submodel (SMC) with seven elements is also visible. The second AAS, "BatteryAAS", is also expanded to show its submodels: "ContactInformations", "Nameplate", "HistoricData", "BillOfMaterial", "TechnicalData", and "OperationalData".

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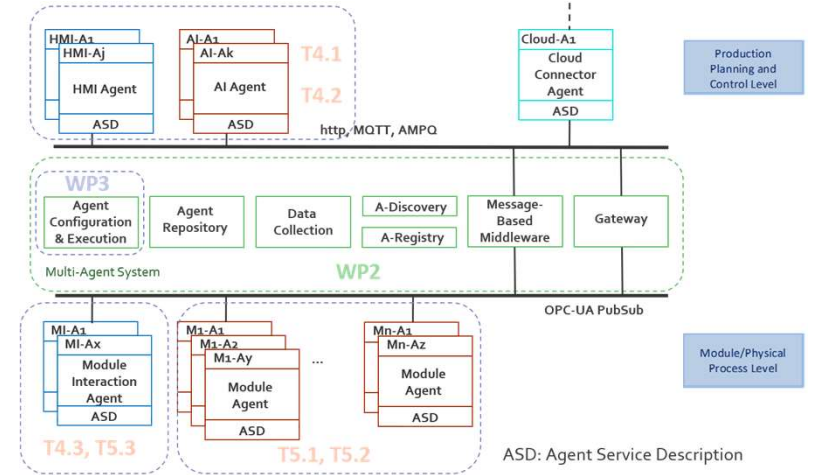
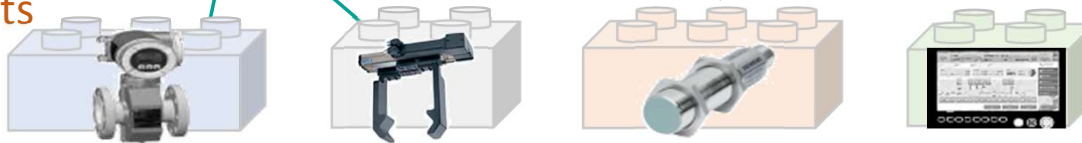
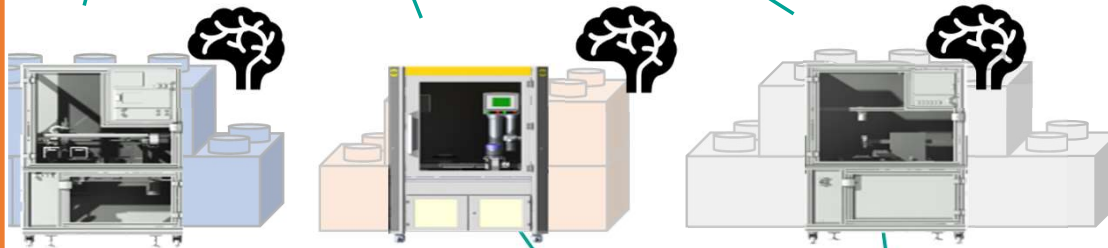
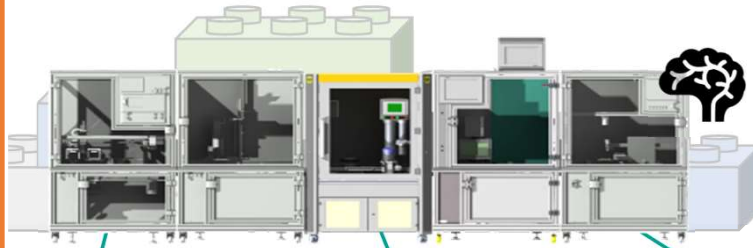
Referentes en Europa

Smart Factories

Smart Machines

25.05.2023

Smart Components



Administration Shell with its identifier ("Internet address") and submodel elements

Industry



Funded by the European Union



AI Platform for Integrated Sustainable and Circular Manufacturing

- 21 Partners
- 11 Countries
- 7,2M€ Budget
- 36 Months

Circular TwAI In will increase the performance, resilience and sustainability of discrete manufacturing and process industries by developing a novel AI platform for circularity.

3 USE CASES
Li-Ion Battery Packs in E-mobility

Consumer Electric and Electronic Equipment Waste

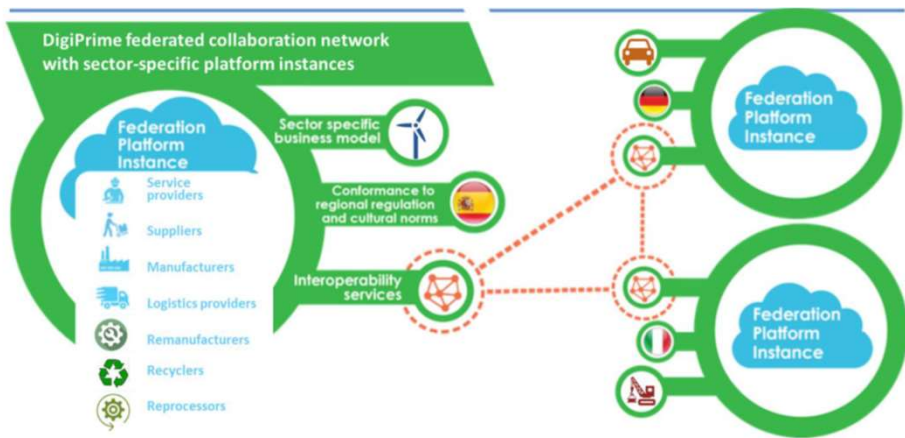
Petrol-Chemical Production Plants

- AI**
Sustainable manufacturing through AI technologies
- End-to-end sustainability in industrial production**
- Industry agility and resiliency**
- Advanced circular manufacturing technologies throughout the product's lifecycle**



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Digital platform for circular economy in cross-sectorial sustainable value networks



The overall architecture level of the DigiPrime platform includes:

- A **Multi-node federation** structure, replicable on different existing and additional sectorial platform instances and with easy access for users;
- A **Semantic data infrastructure** based on ontological repositories and semantic search;
- A **Data Policy Framework** to ensure privacy, security, authentication and authorization policies

Un DSS para el reciclado de composites

Decision Support System For Composite Recycling

INPUT

The user of this service must choose between:

- OFFER if you represent a company that has a plastic/composite waste and wants to understand and decide the most suitable circular processes for it.
- or DEMAND if you represent a company that requires a material and wants to find it in the "secondary" market so needs to find out the circular process to transform a certain offer into the required material.

STAKEHOLDER PROFILE

Main Activity:

Period:

Quantity:

PRODUCT DESCRIPTION

Type of product:

Source:

State of presentation:

Color:

Material:

Matrix:

Reinforce:

Sizing:

Fiber Format:

Product Conditions

Cleaning:

Moisture:

OUTPUT

Best solution for your product is Remanufacture.

The second most suitable solution for your product is Recycling.

Finally, another option you may have into account is Reuse.

Taking into account your company profile, it is considered that the waste or by-product you describe will never go back in the process chain because it would lose added value.

The high periodicity of your product disfavors the reuse option.

Large batches disadvantage reuse and reconditioning options unless their periodicity is occasional.

Products or systems of heterogeneous composition are not conducive to recycling.

Waste consisting of complete pieces or large pieces favours reuse or remanufacturing.

Light colours favour recovery treatments.

Thermoplastic matrices favour any recovery treatment.

The residual value of glass fibre and its low heat capacity are in some cases not conducive to recyclability and energy recovery.

Any treatment is feasible irrespective of whether the fibre retains sizing or not.

Unidirectional fibre format improves recyclability options.

Clean waste facilitates recovery treatments.

Absence of moisture benefits recovery treatments

"DIGIPRIME - DIGITAL PLATFORM FOR CIRCULAR ECONOMY IN CROSS-SECTORIAL SUSTAINABLE VALUE NETWORKS

This project has received funding from the European Union's Horizon 2020 Framework Programme, DT-ICT-07-2018-2019 "Digital Manufacturing Platforms for Connected Smart Factories" topic, under Grant Agreement ID 873111"

Servicio de optimización de parámetros de compounding

CPOS: Compounding Parameters Optimization Service

INPUT

Option 1:

Traction Module:

Tensile Strength:

Option 2:

Matrix Type:

Fiber Type:

Option 3:

Recycling Type:

Fiber Length:

Please fill option 1 or (option 1 and option 2) or (option 1 and option 2 and option 3).

OUTPUT

Tensile Modulus: 4 GPa

Tensile Strength: 40 MPa

Matrix Type: Polypropylene

Fiber Type: Reinforced Carbon Fiber

Recycling Type: Reused

Fiber Length: 15 mm

Fiber Percentage: 30

MACHINE RECOMMENDATIONS:

Working Temperature: 190 °C

Rod Speed: 200 rpm

Matrix Hopper Flow: 30 l/h

Objetivo del modelo de optimización:

Sugerir la consigna (parámetros del control) en la extrusora para crear nuevos composites que se ajusten a los requerimientos del cliente.

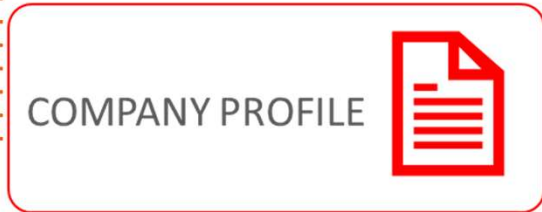
Optimizas el tiempo de producción evitando intentos erróneos.

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DigiPrime



OFFERS

ORDERS



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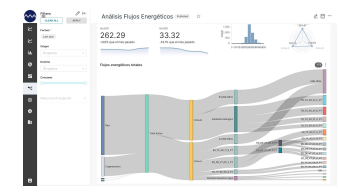


	Tools used	Limitations	When to use
Descriptive Analytics <i>What happened and why?</i>	<ul style="list-style-type: none"> › Data aggregation › Data mining 	<ul style="list-style-type: none"> › Snapshot of the past › Limited ability to guide decisions 	<ul style="list-style-type: none"> › When you want to summarize results for all/part of your business
Predictive Analytics <i>What might happen?</i>	<ul style="list-style-type: none"> › Statistical models › Simulation 	<ul style="list-style-type: none"> › Guess at the future › Helps inform low complexity decisions 	<ul style="list-style-type: none"> › When you want to make an educated guess at likely results
Prescriptive Analytics <i>What should we do?</i>	<ul style="list-style-type: none"> › Optimization models › Heuristics 	<ul style="list-style-type: none"> › Most effective where you have more control over what is being modeled 	<ul style="list-style-type: none"> • When you have important, complex or time-sensitive decisions to make



Descriptive analytics helps organizations understand what happened in the past (the past in this context can be from a minute ago or a few years ago).

Predictive Analytics, allows to model the behaviour of (part of) the process, so future outcomes can be predicted or estimated. This capacity to see what will happen in the future, will allow to inform the operator about this situation, which can be desired or undesired.





Thank you

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