Co-funded by the European Union

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No. 101091903.

Flex4Res

www.flex4res.eu

Project overview

Data Spaces for **Flex**ible Production Lines and Supply Chains **for** **Res**ilient Manufacturing

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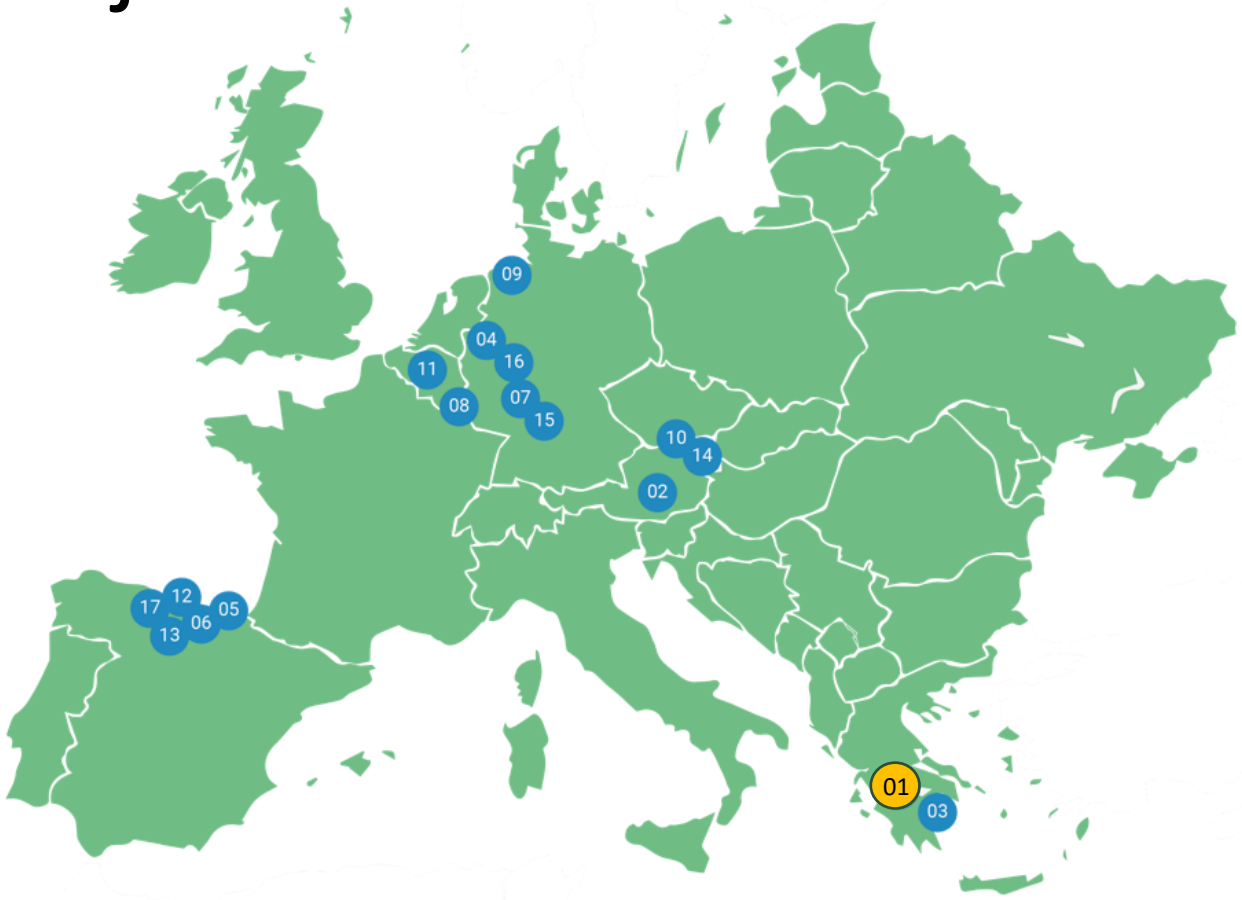
LMS
Laboratory for Manufacturing Systems & Automation

Project overview



01 LMS
02 voestalpine
03 SIDENOR
04 BERG Forming Technologies
05 GOIMEK
06 SORALUCE
07 eit Manufacturing
08 netcompany intrasoft
09 CONTACT Software
10 EXOSCALE member of A³ Digital
11 Beia Consult International
12 SAVVY
13 MONDRAGON
14 TU WIEN IFT Institute of Production Engineering and Photonic Technologies
15 PTW TU Darmstadt
16 Universität Siegen
17 IDEKO Member of Basque Research & Technology Alliance

Co-funded by the European Union

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Call: HORIZON-CL4-2022-TWIN-TRANSITION-01

Type of action: HORIZON Innovation Actions

Starting date: 1 January 2023

End date: 31 December 2025

Duration: 36 months

Objectives

To more resilient supply chains

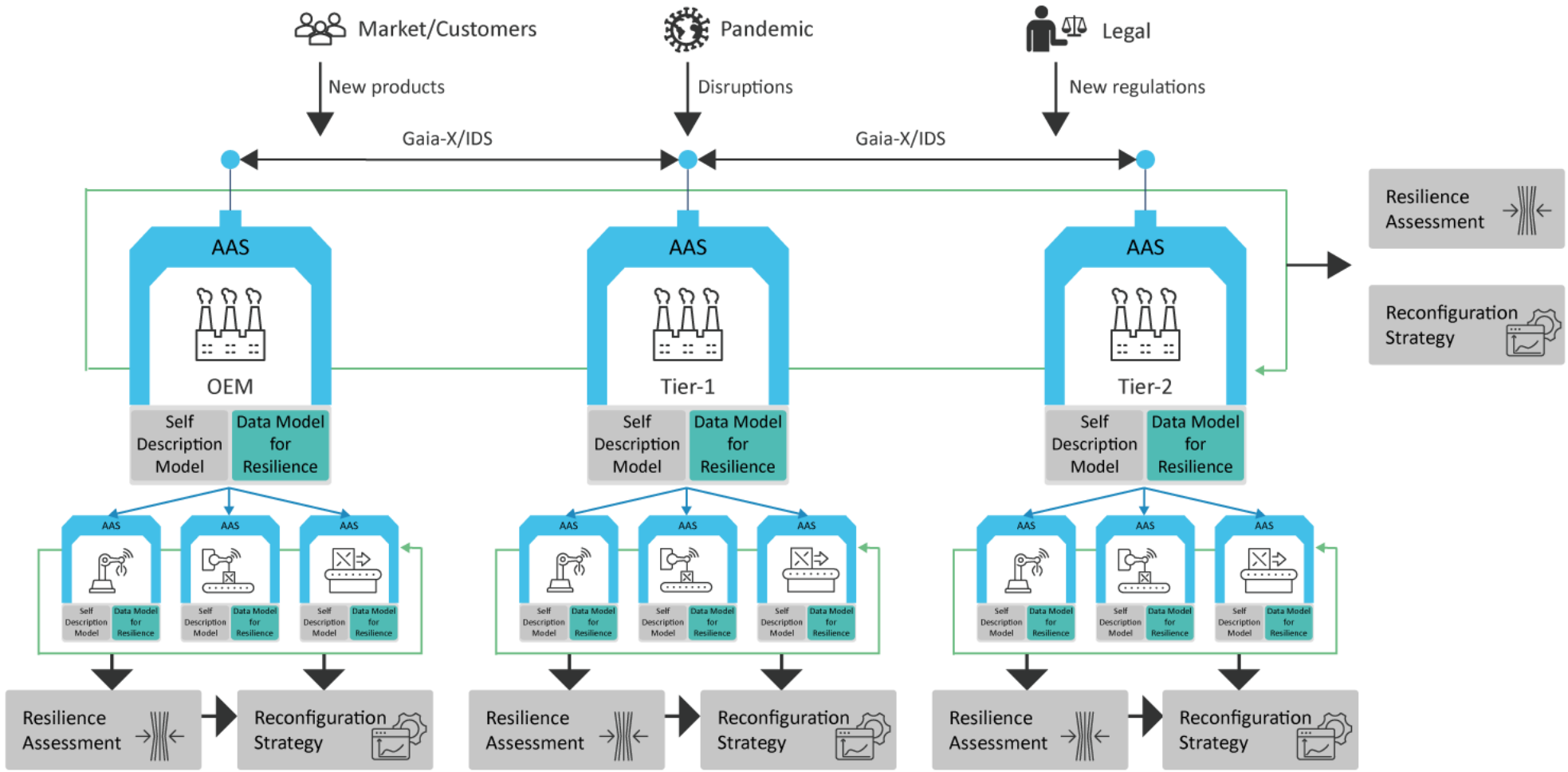
01 Implementation of an open platform

02 Resilience assessment toolbox

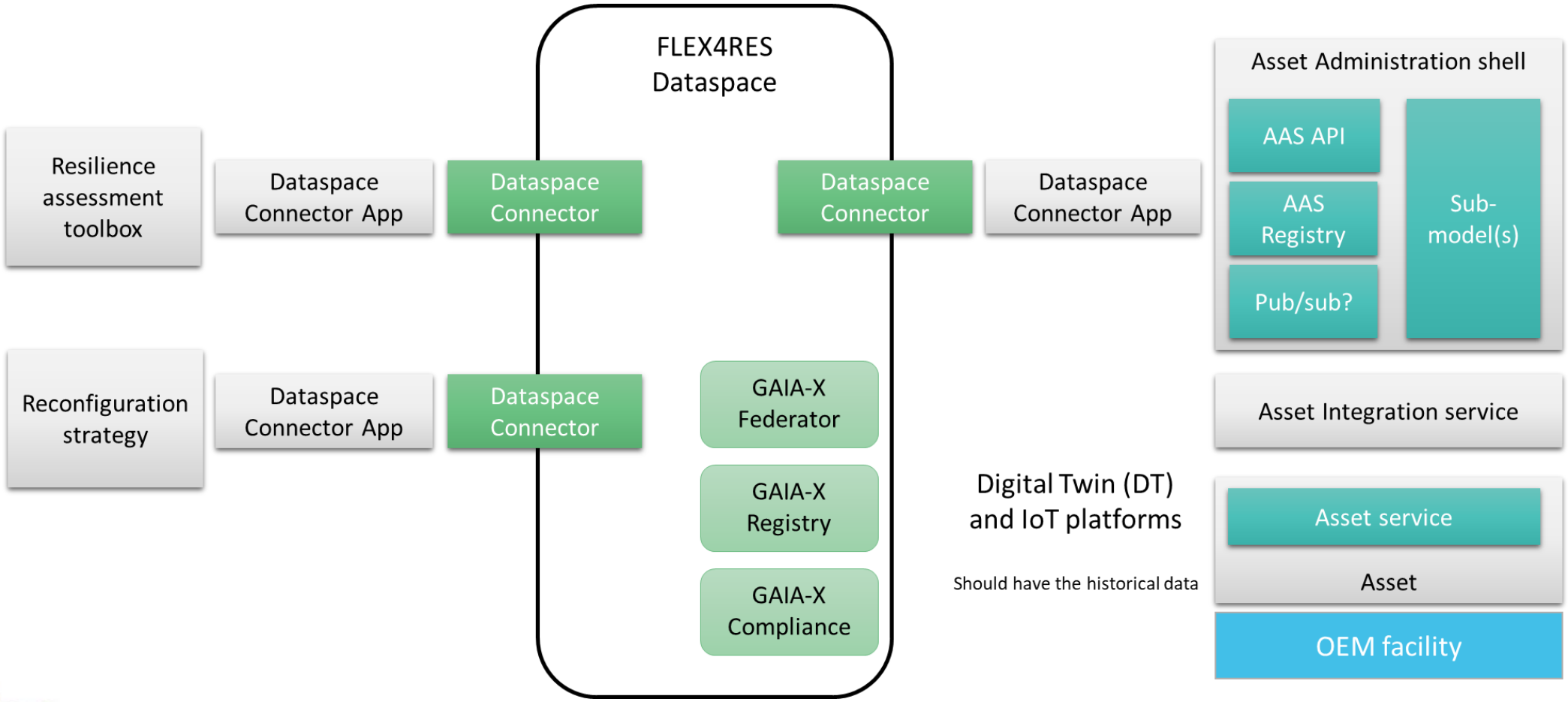
03 Decision making for application of reconfiguration strategies

04 Test and validate the integrated solution into industrial pilot cases

Flex4Res concept



Flex4Res architecture



Resilience assessment toolbox

Co-funded by the European Union

Problem description:

- The need for resilience assessment tools in manufacturing arises from the **increasing complexity** of global supply chains, the **unpredictable nature of disruptions**, and the imperative for businesses to proactively mitigate risks and ensure continuity in operations.

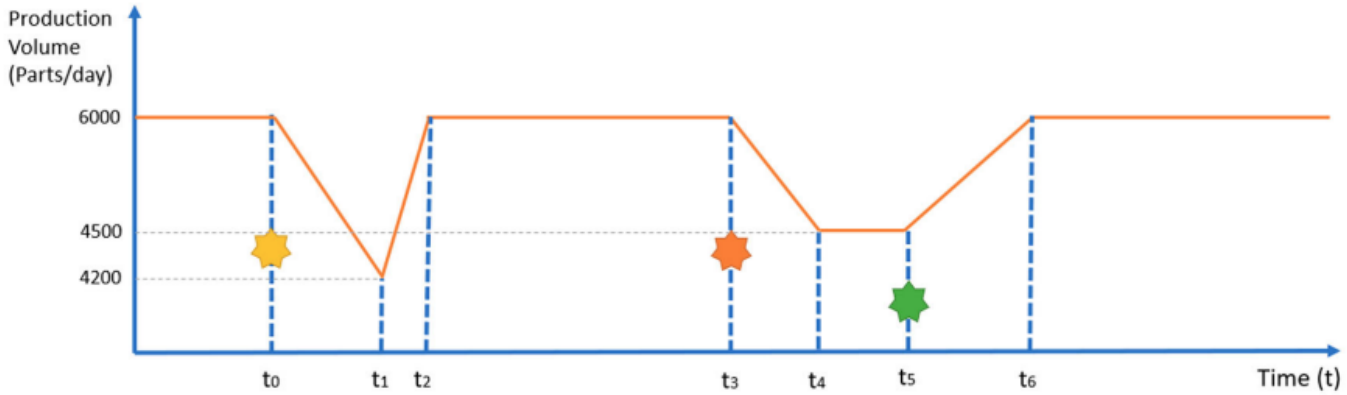
- Assess resilience capability of production systems at three levels
  - Macro: Whole value and supply chain – network
  - Meso: Production Line & Production Systems – company-wide
  - Micro: Machinery & Device Level – Local / On-site

No.	Resilience assessment solution	Leader	Use case
1	Resilience Data Model	PTW	ALL
2	Resilience assessment – supply chain	LMS	SID
3	Resilience assessment – supply chain plan	LMS	SID
4	Resilience assessment – factory	LMS	SID
5	Resilience assessment – shopfloor	IFT	VOE
6	Resilience assessment – shopfloor	PTW	Pre-pilot
7	Resilience assessment – resource	USI	HANS
8	Resilience assessment – resource-to-shop-floor	IDE, SAV	GOI

Resilience assessment – supply chain

Co-funded by the European Union

- **Provider:** LMS
- **Use case:** SIDENOR
- **Objective:** Compute a resilient supply plan. If plan is not resilient trigger the macroplanning tool to recompute a plan.



- **Methodology:** Penalty of Change (POC)

  POC method

  Scenarios: change in raw material price in supply plan. Adjust the product prices and demands based on the scrap price.

  Penalty: difference in profit between initial supply plan and what-if scenarios plans

  Probability: extracted from use case historical data

➢ Alexopoulos, K., Anagiannis, I., Nikolakis, N., & Chryssolouris, G. (2022). A quantitative approach to resilience in manufacturing systems. International Journal of Production Research, 60(24), 7178-7193.

Reconfiguration strategies toolbox

Co-funded by the European Union

Problem description:

- Reconfiguration strategies are vital in manufacturing to **swiftly adapt** to changing market demands, technological advancements, and unforeseen disruptions, ensuring **optimized** production processes, **minimized** downtime, and sustained competitiveness.

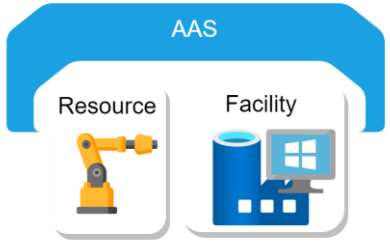
- Reconfiguration strategies tools at three levels:
  - Macro: Whole value and supply chain
  - Meso: Production Line & Production Systems
  - Micro: Machinery & Device Level

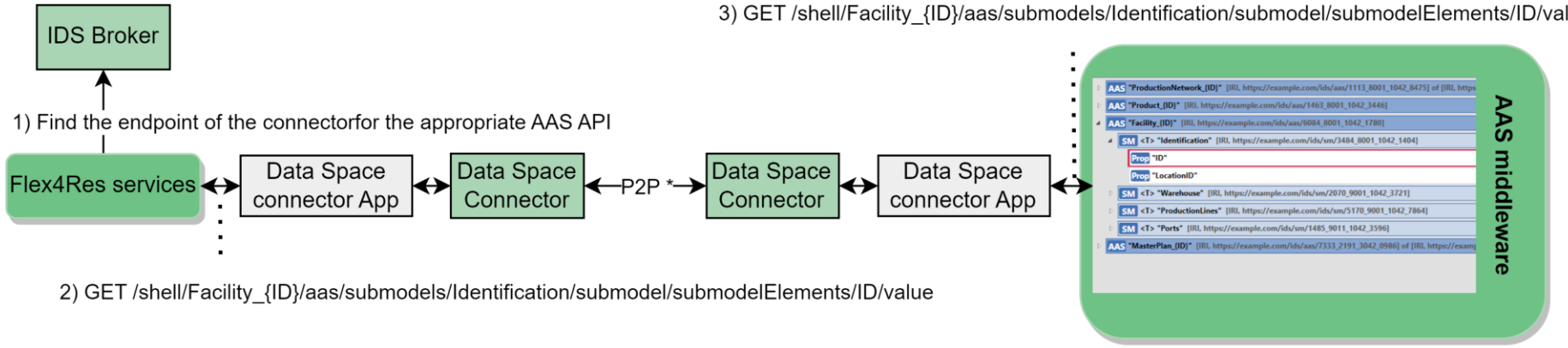
No.	Reconfiguration strategies solutions	Level	Leader	Use case
1	Macroplanning tool	Macro	LMS	SID
2	Macro-Meso transition tool	Macro – Meso	LMS	SID
3	Production Scheduling Tool	Meso	LMS	SID
4	Shopfloor Reconfiguration Tool	Meso	IFT	VOE
5	Human Centric Shopfloor Reconfiguration Tool	Meso	SAV	GOI
6	Fault detection and Human Assistance System	Micro	USI	HANS

AAS & Data Spaces

AAS models:

- Industrial Digital Twin Association (IDTA)
- Develop new models





* According to International Data Space communcation protocol

Four industry use cases

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	Macro level	Meso level	Micro level
Constant reconfiguration of supply plans – Sidenor use case			
Reconfiguration of manufacturing processes during production – Voestalpine use case			
Production planning optimization – Goimek use case			
Reconfiguration measures after a tool change – Hans Berg use case			

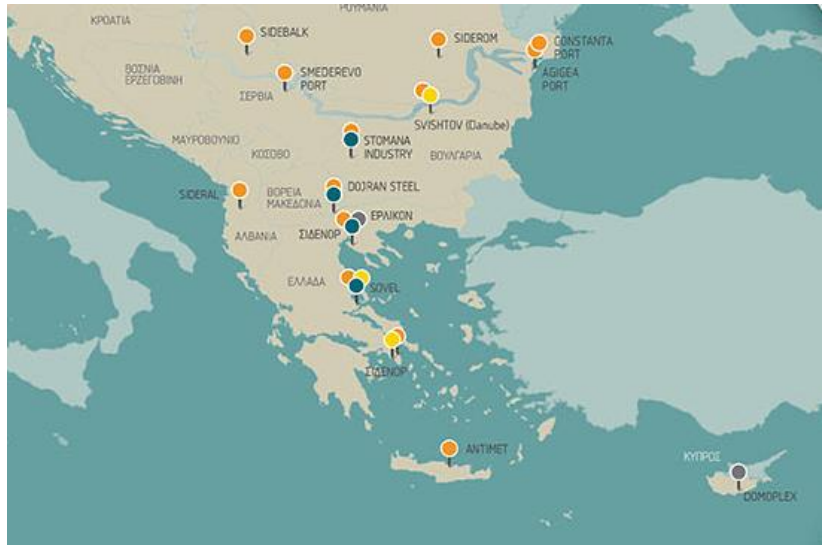
Sidenor use case

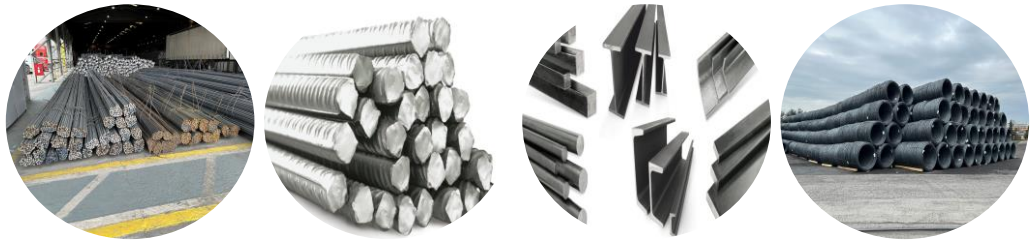
Constant reconfiguration of supply plans

Co-funded by the European Union

Challenge: Disruptions require reallocating the production, which takes place manually. Decisions taken at network level aren't connected to the reconfiguration needed at the factory level.

Goal: Reducing the time required for reconfiguration of the production plans for the production network by supporting the user throughout the reconfiguration planning.





Dataspace: Industrial data space (IDS)
AAS platform: DIMOFAC AAS middleware
Resilience assessment toolbox:

- Resilience assessment – supply chain,
- Resilience assessment – supply chain plan,
- Resilience assessment – factory

Reconfiguration strategies toolbox:

- Macroplanning tool,
- Macro-Meso transition tool,
- Production Scheduling Tool.

Partners involved:

SIDENOR | LMS Laboratory for Manufacturing Systems & Automation | netcompany intrasoft

Sidenor use case

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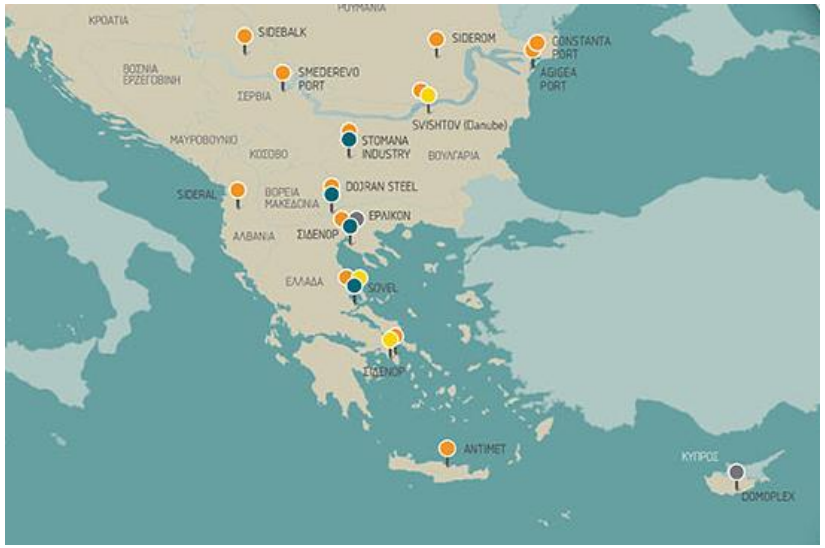

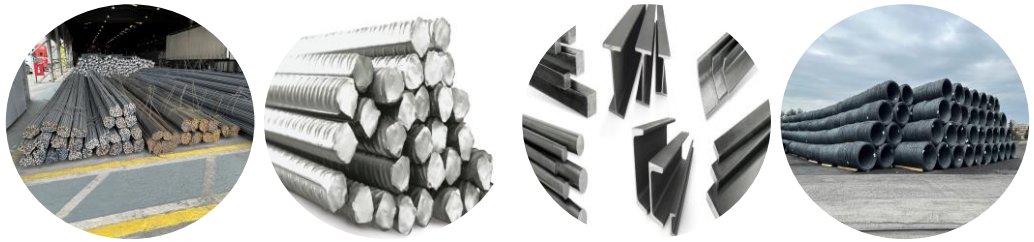

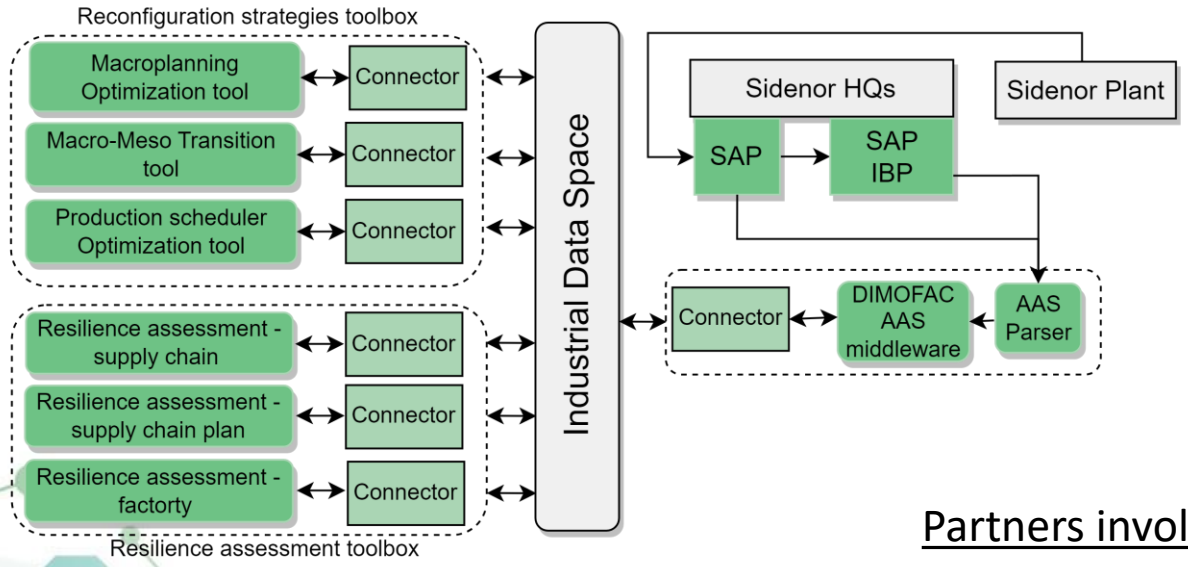

Partners involved:

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Sidenor use case

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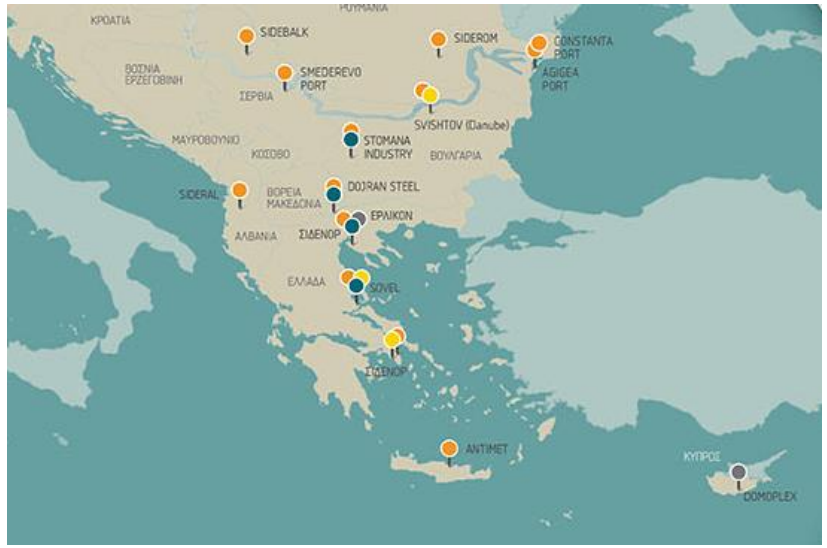
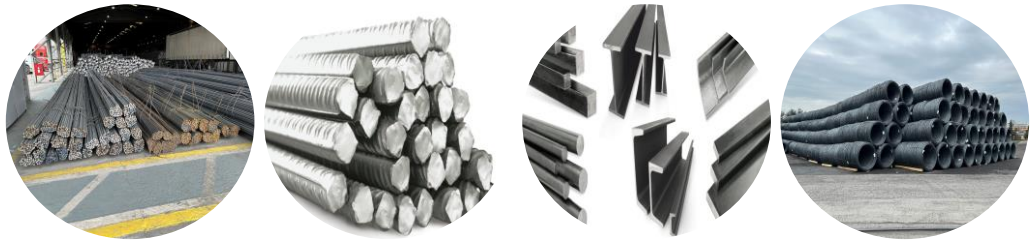
Goal: Reducing the time required for reconfiguration of the production plans for the production network by supporting the user throughout the reconfiguration planning.

Expected benefits:

1. Improve overall profit of the network
2. Improve utilization of production resources
3. Reduce inventory costs





Partners involved:

SIDENOR | LMS Laboratory for Manufacturing Systems & Automation | netcompany intrasoft

Hans Berg use case

Reconfiguration measures after a tool change

Co-funded by the European Union

Challenge: Adjustment measures are necessary when a tool or material has changed, but its duration and success depend on the experience of the employee executing it.

Goal: Reducing the time required to reconfigure the tools, the amount of produced defective components, and the need for the experience required to perform the adjustment tasks.

Dataspace: Gaia-X

AAS platform: DIMOFAC AAS middleware

Resilience assessment toolbox:

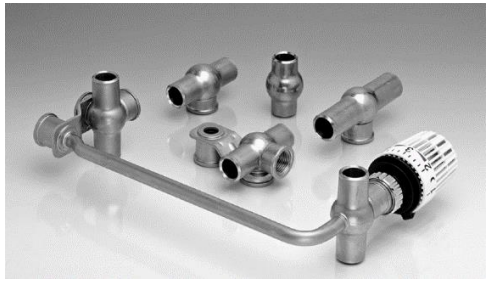
- Resilience assessment – resource

Reconfiguration strategies toolbox:

- Fault detection and Human Assistance System

Tubular components

Heating components



Deep drawn components

Partners involved:

Hans Berg use case

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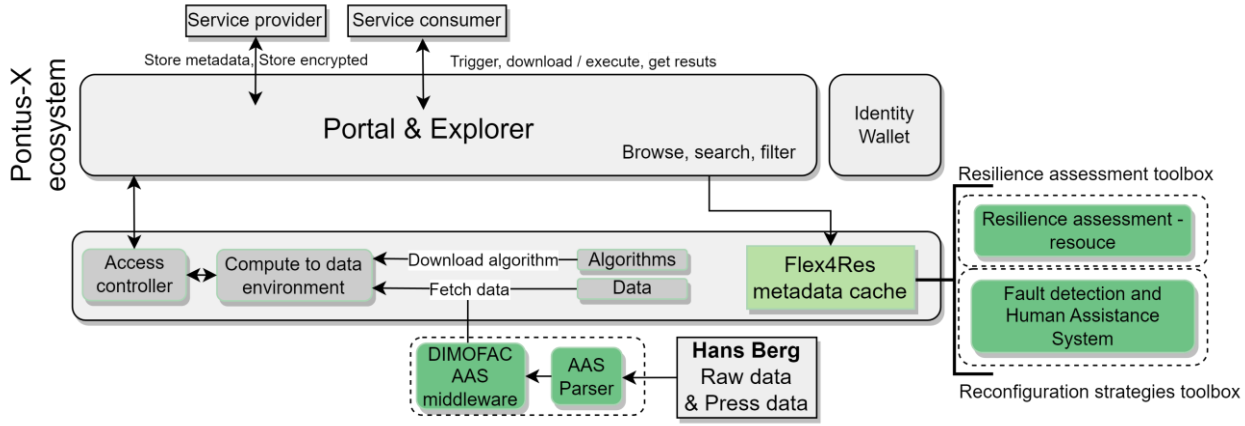
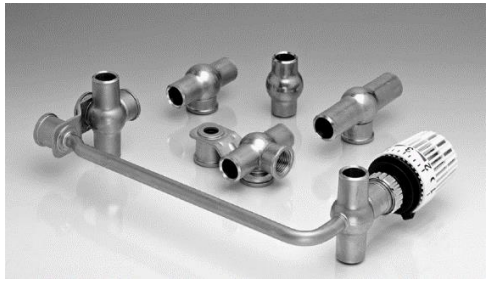


Tubular components

Heating components



Deep drawn components

Partners involved:

TU WIEN IFT Institute of Production Engineering and Photonic Technologies

Universität Siegen

BERG Forming Technologies

Beia CONSULT INTERNATIONAL

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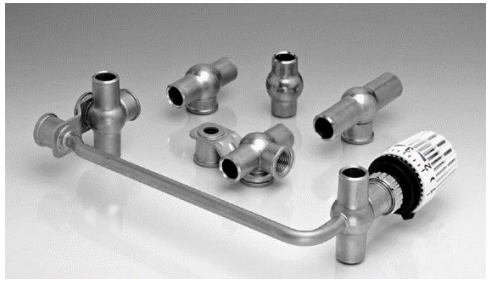
Goal: Reducing the time required to reconfigure the tools, the amount of produced defective components, and the need for the experience required to perform the adjustment tasks.

Expected benefits:

1. Reduce reconfiguration time needed to change tools for new production batches

Tubular components

Heating components



Deep drawn components

Partners involved:

Voestalpine use case

Reconfiguration of manufacturing processes during production

Co-funded by the European Union

Challenge: The products vary in size and shape and can only be machined on machinery providing the necessary capabilities, which also vary on other factors such as tools.

Goal: Highly flexible production planning and scheduling, also depending on the current machine state and manufacturing utilities with the opportunity to reconfigure the processes during production.

Dataspace: Gaia-X

AAS platform: CONTACT IoT platform

Resilience assessment toolbox:

- Resilience assessment – shopfloor

Reconfiguration strategies toolbox:

- Shopfloor Reconfiguration Tool

Voestalpine Group

Partners involved:

Voestalpine use case

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Goal: Highly flexible production planning and scheduling, also depending on the current machine state and manufacturing utilities with the opportunity to reconfigure the processes during production.

Expected benefits:

1. Reduce reconfiguration time
2. Reduce reconfiguration cost
3. Rescue lead time

Voestalpine Group

Partners involved:

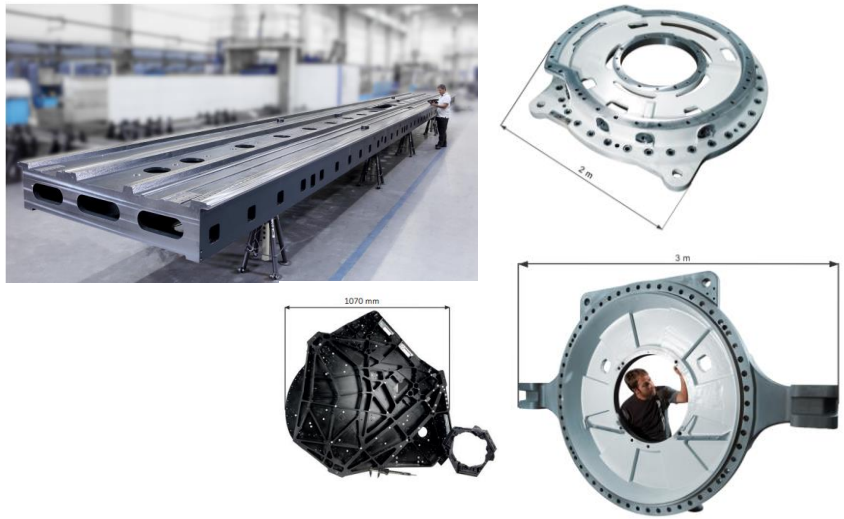
Goimek use case

Production planning optimisation

Co-funded by the European Union

Challenge: The process steps within the production of one part are performed in several working centres. They need to be fixed according to the daily production needs.

Goal: Increasing the efficiency and competitiveness as well as the predictability of production by developing a cross-site production planner, which can be constantly reconfigured.



Dataspace: Gaia-X

AAS platform: SAVVY IoT platform

Resilience assessment toolbox:

- Resilience assessment – resource-to-shop-floor

Reconfiguration strategies toolbox:

- Human Centric Shopfloor Reconfiguration Tool

Partners involved:

MONDRAGON HUMANITY AT WORK Finance Industry Retail Knowledge

IDEKO MEMBER OF BASQUE RESEARCH & TECHNOLOGY ALLIANCE

GOIMEK SORALUCE SAVVY

Goimek use case

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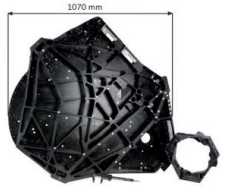

Expected benefits:

1. Reduce reconfiguration time
2. Reduce reconfiguration costs
3. Increase throughput
4. Increase efficiency through automated data exchange

Partners involved:

MONDRAGON HUMANITY AT WORK Finance Industry Retail Knowledge

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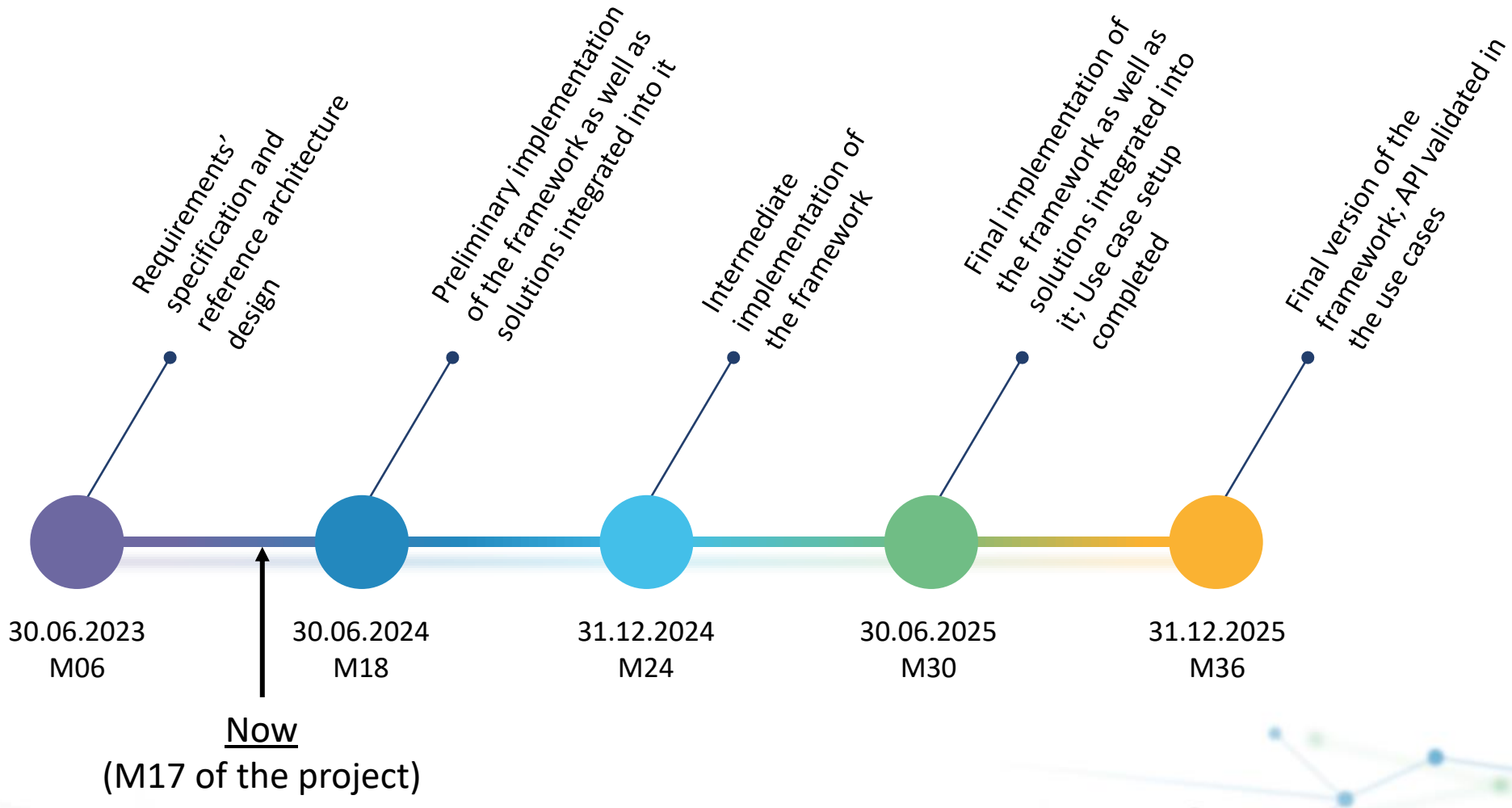
GOIMEK SORALUCE SAVVY

Milestones

Our way to more supply chain resilience



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voestalpine ONE STEP AHEAD.

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