Sustainable Surface Treatments of Complex Shape Components for Transsectorial Industrial Innovations

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Outline

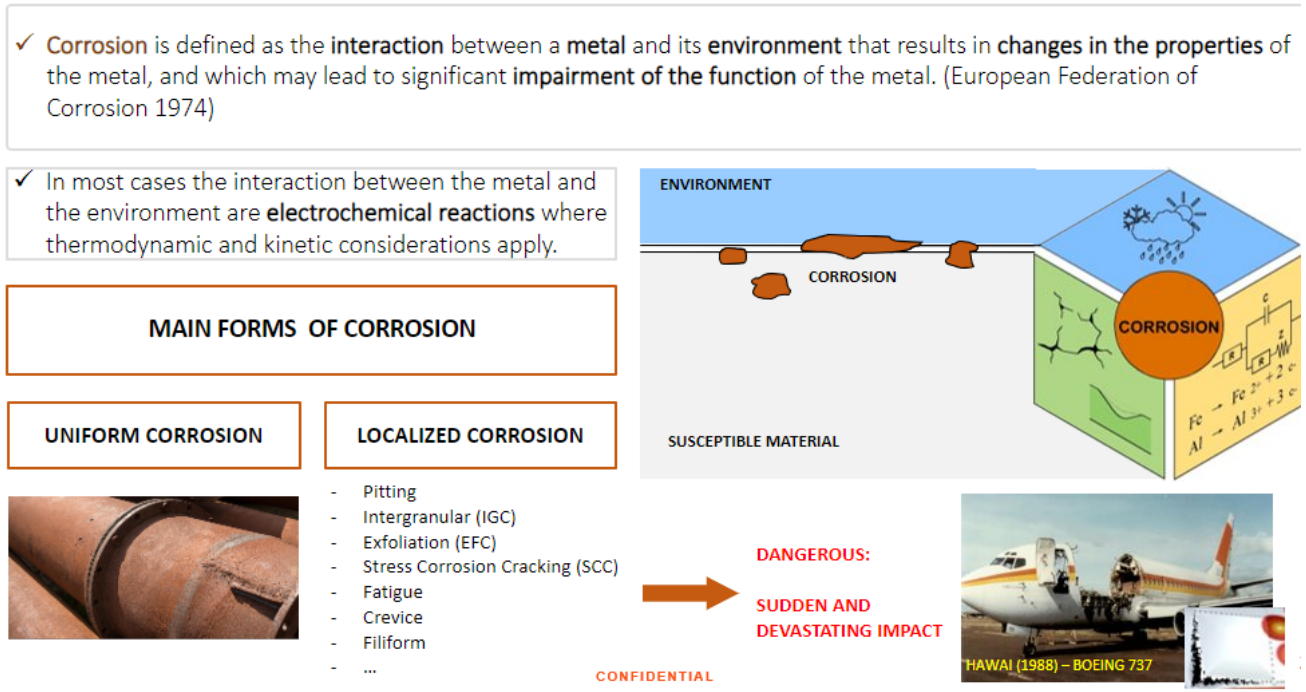
1. Introduction
2. Project methodology
3. Surface Technologies integration into manufacturing lines

1. Introduction

Project Motivation

Steel, commonly employed in constructing buildings, ships, and machinery, has long been a stalwart material. Various industries are now seeking alternatives to reduce product weight and associated costs, along with the increase of thermal conductivity, being **aluminium (Al) and copper (Cu), good candidates**.

However, without protection, **Al is prone to corrosion in harsh environment** (e.g. heat exchangers, heat storage units, components which have to be cleaned frequently with acidic and alkaline chemical products). **Cu is a rather durable material, although its corrosion resistance can be improved**.



Source: NDTCorr 2023 (courtesy CIDETEC)

Sure2Coat ambition and goal

SURE2COAT project aims to facilitate the **adoption of Aluminium in new sectors** and **extending lifetime of Copper**, particularly those involving products with intricate shapes.

To address the corrosion problem, SURE2COAT is developing **novel surface treatments** for **gearbox housings*, heating systems and heat storage units**.

*The project had initially as use case housings for electrical engines in Food & Beverage industries. Gearbox housings will replace this use case (request for amendment under preparation).

Consortium

The consortium is made up of **13 industry and research partners** from 8 European countries.

- 4 industries (COWA & MicroArc as SME, GE-Avio* & BOSCH as Large companies)
- 3 RTO (SINTEF, CIDETEC & HEREON)
- 5 academia (UA-DEMaC, SUPSI, PWR, POLIMI* & ULjiubliana)
- 1 standardisation body (UNE)

*Avio Aero (GE Aviation business) and Politecnico di Milano (POLIMI) are currently in the process of joining the SURE2COAT consortium

*SIEM is no longer partner in the project from 31/01/24

Multiple skills Partnership

Research Institutions

- SINTEF – Project coordination, TRL 6 (pilot scale) testing, techno-economics and CFD simulations
- Fundacion CIDETEC – Anaphoretic e-coating of Al
- Helmholtz-Zentrum Hereon – Plasma electrolytic oxidation (PEO)

Universities

- Politechnika Wroclawska (WUST) – Casting of complex Al shapes, CFD simulations
- Universidad de Aveiro (UAVR) – Laser structuring of Cu, dissemination coordination
- The University of Applied Sciences and Arts of Southern Switzerland (SUPSI) – Integration into manufacturing lines
- Politecnico di Milano (POLIMI) - Cold Spraying*
- University of Ljubljana (UL) – Life cycle assessments

Industry partners & Associations

- BOSCH – Use Case for gas-water heaters, TRL 6 testing
- COWA – Latent heat storage units, TRL 6 testing
- GE-Avio Aero – Aerospace use case*
- Micro-Arc – Industrial PEO coating
- Asociación Española de Normalización (UNE) – Standardization activities

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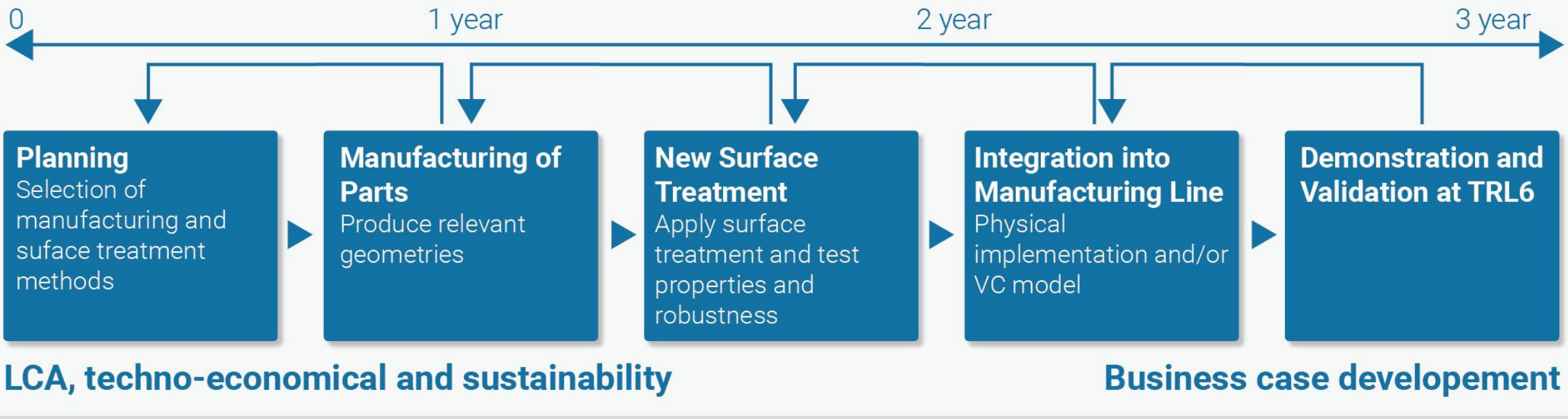
2. Project methodology

Methodology

Demonstration through Use Cases

Hypothesis

Identify challenges and propose new surface treatments that can enable more sustainable manufacturing and lower energy and resource consumption for the end user



Overall Concept

SURE2COAT TOOLBOX

Manufacturing Methods
- Casting
- Extruding
- Cutting&Stamping
- Additive manufacturing

Surface Treatments
- Anaphoretic e-coating
- c-PEO
- Laser Structuring
- Spray Coating
- LDH, Sol-Gel, CCC, HOT-AC

Validation
Corrosion testing
Pilot testing
LCA, techno-economical, environmental

Integration
Automation
Robotics
Physical test case
Virtual commissioning

Business case
Cost analysis
Market evaluations
Uptake strategies

Dissemination
Publications
Conferences
Webinars
Skills development
Course development

Use Case 1:

Electrical engine housings

Objective:
Replacing stainless steel housings with aluminium with modified surface to withstand harsh operating conditions in the F&B industry

Outcome:
- Reduced energy consumption for end user by up to 60% and reduced weight by up to 70%
- Increased use of recycled Al

Industry partner: SIEMENS

Use Case 2:

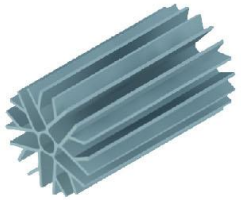
Gas-water heaters

Objective:
Modify surface of copper fins in GWH to increase heat transfer and reduce pitting corrosion

Outcome:
- 5% reduction in copper usage and 5% increase in energy efficiency for the final product.
- Overall savings 1.5 M€.
- New innovations in LST

Industry partner: BOSCH

Use Case 3:



Heat exchangers for LHS

Objective:
Enable the use of recycled Al for salt-based HX-internals

Outcome:
- Enabling fast charging LHS systems for industrial applications, not currently available
- Demonstration of surface treatment of aluminium to allow operation with salt-based PCMs
- New market sectors

Industry partner: COWA

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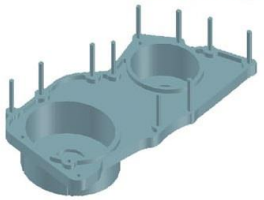
Use Case 1:



Accessory Gear Box

Objective:
Repair of Gear Box aluminum housings avoiding the scrap of the component and improving wear resistance of mating surfaces

Outcome:
- Improve lifing of the component by >5 years
- Improve wear resistance of the mating surfaces

Industry partner: AVIO

Use Case 2:

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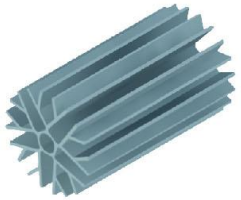
Industry partner: BOSCH

Use Case 3:



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- New market sectors

Industry partner: COWA

Specific Objectives

1 To develop **new flexible and environmentally friendly surface treatments for aluminium (Al) and copper (Cu),** enabling multifunctional corrosion resistant and conductive surface functionalities on **complex shape components**.

2 To **integrate the new surface treatments into manufacturing lines** for the production of gearbox housings, gas-water heaters for residential heating units, Al-based heat exchanger internals for latent heat storage applications.

3 To **demonstrate** at TRL6 that the new production line will have **higher efficiency**, reduced material and energy consumption and lower environmental footprint than the current ones.

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Specific Objectives

4 To **demonstrate >50% reduced energy consumption** during use for Al-based electrical engine housings* and latent heat storage heat exchanger internals and 5% increase in energy effiency and 10% reduction in Cu consumption for gas-water heaters. Simulation techniques and digital twins will be used to demonstrate integration of the technologies through the use cases.

5 To **enable the use of Al profiles in environments currently not applicable due to corrosion challenges, which will open new emerging markets**: electrical engines for the mobility, shipping and aerospace sectors, construction elements, and future ultrathin heat exchangers.

6 To **reduce manufacturing costs by 10%** by reduced energy consumption.

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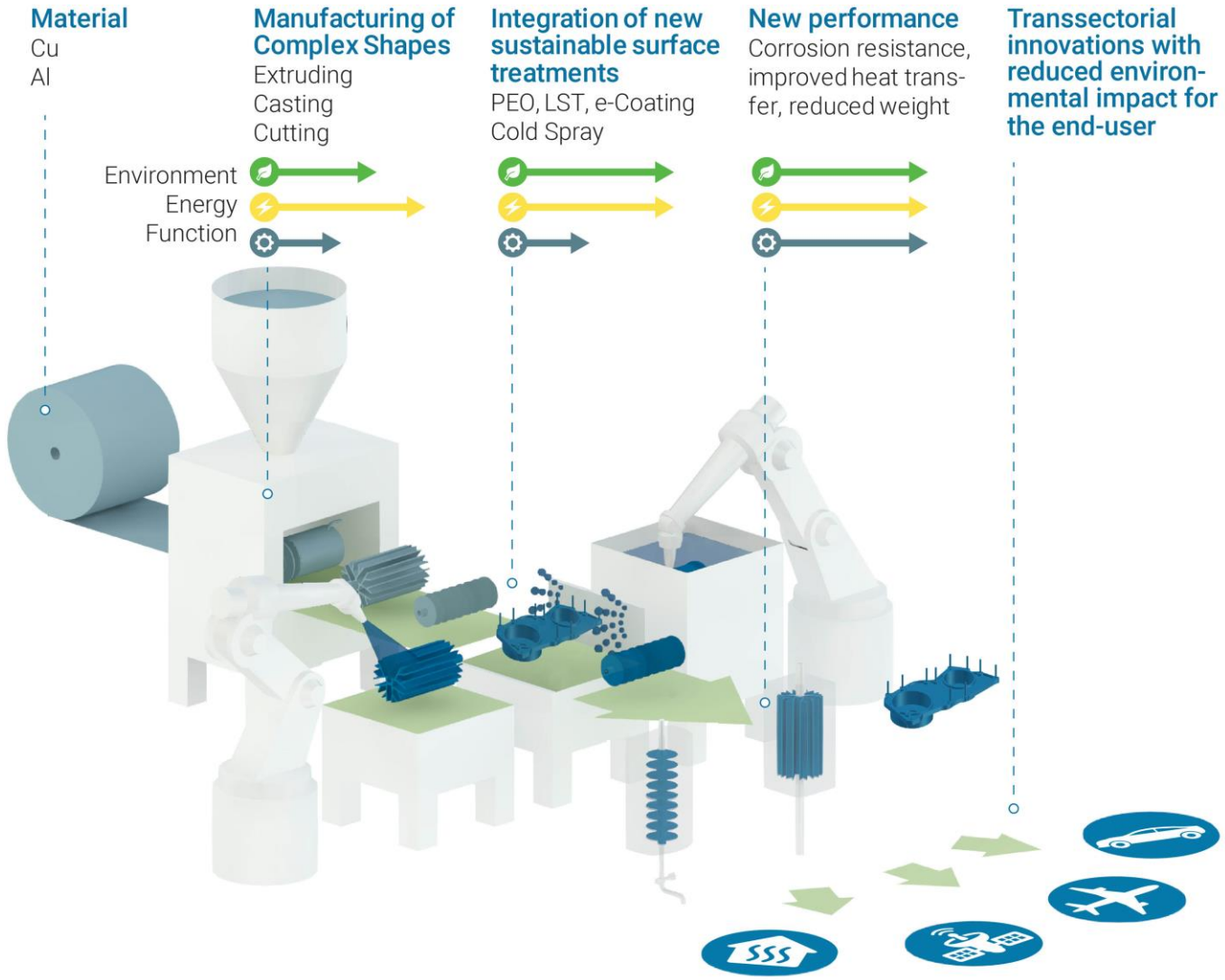
Overall Methodology

Surface Treatments and Shapes Development	Validation	Integration (into production lines)	Business cases	Dissemination of results
• Composite PEO coatings • Laser Surface Structuring • Anaphoretic e-coating • Complex shapes developement	• Corrosion & Robustness • Pilot testing • LCA, techno-economic and environmental evaluations	• Automation • Robotics • Physical test cases • Virtual commissioning	• Cost analysis • Market evaluations • Uptake strategies	• Publications, conferences, webinars • Skills development • Course development

3. Surface Technologies integration into manufacturing lines

Integration into manufacturing line

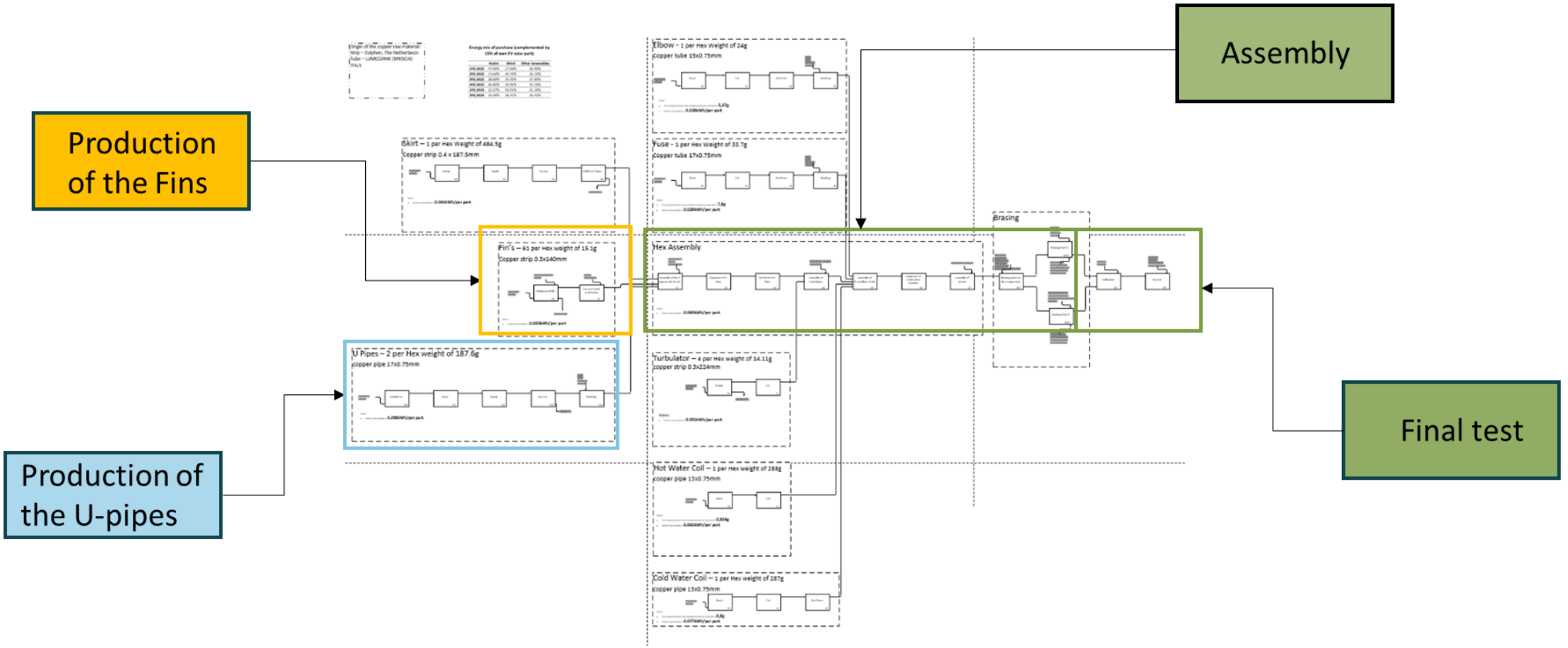


INTEGRATION INTO MANUFACTURING LINES

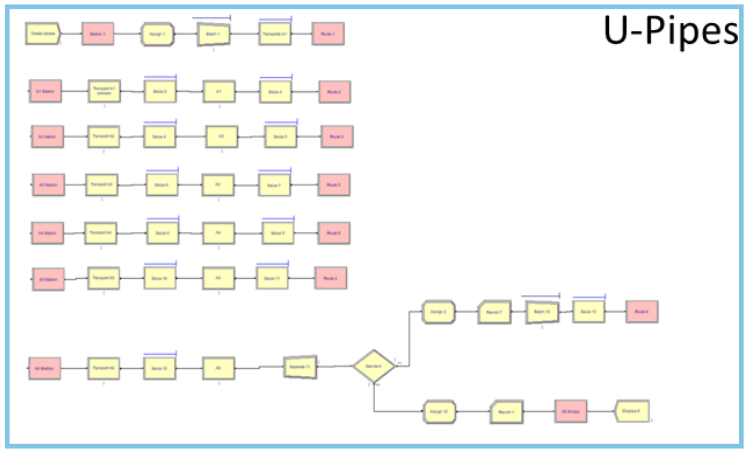
- SUPSI: Virtual and physical integration
- BOSCH: Use case 2
- COWA: Use case 3
- WUST: Investment casting
- Micro-Arc: Industrial PEO surface treatment

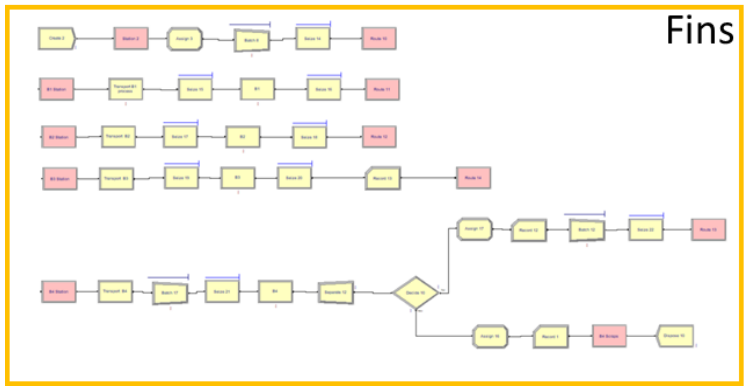
* Use case 1 under revision

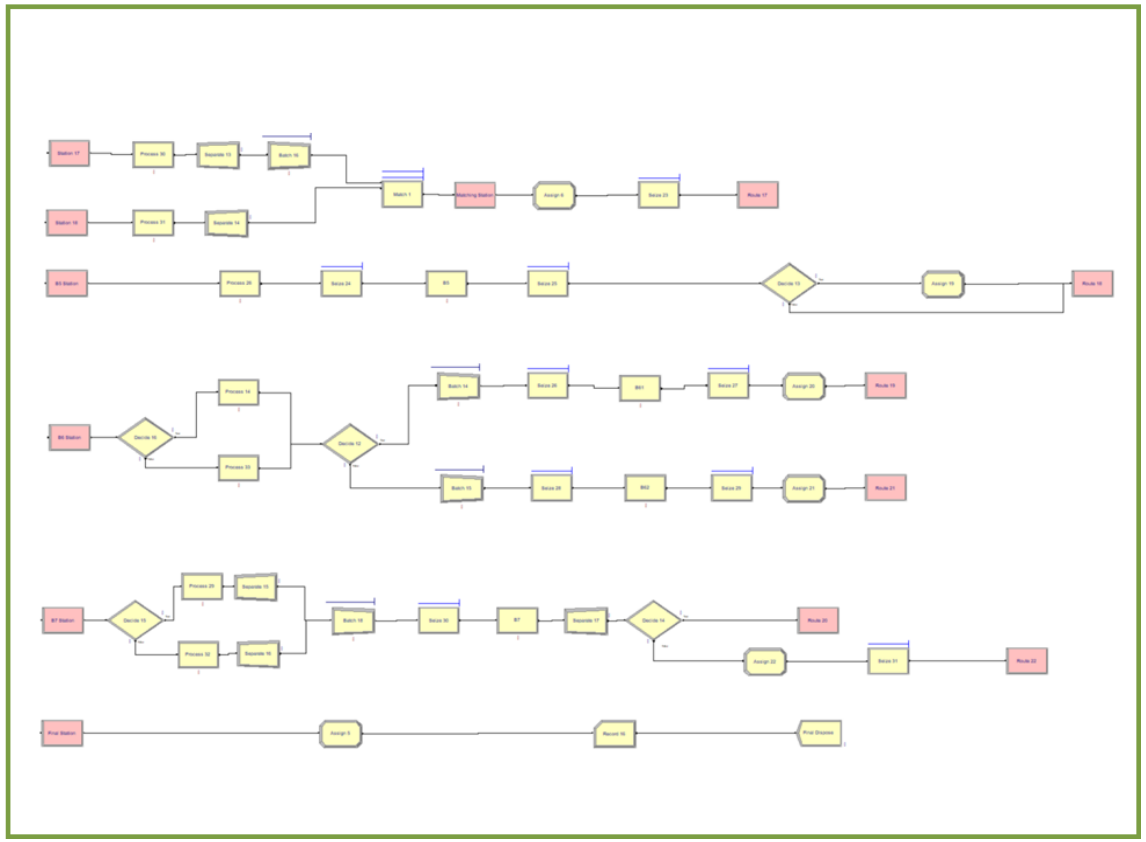
Step 1: Detailed Analysis and Requirements Gathering



Step 2: Technical Desing and Process Simulation

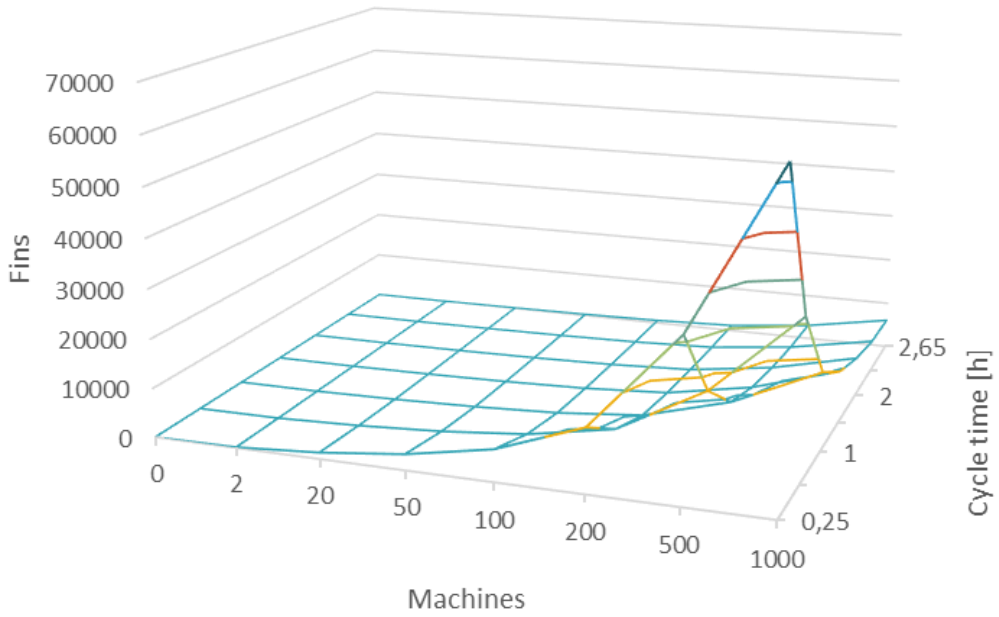






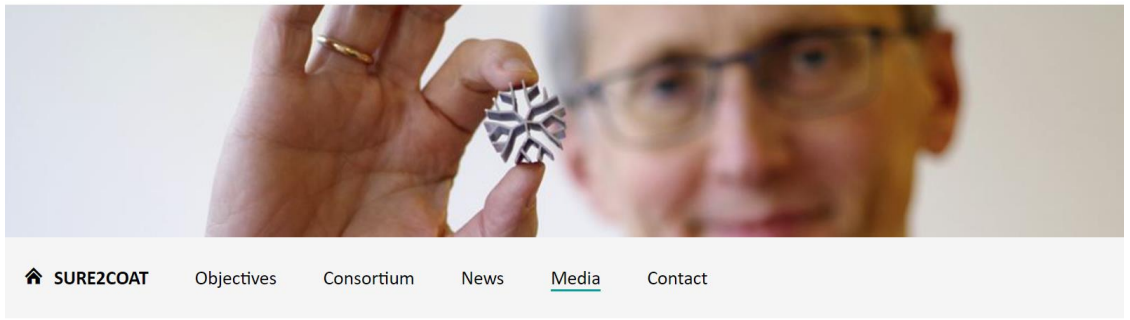
Process simulation

- **Results comparison**

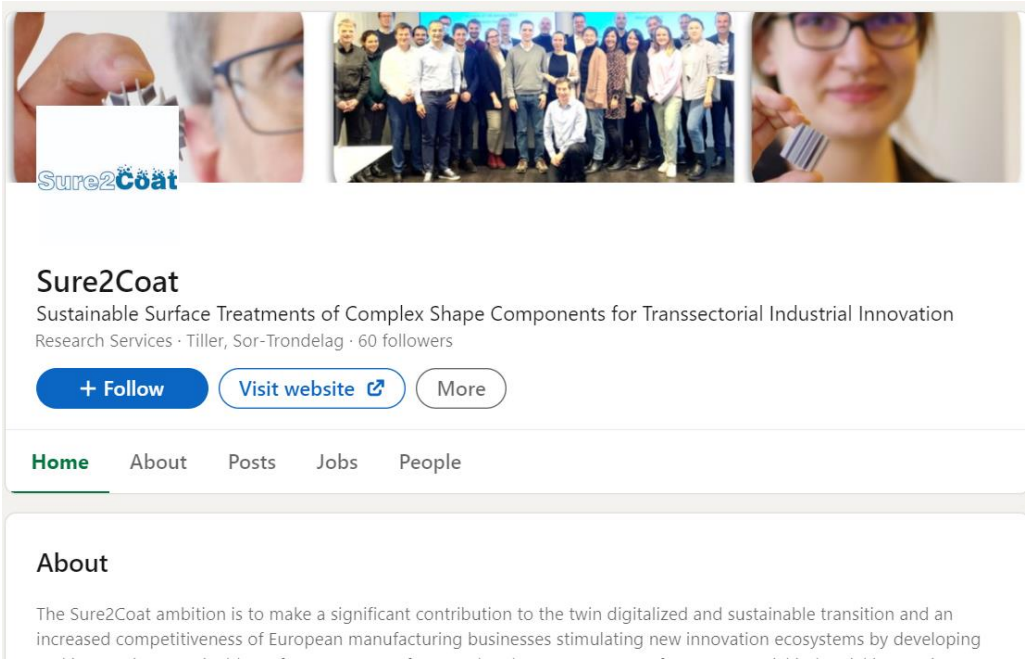


Step 3: System delivery and field testing

- **Pilot cell at SUPSI:** for testing some key features of the cold spray process a pilot cell will be set up at the SUPSI MiniFactory. Here we have the possibility to try how the system will behave by a point of view of the automation and system integration.
- **Field testing**: after the pilot, we perform the integration into real manufacturing lines. By using distributed control logic (IEC61499) the control logic can be develop independently of the final choose hardware, allowing an easy and quick integration.



https://www.sintef.no/projectweb/sure2coat/media/a-new-project-was-started-in-2023-named-sure2coat/



https://www.linkedin.com/company/sure2coat/

THANK YOU FOR YOUR ATTENTION

See you in Stand Nº 14

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