FLASH-COMP

FLASH-COMP: Flawless and sustainable production of composite parts through a human centred digital approach

GAnº. 101058458

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General Data

- Starting Date: 1st October 2022
- Duration: 42 months (30th March 2026)
- Project Budget: 6,69 M€
- Funding: 5,61 M€
- 14 partners:

Context

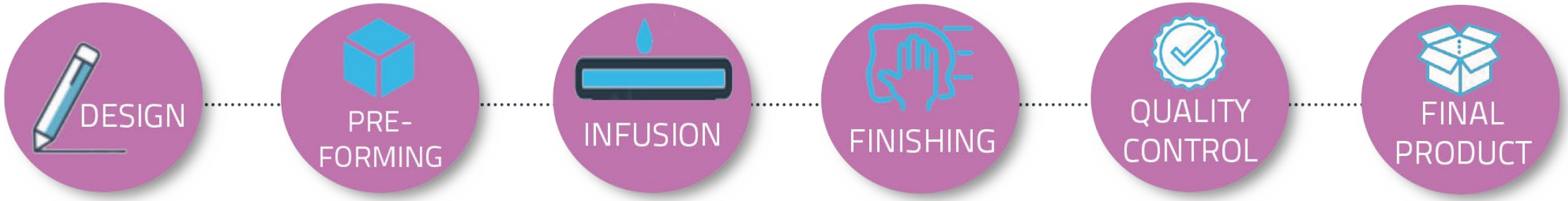
- Transition towards climate neutrality: need to reduce manufacturing waste
- Composites play an important role In EU manufacturing: energy, naval, aerospace sectors…
- Manufacturing of these parts largely based on manual operations (difficult to control)
- Current processes: unsustainable and inefficient (excess of material, need of reparation…)
- Considerable environmental impact (135.000 to 372.000 Tones/year in Liquid resin process)

Goal of the Project

- The **main objective** of FLASH-COMP is is to **develop a fast and reliable (FLASH) human-oriented quality control solution capable of identifying in a timely-manner defectiveness during process and**, consequently, **to determine the in-situ corrective actions to be implemented**.

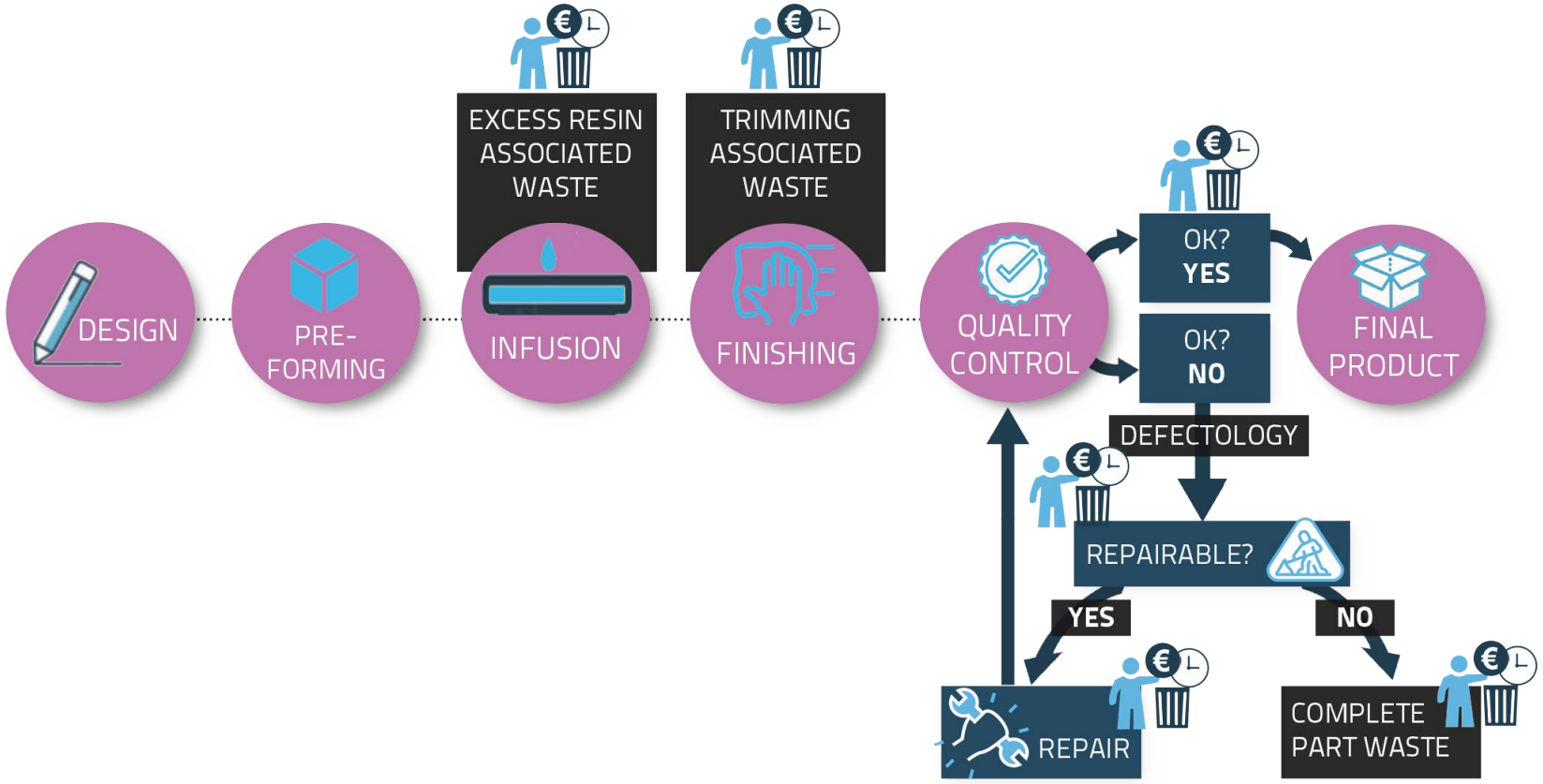
- **Application field** will be **composites**, specifically Liquid Resin Infusion (**LRI**) processes, with the objective of reaching the **zero-defects paradigm** thus significantly **reducing the generation of** polymer composites **waste**.

- LRI **Process Steps**:



Main Concept

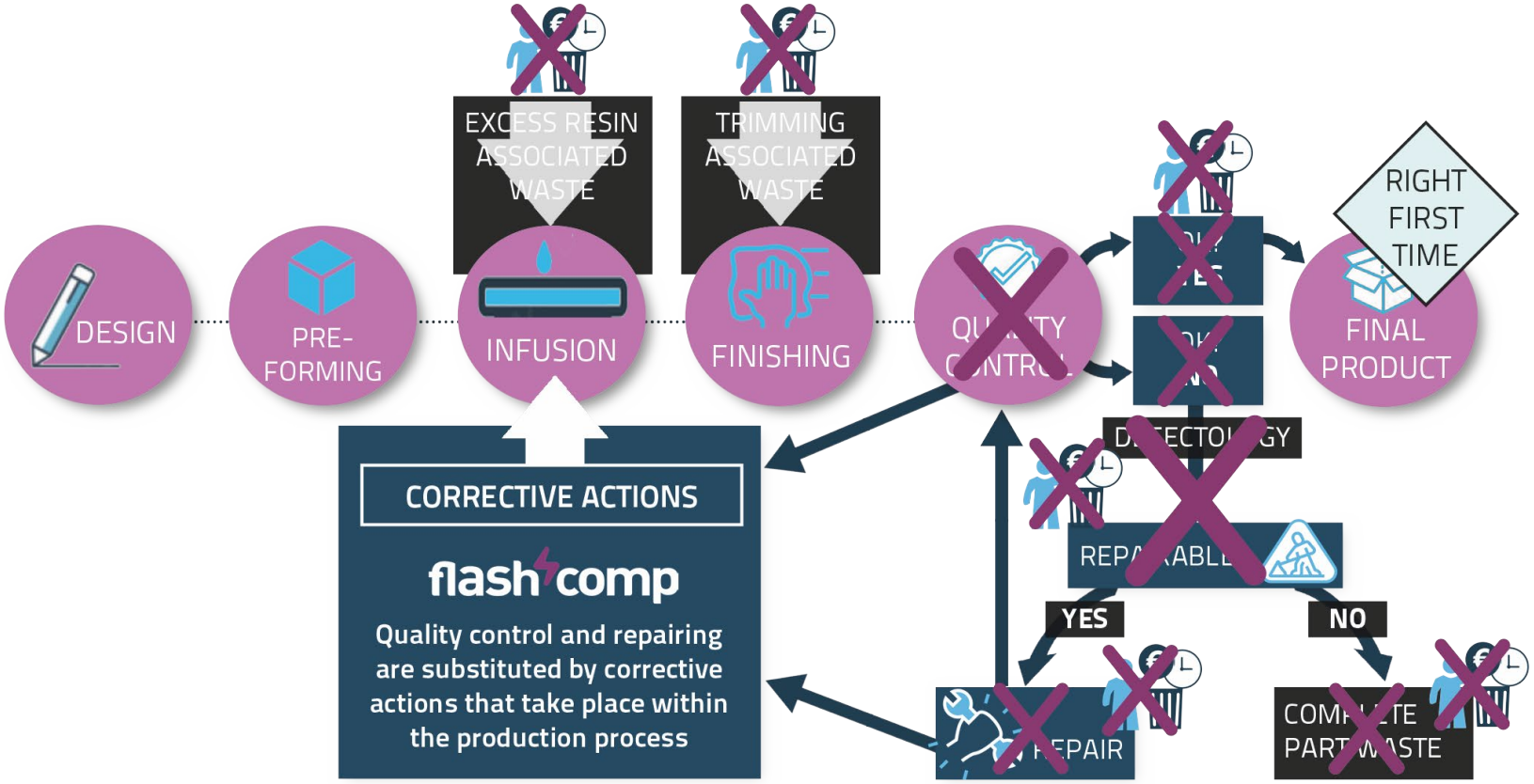
Current Approach:



- Defectiveness occurs (mainly) due to issues in the Pre-Forming and Infusion stages.
- Difficult to act over the Infusion process once it has started.
- Feasible defectiveness (voids, pores, …) is avoided by introducing resin in excess:
  - waste within the Infusion and Finishing process
  - tedious and expensive quality control loop after the part is finished
- Possible to reduce costs from waste and the quality control loop by “simply” establishing corrective actions over the resin-infusion stage

Main Concept

FLASH-COMP Approach:

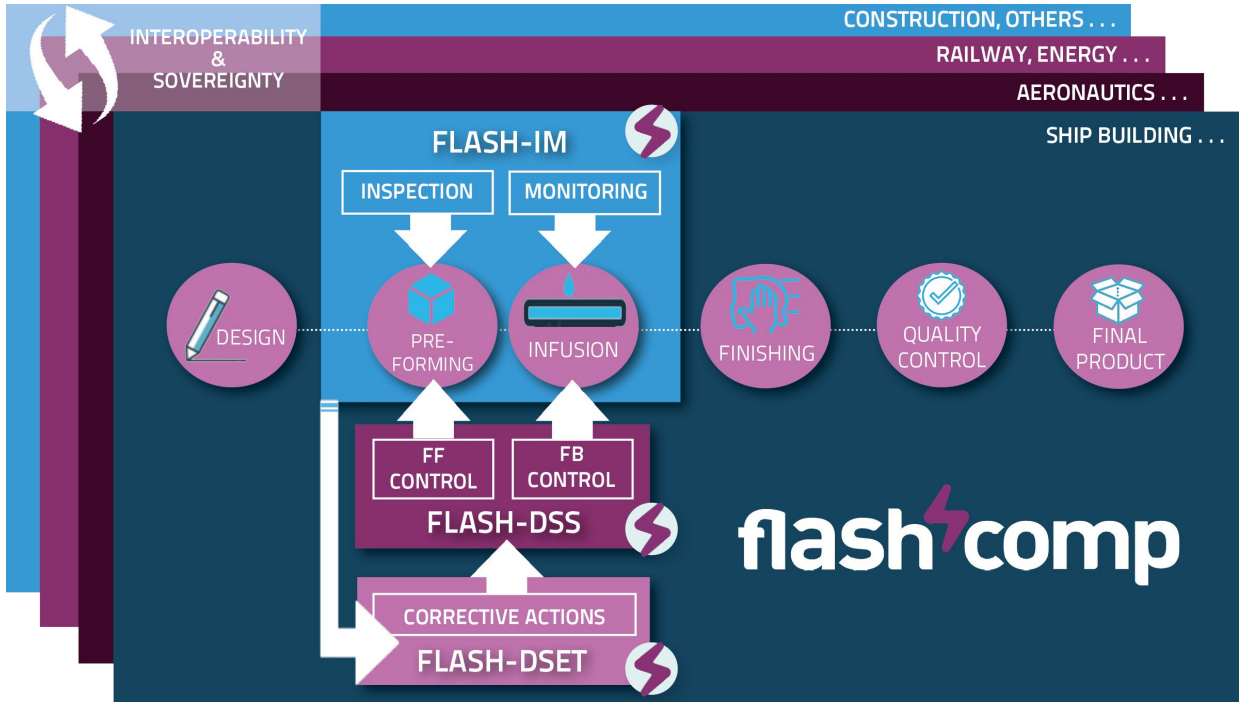


Corrective actions within the Infusion stage will allow:

- Manufacturing with no defects.
- Reducing excess resin and trimming associated waste.
- Eliminating the Quality Control stage.
- Producing “right-first-time” products.

Concept:

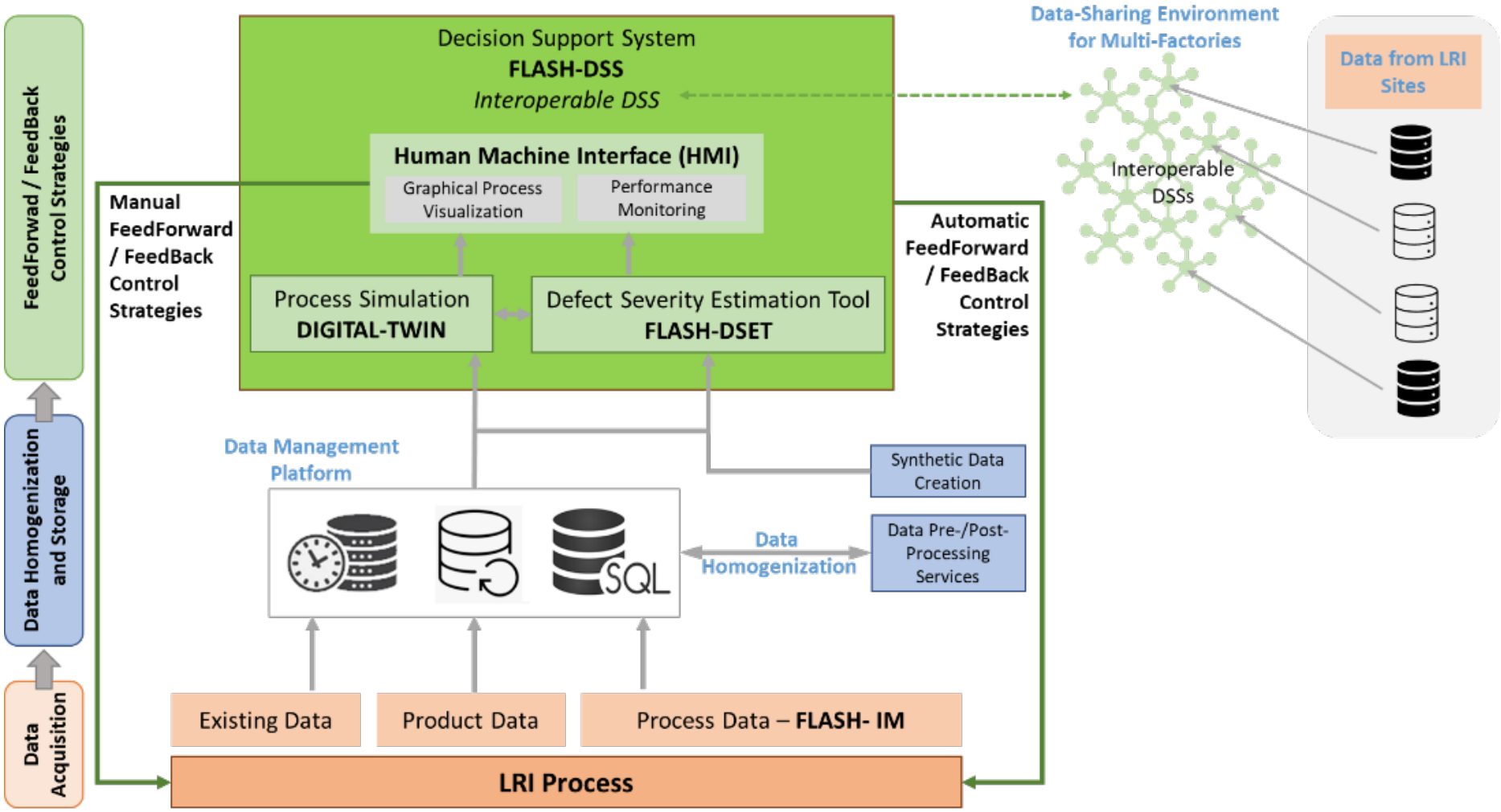
- **FLASH-COMP will employ** novel, fast and accurate **Inspection and Monitoring techniques (FLASH-IM)** within the most critical manufacturing stages (Pre-Forming and Infusion), to retrieve key process parameters. This data will feed **an AI-based Defect Severity Estimation Tool (FLASH-DSET)**, capable of estimating the generation of defects and, in consequence, determining if and what kind of corrective actions should be adopted. Instructions will be linked to **real-time feedforward and feedback (FF/FB) control strategy Decision Support System (FLASH-DSS)** .



- **The solution will increase its knowledge by sharing interoperable and sovereign data among different sites** and factories.

Project Approach

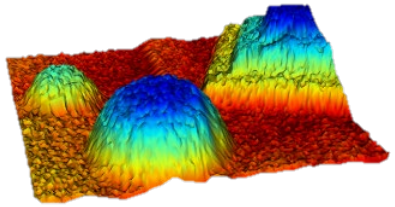
FLASH-COMP Solution



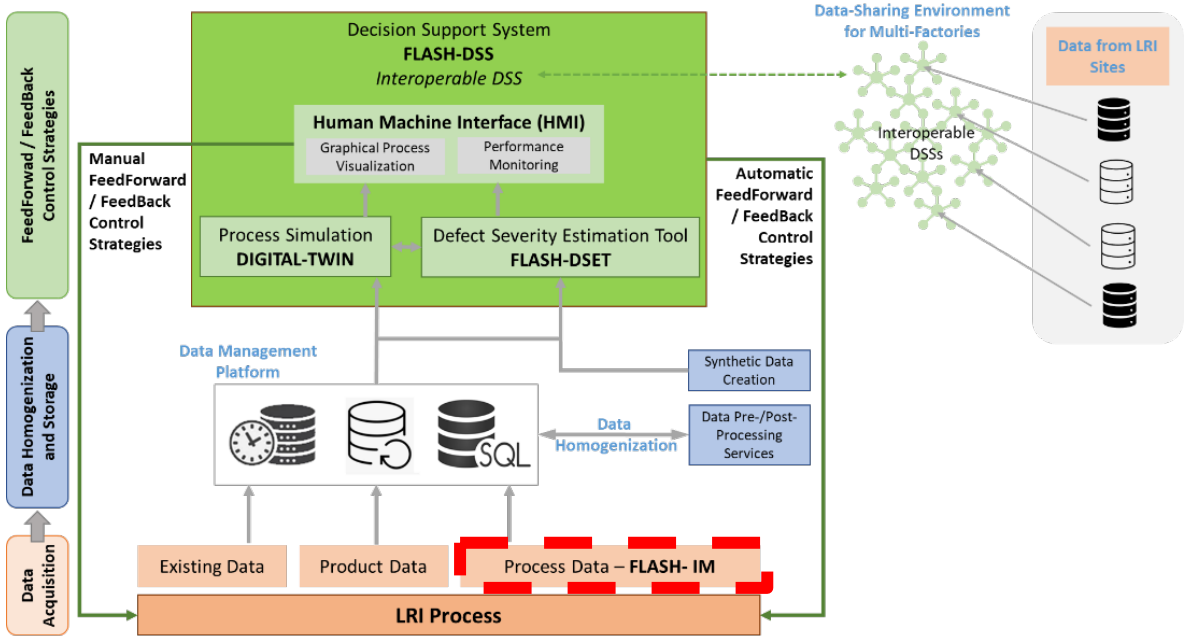
First results:

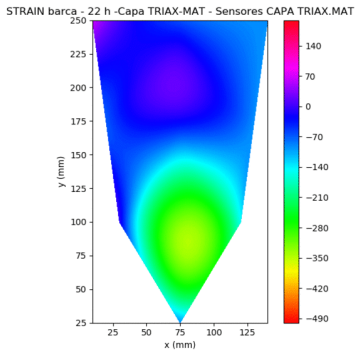
FLASH-COMP Solution: FLASH-IM (Inspection and Monitoring instruments):

- **FLASH-IM** –aim: collect relevant data from the Pre-Forming and Infusion stages



  - Pre-forming Inspection:
    - Linear Scan Cameras
    - Spectral Imaging,
    - 3D Laser Line Profilers
    - FLASH-LIDAR: Inlets positioning
  - Infusion Process Monitoring:
    - Embedded Sensors: temperature, pressure….
      - Fibre Optic Sensors (FOS)
      - PyzoFlex®

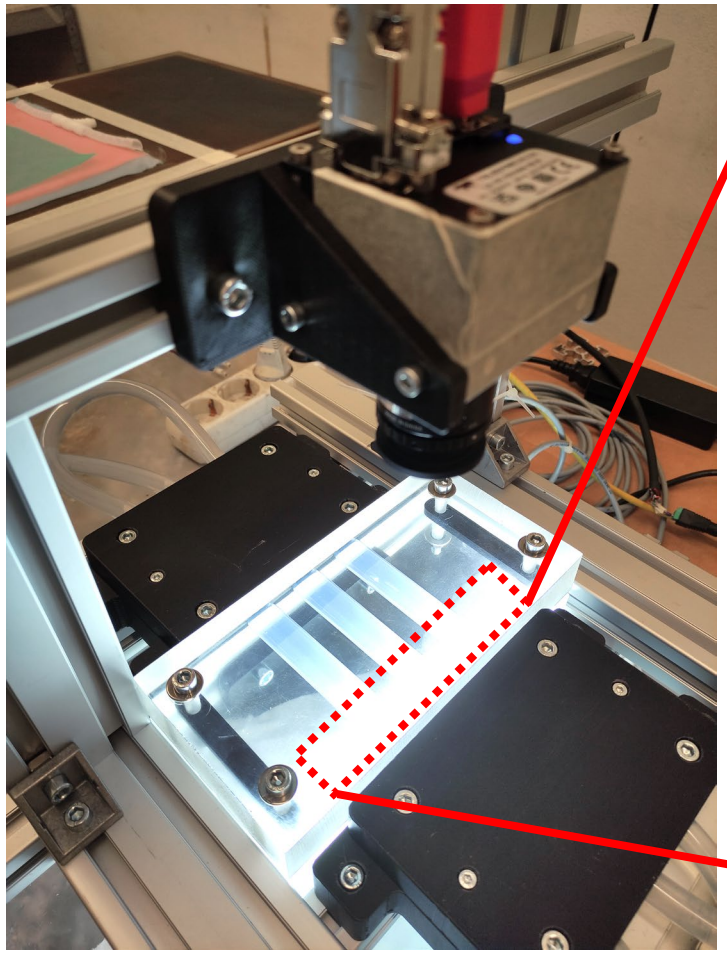




Novel FLASH-IM Systems Development

Linear camera | Optical flow meter and voids detector

Bubble Count and Plotting

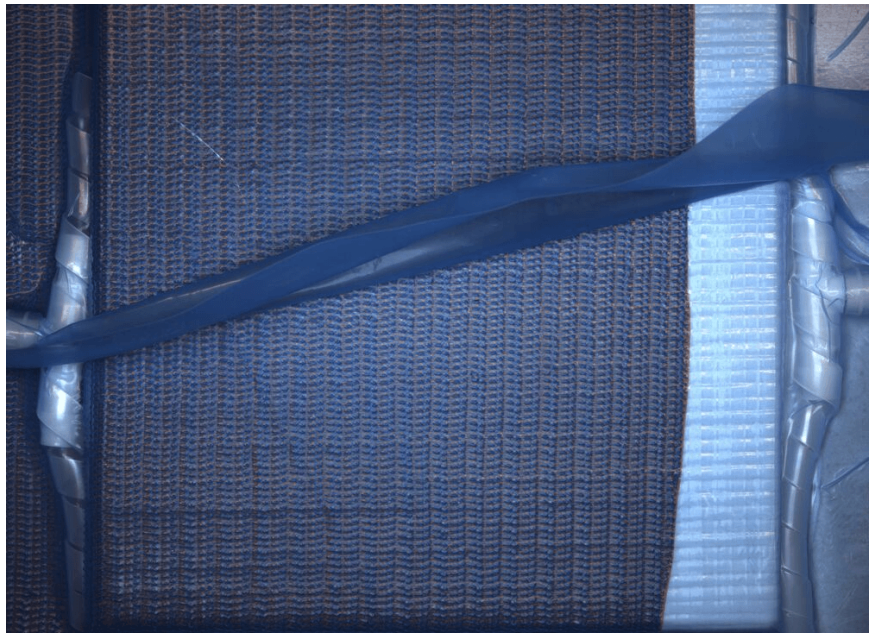


Novel FLASH-IM Systems Development

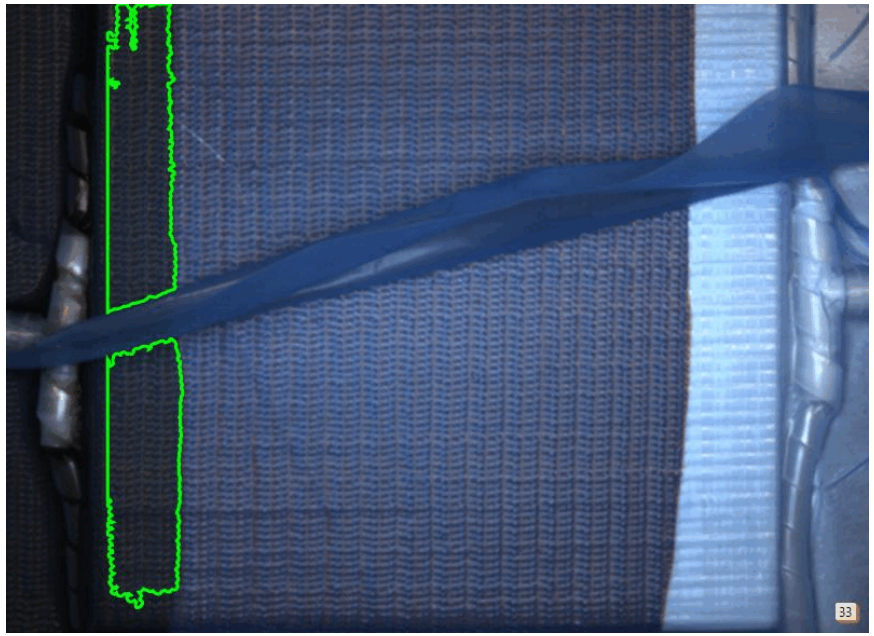
Lab Tests - Resin Flow Front

Test number 2: Infusion with a wrinkle throughout the part

RAW Frames



Post Processing Overlay



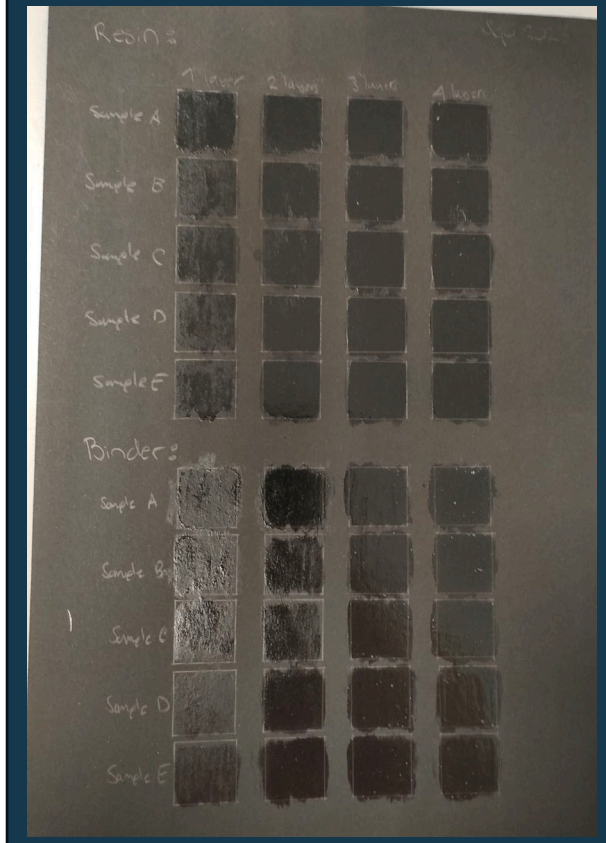
✓ Flow Front Detection is detected

Novel FLASH-IM Systems Development

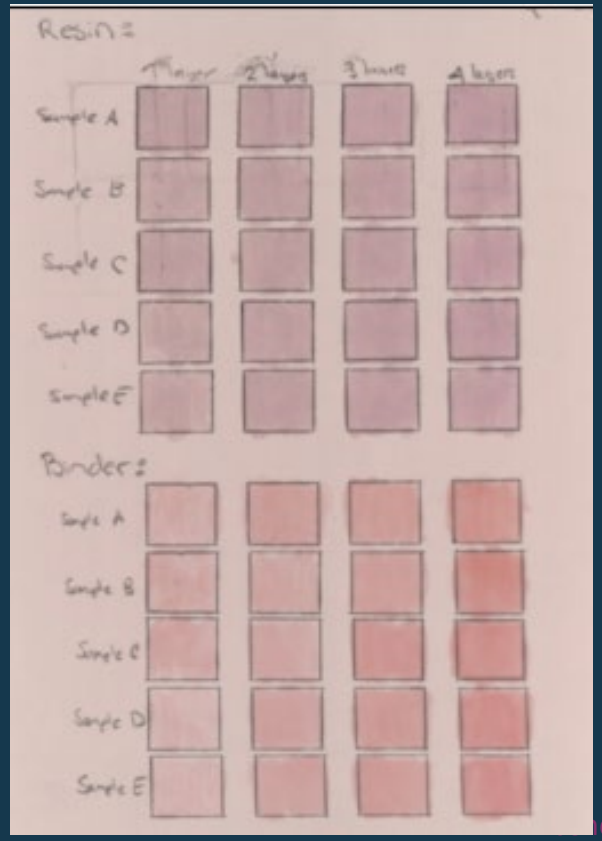
- Test with different layer thickness:

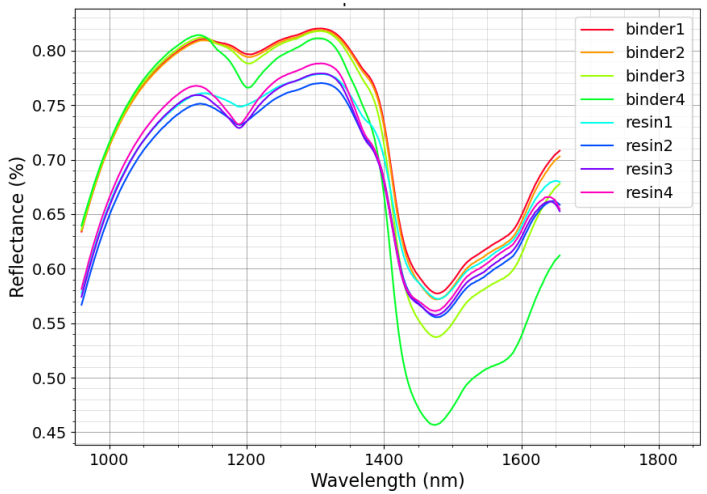
Sample with different layers (resin and binder)

Photo of the sample:



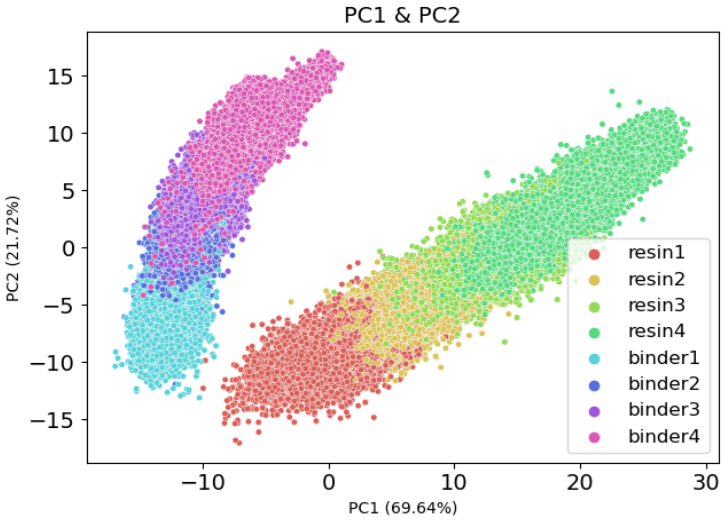
Hyperspectral image (false color):





Spectra data:

- Differences between binder and resin.
- Progressive changes between thicknesses.



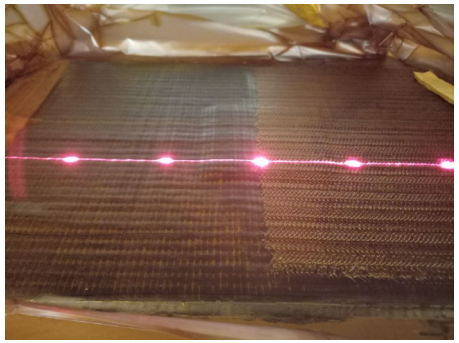
PCA analysis:

- Good discrimination between binder and resin.
- Clear progressive changes between thicknesses.

As a preliminary conclusion, It could be possible to measure small material layer thicknesses.

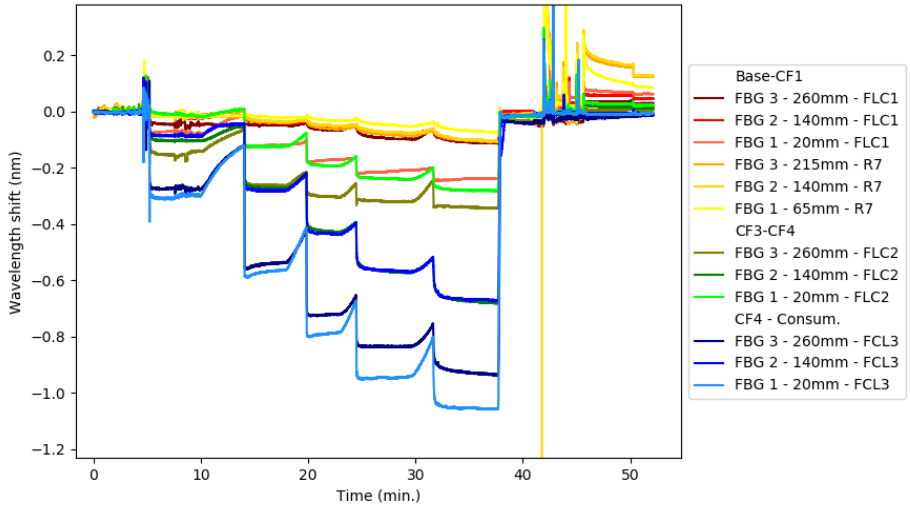
Novel FLASH-IM system development

FOS: FBG's (Fiber Bragg Grating)

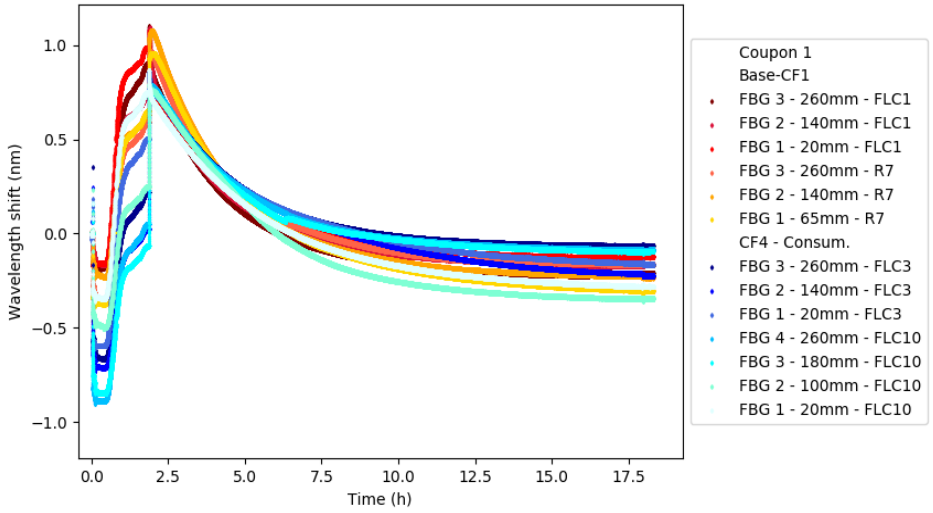


During preforming

- Capacity to react to different vacuum levels
- FBG's have different response depending on the sensor position (mold/tool surface or over the laminate)



FGB's test at different vacuum levels at room temperature



FGB's at full vacuum (950 mbar) with temperature up to 100º C

Next steps:

FLASH-COMP Solution: FLASH-DSET (Defect Severity Estimation Tool):

- **FLASH-DSET** –aim: infusion process simulation. Predict the generation and propagation of defectology and to evaluate its severity (Digital-Hybrid Twin).

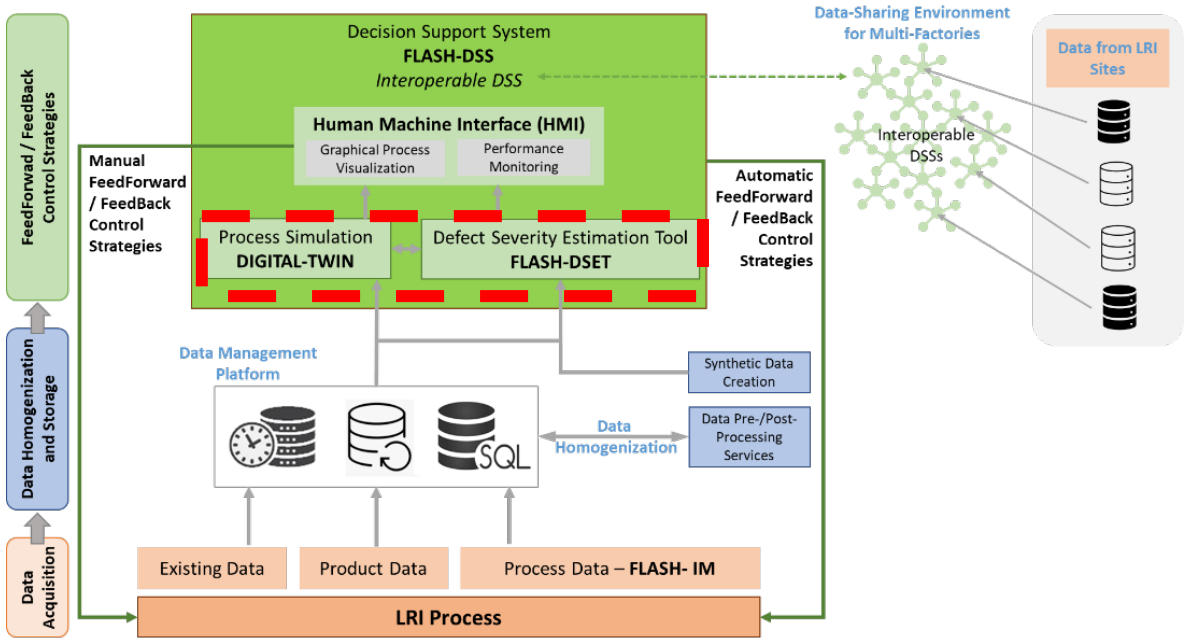
- Hybrid approach:

  - Physic based simulation (near real time simulations):
    - Infusion process simulation
    - Model Order Reduction (MOR)

  - Artificial Intelligence based simulation (real time-process data):

    - Data-Driven
    - Based on data retrieved by FLASH-IM

Comparison of process estimation and process reality



USE CASES

NAVAL SECTOR: AZIMUT

- Yatch manufacturing, composite: 14-50 m in length
- Expected savings: 30 % resin waste, 20 % repairing materials and 808 MWh energy comsuption
- Annual Production: 250 yatchs, 1400 big components

AERONAUTICAL SECTOR: IAI

- Aircraft structures manufacturing: wing skin
- Annual Production: 72 wings per year
- Expected savings: 30 % reduction resin waste, 100 % reduction in discarded spars and wingboxes

flashcomp

Any questions?

This project receives funding from the European Union's Horizon Europe research innovation programme under grand agreement No.101058458

Stay informed