AACOMA

Demo project #3

Composite repair guidelines for restoring structural functionality

Lead partner: Flanders Make

Presenter: Ahmed Elmahdy – Research Engineer at Flanders Make

Motivations

- **Repair of damaged** composites is **cost effective** compared to replacing the whole part (especially for large structures)

- However, composite repair is a complex multistep process, with some limitations:
  - **Lack of standardization** and control on damage removal and patch application.
  - **Optimum design** of the repair patch parameters
  - Need for **highly skilled** operators

- **High risk for SMEs** to adopt composite repair as mainstream process.

https://www.yumpu.com/en/document/read/3715769/detection-of-hail-impact-damage-in-composite-structures-at-the-
https://www.compositesworld.com/artides/composites-repair

Goals of the demonstrator

Solutions

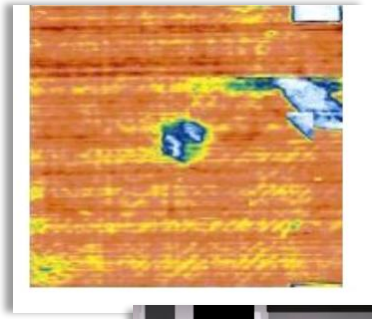
- Provide a **set of guidelines for controlled composite repair** regardless of the application or material.
- Reducing the need for highly skilled operators in composite repair with **digital work instructions**.
- Encouraging SMEs to adopt **modeling and automation approaches** in the repairs of composite structures.

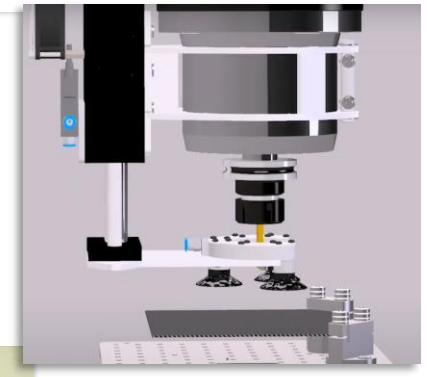
Target sectors

- Aerospace, Automotive, Energy, Thermoplastic pipes.
- The guidelines can be valid for any sector.

Key Innovations

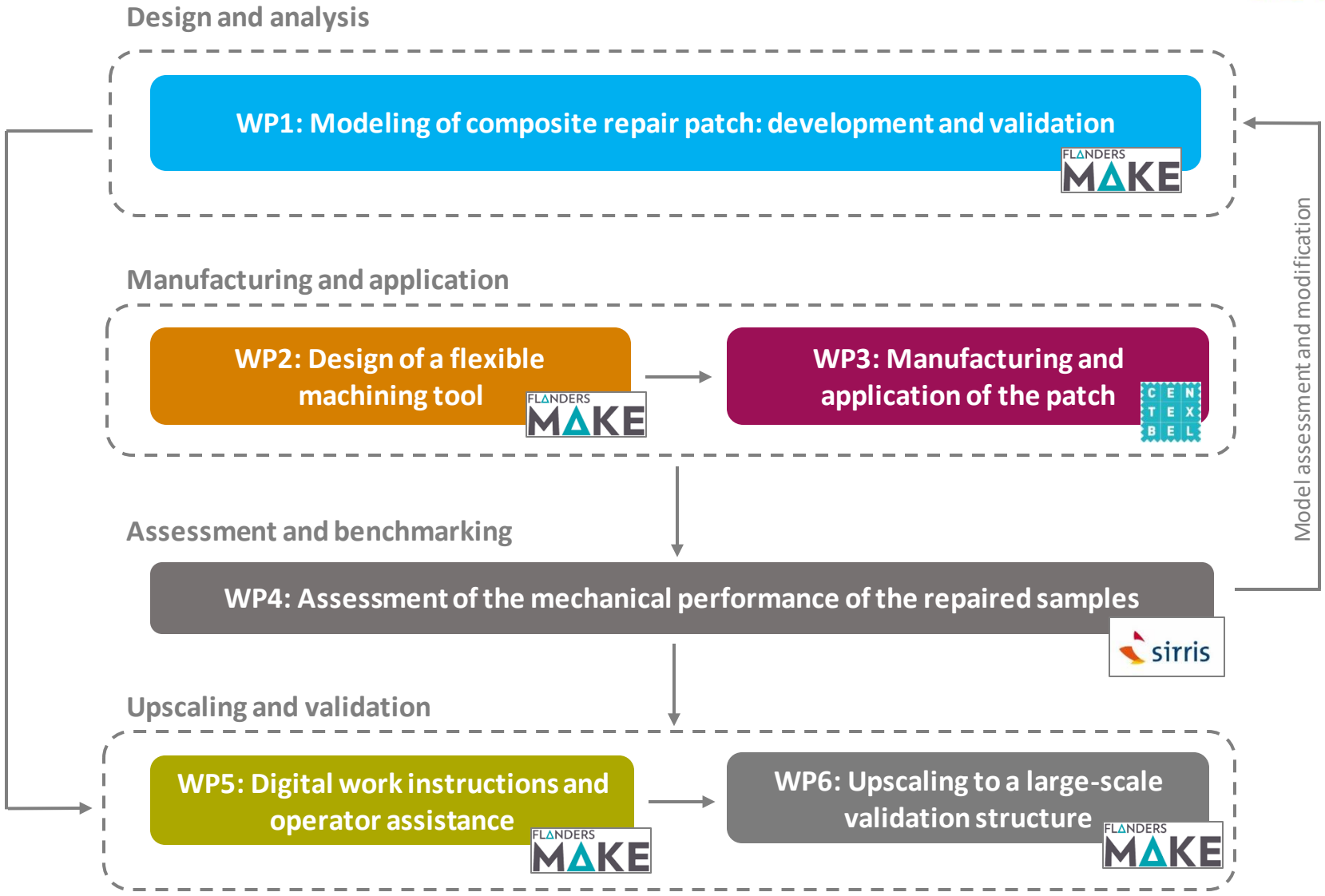
- A **free** and simple to use **simulation tool** for patch design, selection, and optimization.
- A **flexible machining tool** for damage removal in composite structures.
- **Induction welding** of thermoplastic composites.





https://www.yumpu.com/en/document/read/3715769/detection-of-hail-impact-damage-in-composite-structures-at-the-

Tasks & Workplan



Indicated logos show the WP leader

Current status

Milestones:

M1: (May 2021)

- Machining techniques are selected. Materials, modeling approach, patch application method, testing requirements, and industrial use case are identified

M2: (November 2021)

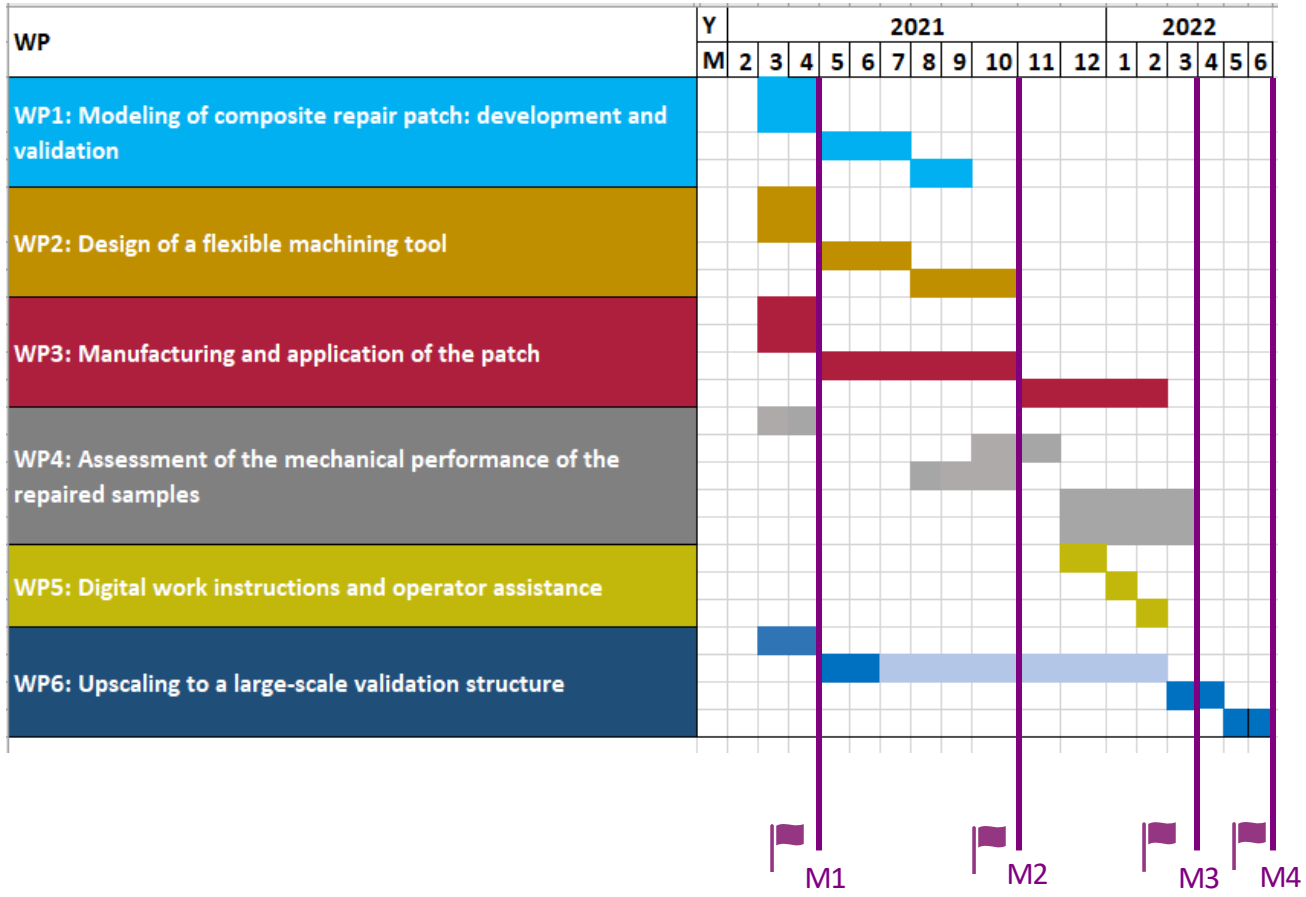
- Calibrated patch model, validated flexible machining tool are available.

M3: (April2022)

- All coupon samples are manufactured, mechanical performance is assessed, DWI tool is available

M4: (July 2022)

- Developed technologies are validated on large scale structure



Current status

Validation use cases

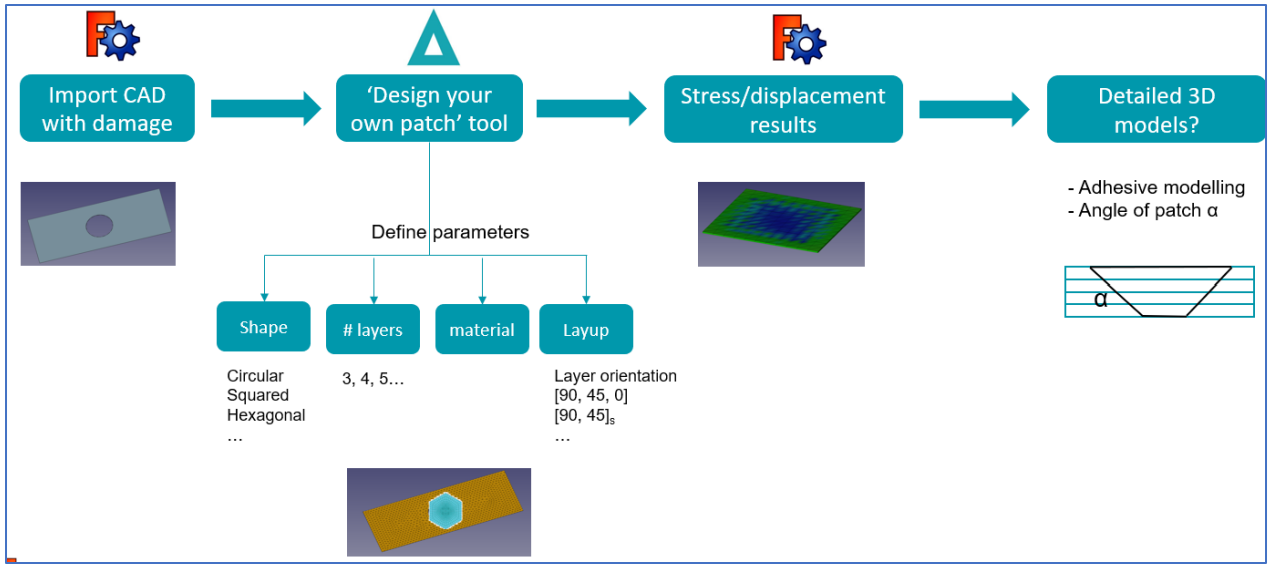
- Repair of Wind turbine blades and thermoplastic composite pipes

Materials

- Glass fiber reinforced (epoxy) composites – Polyamide

Modeling approach

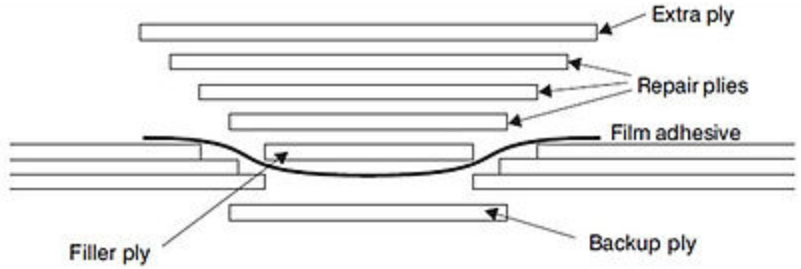
- "Design your own patch" selector tool based on FreeCAD and Calculix FEM solver



Current status

Patch application methods

- Bonded Stepped repair of hard patch with adhesive bonding.
- Induction welding of 3D printed thermoplastic patches.
- Soft patch with resin transfer molding can be considered in a later stage.



Stepped repair

Testing

- Mechanical characterization tests for model calibration and validation.
- Ultrasonic NDT for damage size and severity assessment.
- Static bending performance of patched coupon level samples and validation structures.
- Optimum machining parameter identification → mechanical tests + optical microscopy for delamination assessment.

Thank you!

DEMO #3 Leader

Ahmed Elmahdy: Ahmed.Elmahdy@flandersmake.be

Manuel Michiels: Manuel.Michiels@flandersmake.be

AACOMA Project Coordinator

Bernard Paquet - bernard.paquet@centexbel.be

AACOMA Communication

Michael Effing - amac@effing-aachen.de

Mona Ziegler - amac-communications@effing-aachen.de

Follow us on our website

https://aacoma-interreg.eu/