SuCoHS

SUSTAINABLE & COST EFFICIENT
HIGH-PERFORMANCE COMPOSITE STRUCTURES
DEMANDING TEMPERATURE
AND FIRE RESISTANCE

SuCoHS Project

Final Public Workshop

Tobias Wille (Project Coordinator on behalf of the consortium)
German Aerospace Center (DLR)
22-23 February 2022

SuCoHS project, Grant Agreement N° 769178

Outline

- Motivation
- Objectives
- Consortium
- Selected results
- Contact

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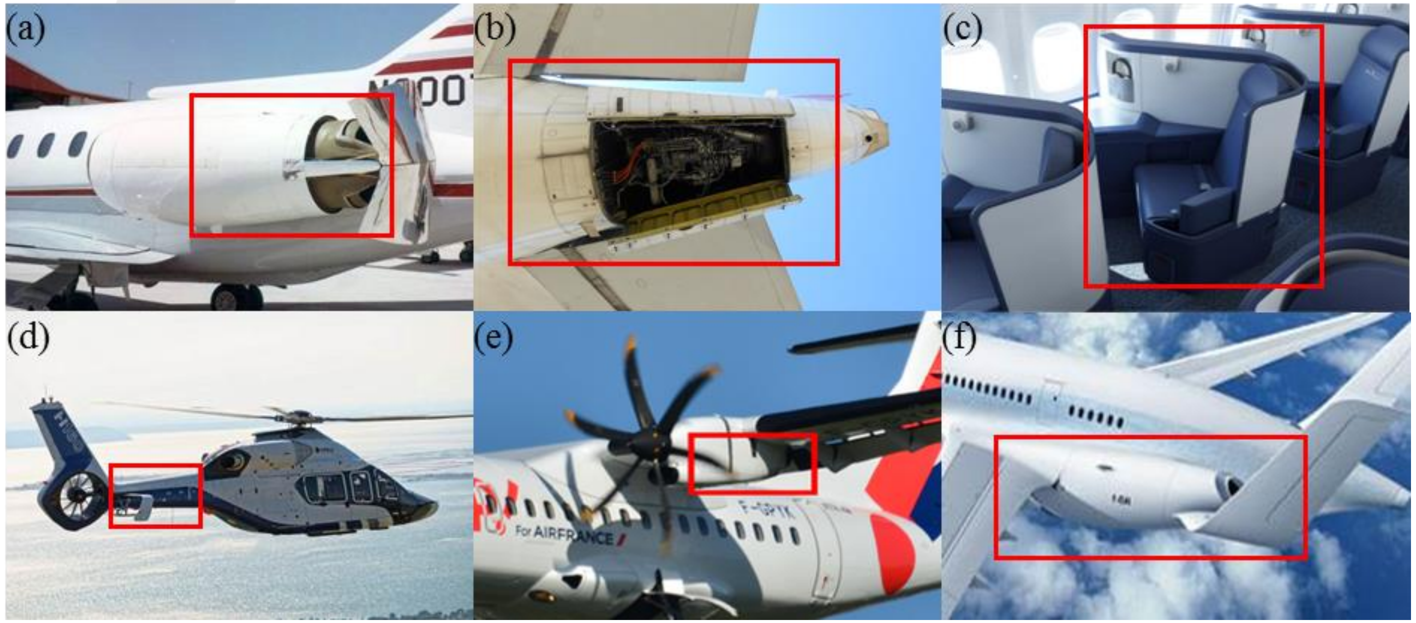
Motivation

- Several aeronautical applications demanding high thermal conditions
  - Temperature
  - Fire



- Maintain industrial leadership through expanded use of composites for:
  - Reduced weight
  - Improved performance
  - Increased efficiency
  - Reduced costs

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Objectives – Pilot Demonstrator Requirements

- Reduce part complexity
- Multidisciplinary loading
- Reduce number of subparts
- Use of composites at T>335°C

- Avoid titanium APU housing
- Use of composites at T>300°C
- Ensure fire resistance
- Ensure damage tolerance

- New structural concepts and materials for improved performance at reduced costs
- Flammability and FST requirements

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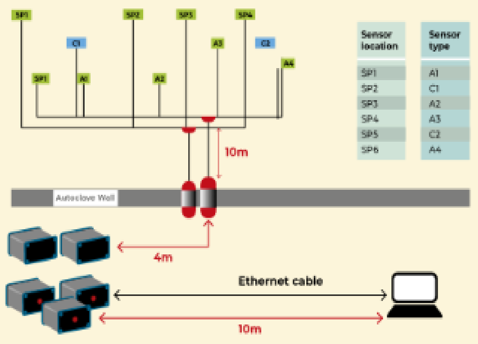
Objectives – Technologies under Investigation

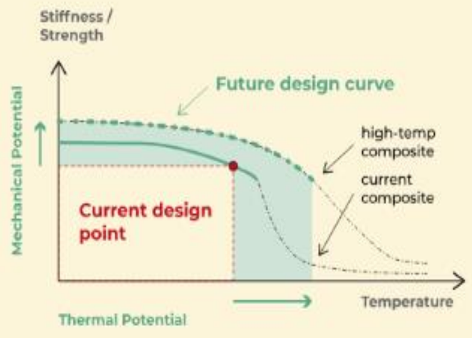
- Design
- Manufacturing
- Operation

Manufacturing



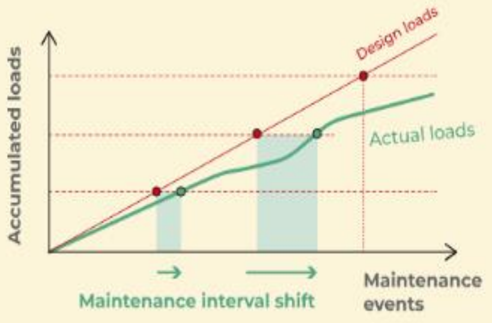
- Tailored multifunctional preforms
- Advanced hybrid manufacturing technologies
- Zero-defect manufacturing

Design



- New composites materials
- Reliable multidisciplinary analysis tools and allowable
- Robust multifunctional structural concepts

Operation



- Reliable multifunctional sensors
- Efficient tools for structural usage evaluation
- Enhanced maintenance scheduling

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Objectives – Methodology

New Materials and Manufacturing Processes

- Increased understanding and exploitation of composites
- Developments of higher resistant composites (temperature and fire)
- Tailored multi-material preforms
- Hybrid manufacturing and integrated quality control methods

New Analysis Methods, Allowable and Structural Concepts

- Material modelling considering ageing and peak loads
- Damage allowable during manufacturing and operation
- Multidisciplinary structural and reliability analysis methods
- Structural concepts for composite shells under thermo-mech. loading

New Sensors and Evaluation Systems

- In-situ preforming monitoring and evaluation system
- In-situ consolidation monitoring and evaluation system
- Structural loading monitoring and evaluation system
- Structural usage evaluation and scheduling system

Technology integration, Testing and Validation on Coupon and Small Scale Prototype (TRL 2-4)

Demonstration by Pilot Activities
near to Operation Environment (up to TRL 5)

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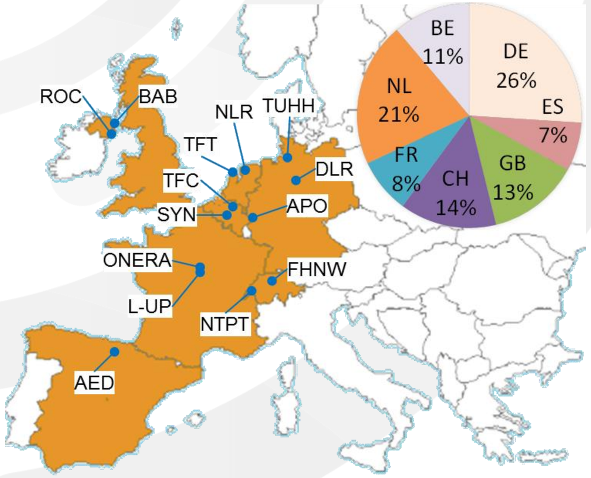
Consortium



40 Researchers and engineers

14 Partners

7 European Countries

571.5 person-months

EU contribution 6 638 939 €

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Industrial End Users

- Structural design and simulation
- Production verification
- Pilot demonstration and evaluation

SME and Industrial Facilitators

- Materials
- Sensor systems
- Data base

Research Organisations

- Material characterisation and modeling
- Manufacturing technologies
- Structural analysis and testing

Universities

- Materials
- Process simulation
- Probabilistics

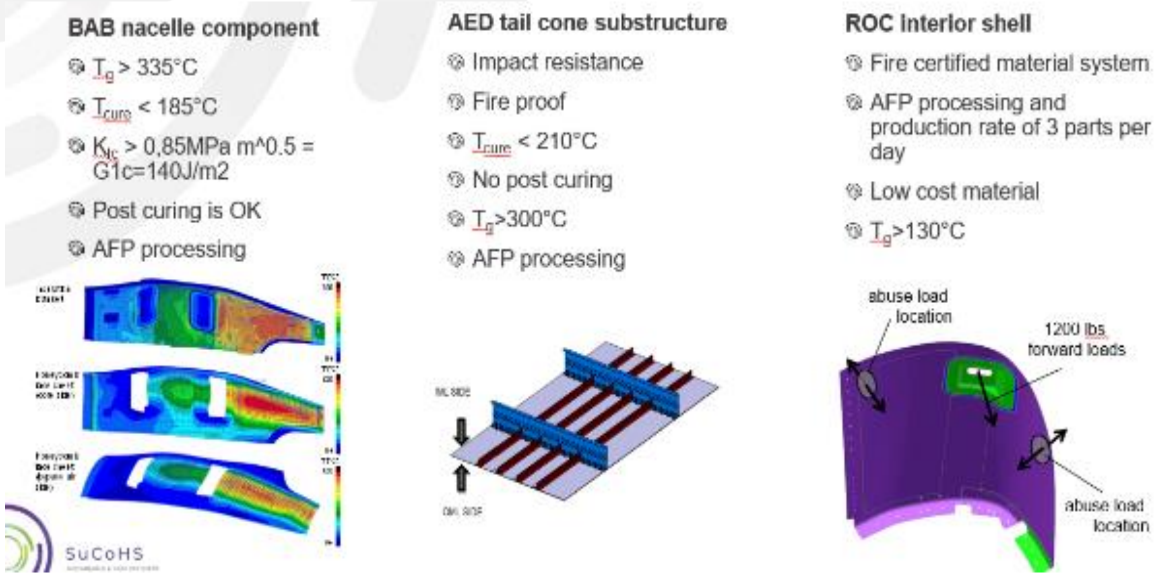
Selected results – Material Assessment

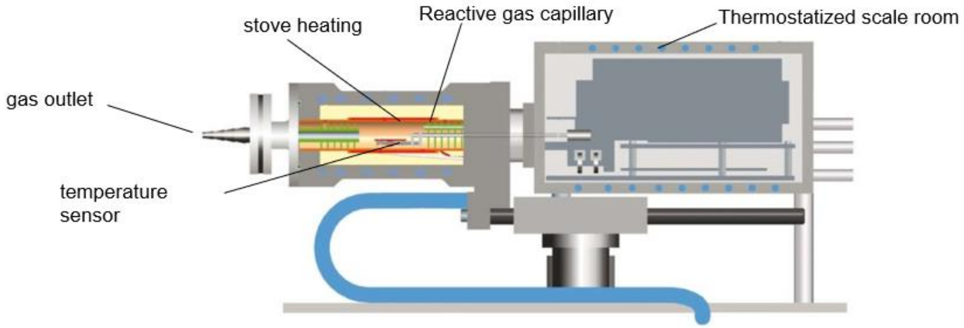
- Material screening and down selection according to use case requirements

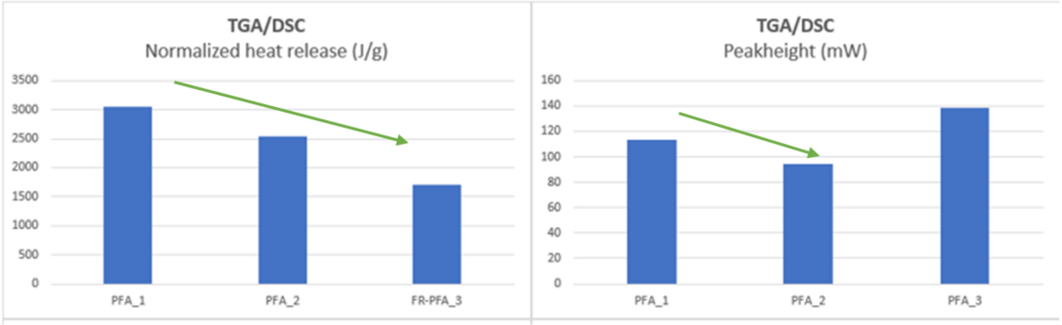
  → *Cf. public deliverable* C. Huchette et al.: Review and evaluation of material candidates compared to industrial requirements, SuCoHS D2.1, August 2019

- Efficient test procedures and material characterisation using combined TGA/DSC

  → *Cf.* A. Kühn, M. Monkiewitsch: Know your fire – from laboratory methods to fire simulation, DLR Innovation Report, 2021



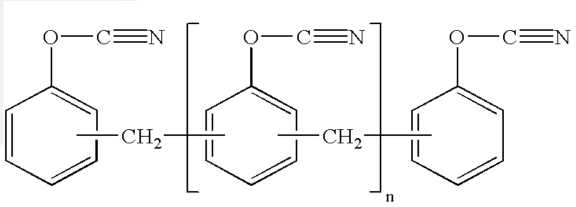


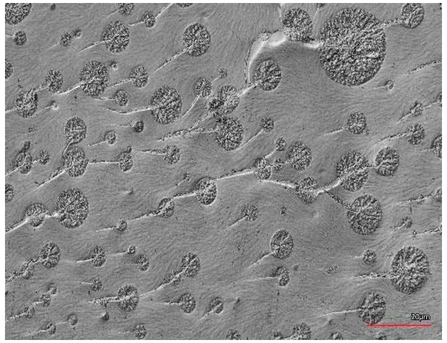


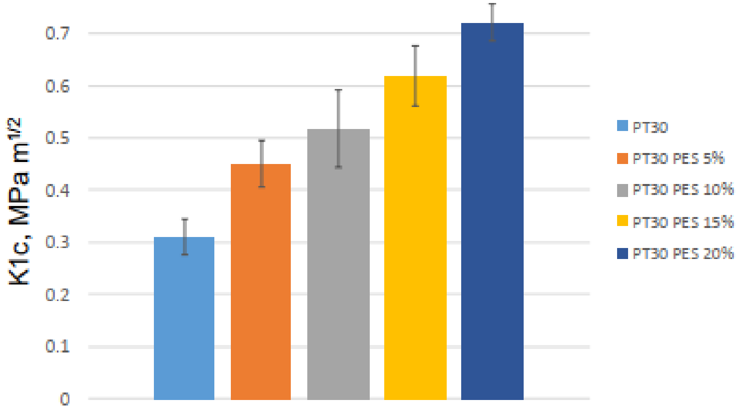
Selected results – Material Development

- Cyanate Ester based toughened thin ply prepreg

  → *Cf. presentation by Ch. Brauner et al.*
  → *Cf. presentation by Th. Ricard et al.*

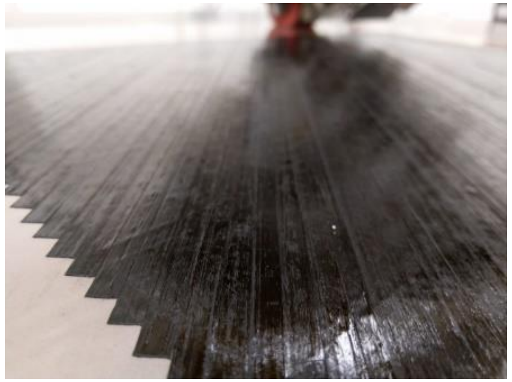


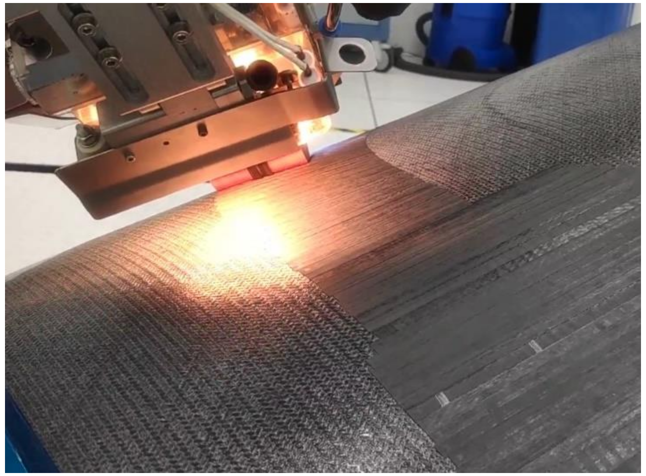




- CF/PFA composites with enhanced fire performance

  → *Cf. presentation by H. Hoydonckx et al.*

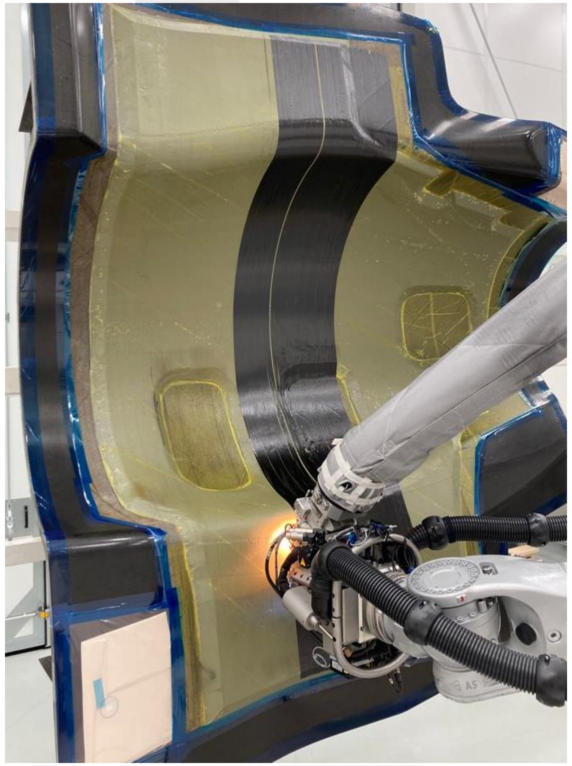


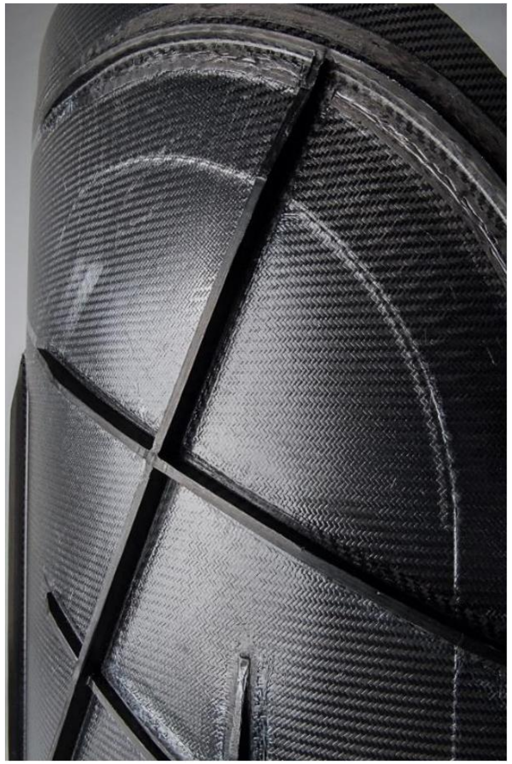


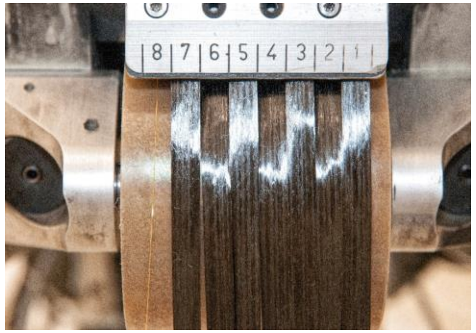
Selected results – Manufacturing Technologies

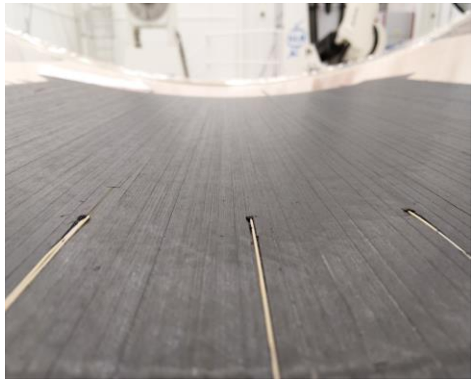
- Automated Fibre Placement
  - Material verification for excellent deposition accuracy
  - Complex geometry
  - Fibre Steering
  - Thin ply material
  - Sensor integration
  - …

→ Cf. presentation by W. Gerrits et al. and lab tour









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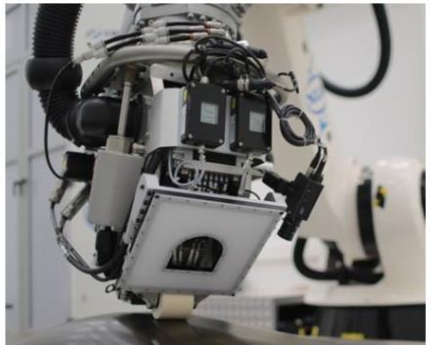
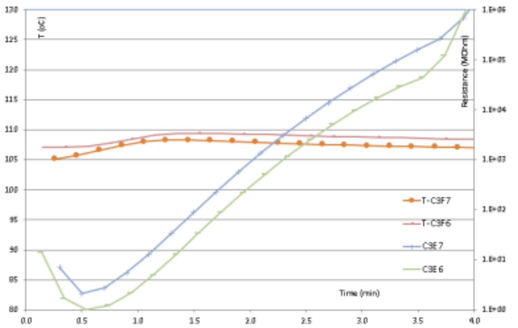
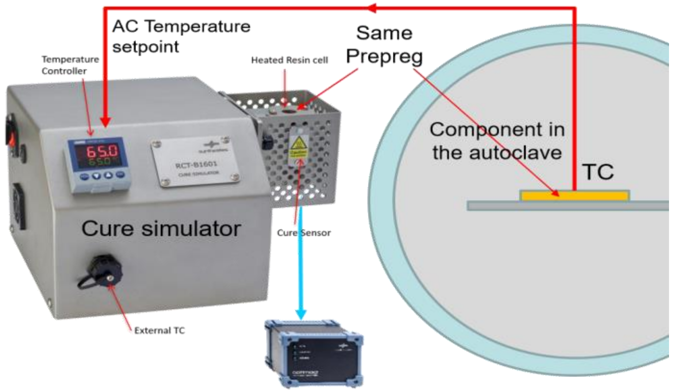
Selected results – Process Monitoring and Evaluation

- Fibre Deposition Monitoring
  at review meeting in MAR 2020



- Cure Process Monitoring
  → *Cf. presentation by N. Pantelelis et al.*

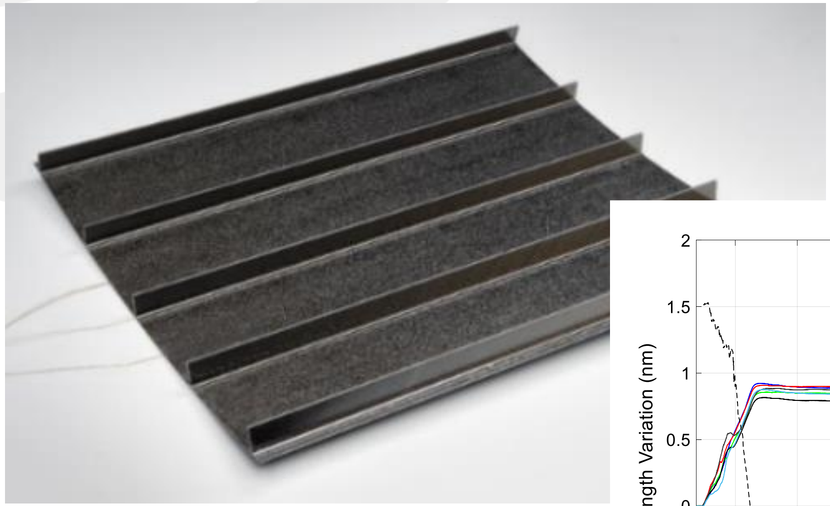


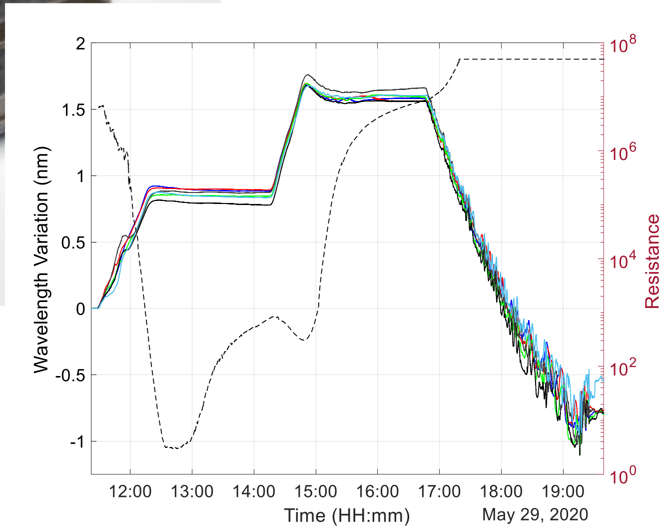


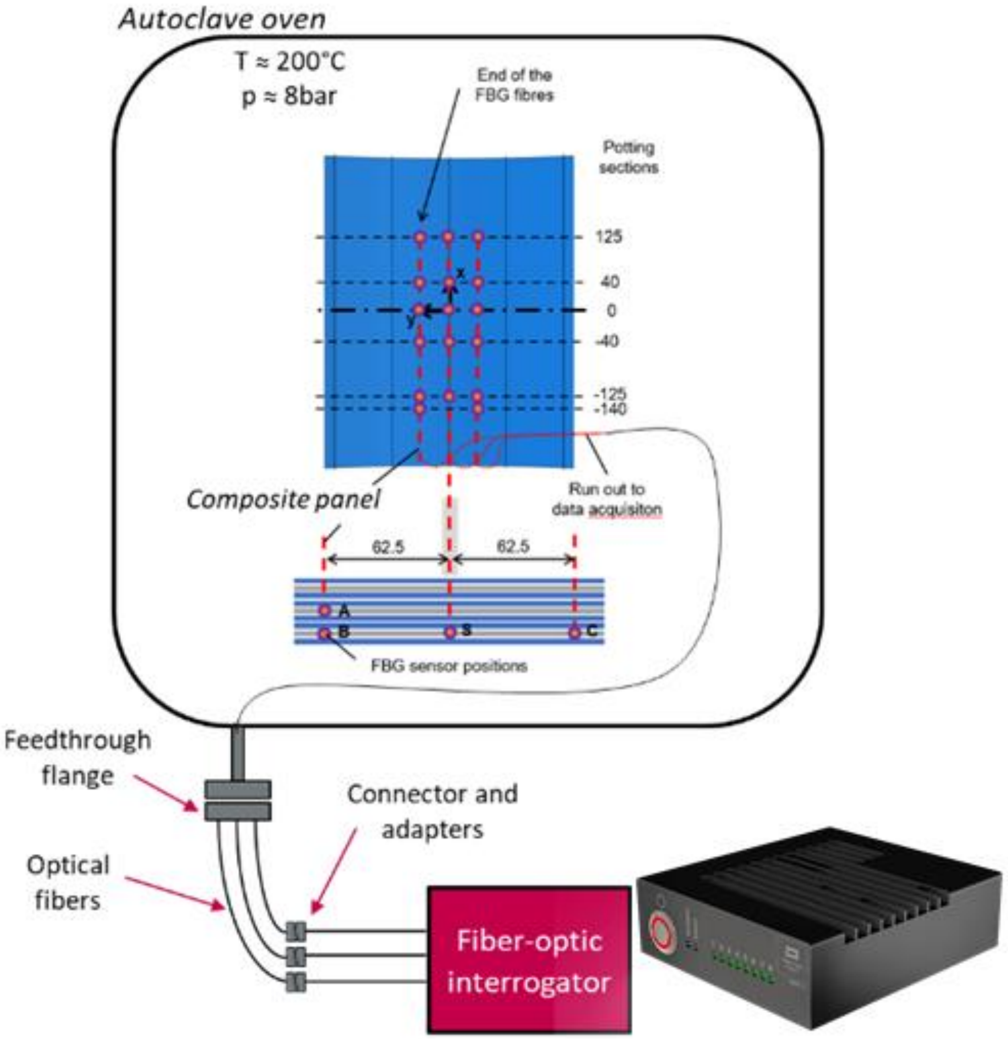
Selected results – Load and Structural Health Monitoring

- Embedded FBG sensors
  - Cure monitoring
  - Load and Structural Health Monitoring

→ *Cf. presentation by G. Langedijk et al.*







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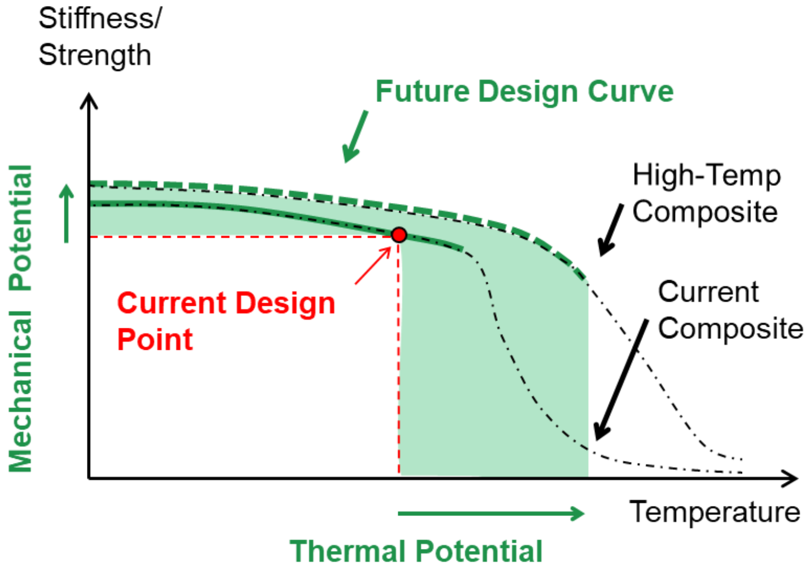
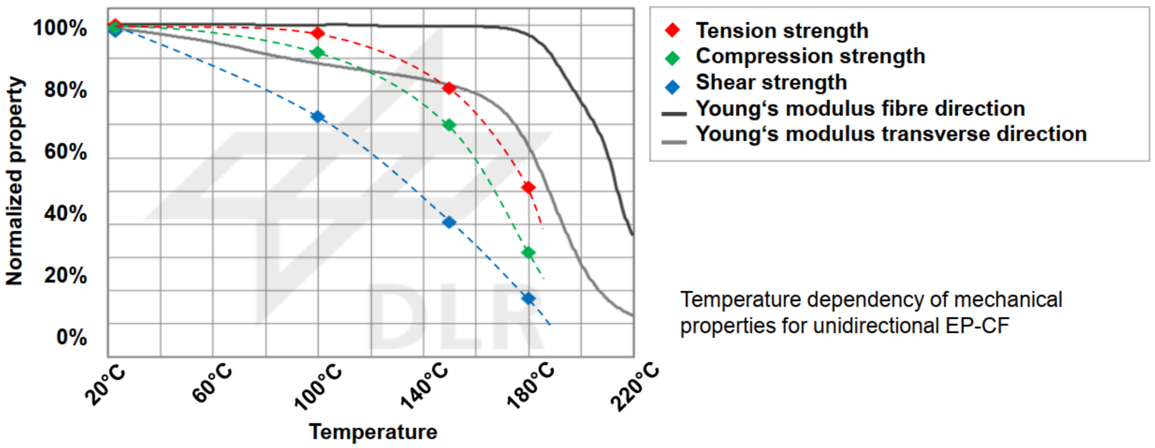
Selected results – Allowables

- Exploit structural reserves
  - Nonlinear material modeling
  - Enhanced analysis methods
  - Allowables
  - Design criteria



- Material modeling
  - Stiffness
  - Strength
  - Degradation



Temperature dependency of mechanical properties for unidirectional EP-CF

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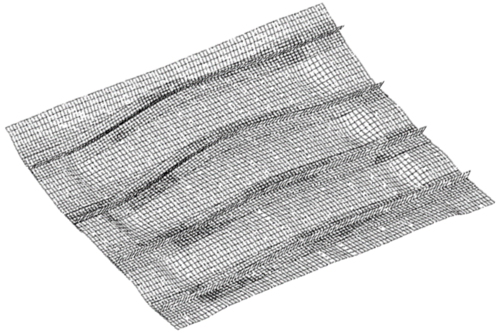
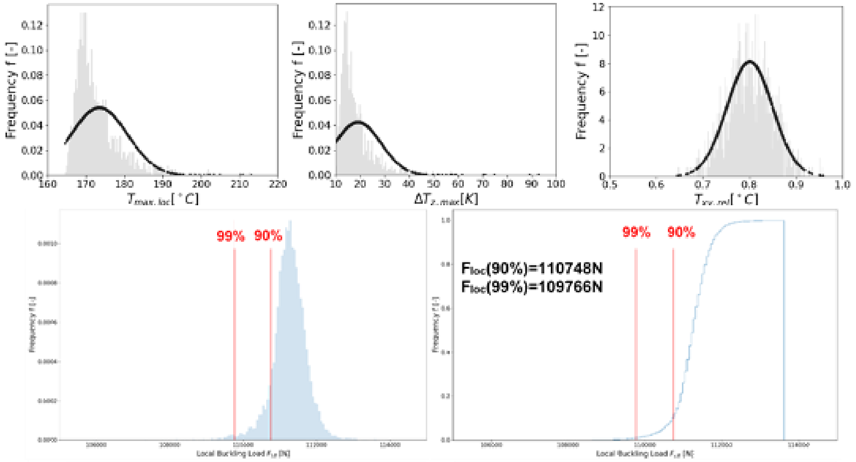
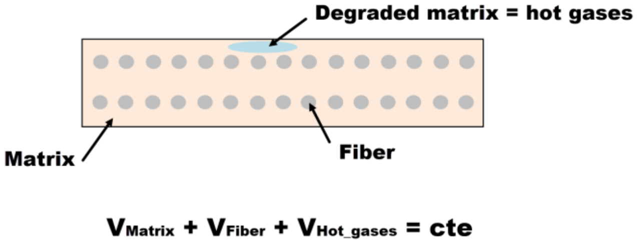
Selected results – Analysis Methods

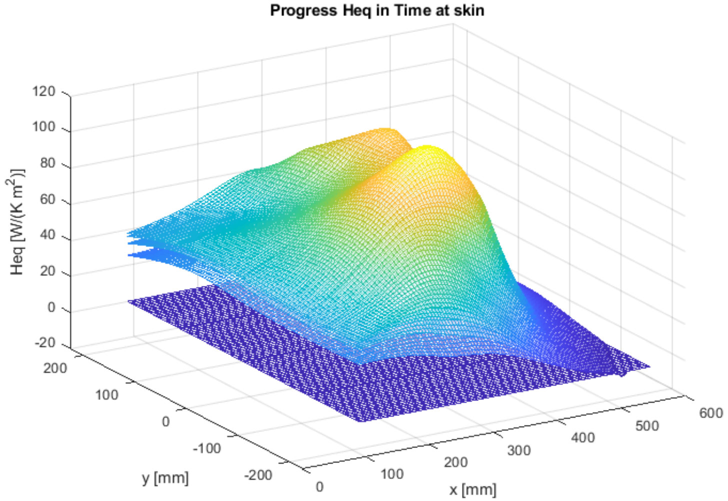
- Probabilistic structural analysis
  → *Cf.* M. Liebisch et al.

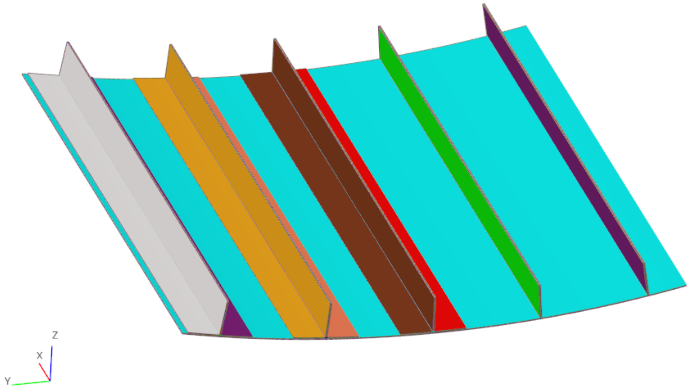




- Fire simulation
  → *Cf. J Penche et al.*







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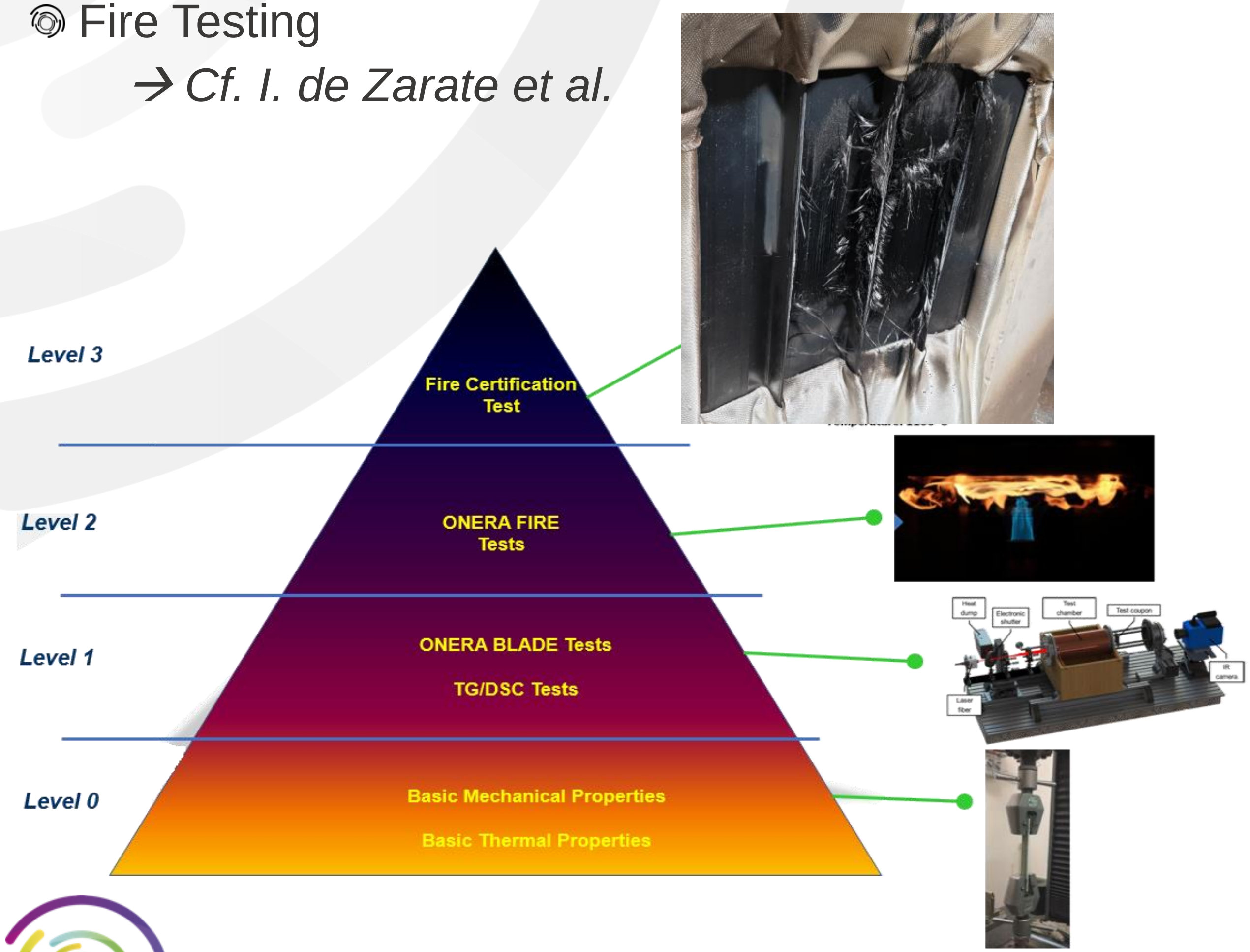
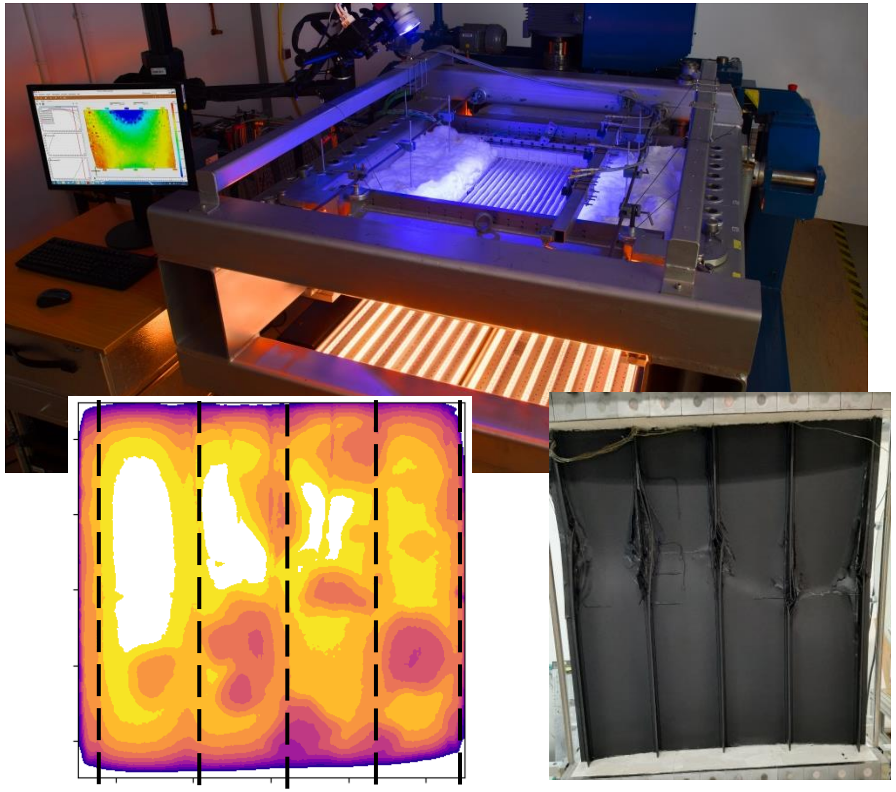
Selected results – Fire Testing and Validation

- Fire Testing
  → *Cf. I. de Zarate et al.*



- Thermomechanical Testing
  → *Cf. M. Liebisch et al. (lab tour)*



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Finally…

- Comprehensive investigation and development of new Materials, Manufacturing Technologies, Methods, Tools and Systems
- Industrial Demonstration (Manufacturing and Testing)

Nacelle Component
Spirit AeroSystems

Tail Cone Panel
Aernnova Engineering

Interior Shell
Collins Aerospace

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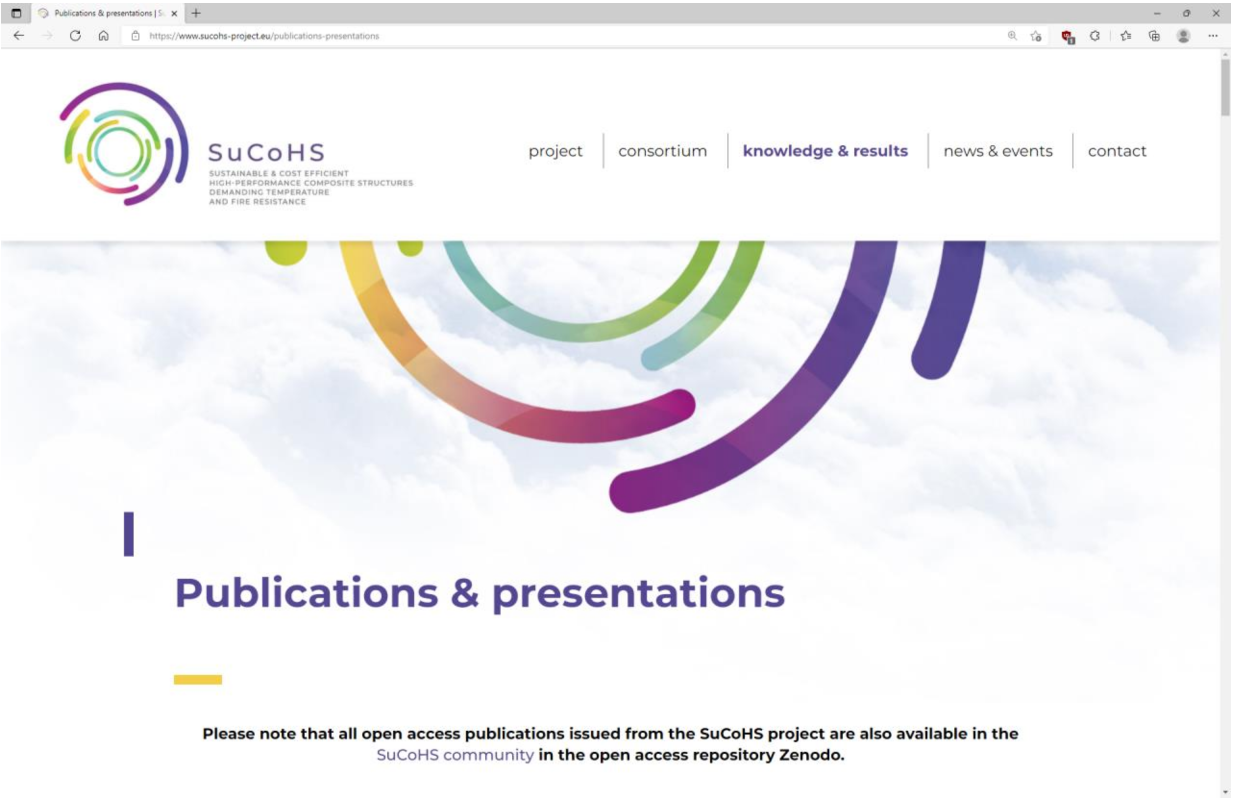
Contact – Stay tuned

- Homepage
  www.sucohs-project.eu
- Publication downloads
  - Public deliverables
  - Conference presentations
  - Journal papers
  - Final Public Workshop
    - Presentations
    - Videos
    - Q&A
- Newsletters 1-5 published
- Linkedin account for SuCoHS (“company page”)
  https://www.linkedin.com/company/sucohs-project/



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Contact – SuCoHS Coordinator

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 769178.

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