CATALOGUE OF SERVICES

Open access single entry point for scale-up of innovative Smart lightweight composite materials and components
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 814581

STRUCTURE OF THE CATALOGUE

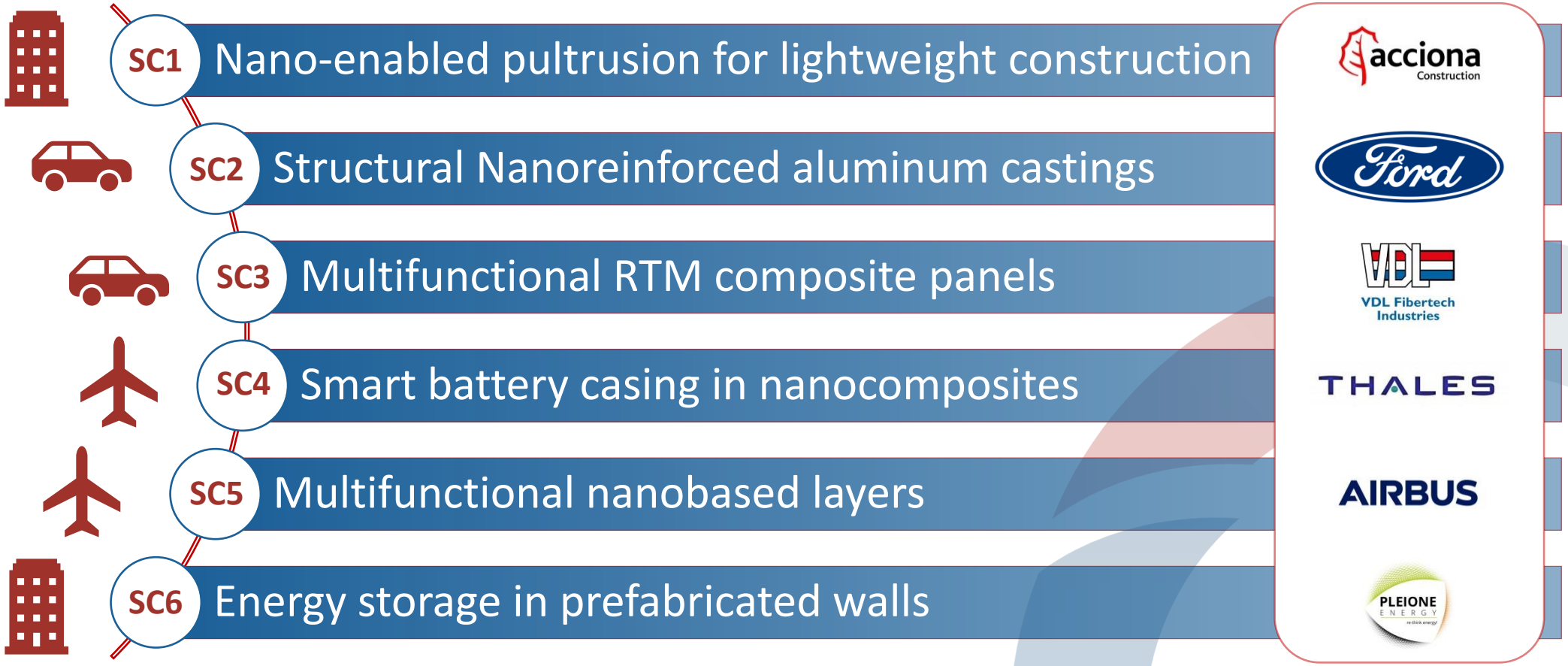
Showcases

- Examples of projects led by industrial partners utilizing a combination of multiple OASIS services

Catalogue of services

- Technical services
  - Pilot line products
    - Nano-materials
    - Nano-intermediates
    - Nano-enabled products
  - Product process engineering
  - Design, modelling and simulation
    - Design
    - Modelling and simulation
  - Testing and characterization
  - Sustainability
- Business support services

SHOWCASES


SC1
Nano-enabled pultrusion for lightweight construction
SC2
Structural Nanoreinforced aluminum castings
SC3
Multifunctional RTM composite panels
SC4
Smart battery casing in nanocomposites
SC5
Multifunctional nanobased layers
SC6
Energy storage in prefabricated walls
acciona Construction
Ford
VDL Fibertech Industries
THALES
AIRBUS
PLEIONE ENERGY

Showcase #1: Nano-enabled pultrusion for lightweight construction

acciona Construction

THE PROBLEM

Current gaps in the technology:
- Mechanical performance at elevated temperatures
- Slow productivity
- Durability to aggressive conditions

Requirements and specifications:
1. Rebar with enhanced mechanical performance at elevated temperatures/fire
2. Higher productivity of the rebar pultrusion
3. Corrosion resistant nano-enabled coating for RC elements

Technical requirements:
- Curing: > 98-99% curing degree
- Production speed: > 20cm/min for a 16mm rebar
- Material specifications:
  - Glass fibre type E
  - Rebar diameter 16 mm
  - Fibre fraction (in weight) > 70%
  - Tg > 90°C
  - Specific gravity > 1.25 gr/cm3
  - Tensile strength 70MPa
  - Elastic modulus > 50GPa

THE SOLUTION

1. **Rebar with enhanced mechanical performance at elevated temperatures**
- Enhanced mechanical performance **nano-particles** specified to this need are used. A multifunctional tool particle is created using layered double hydroxides as flame retardant component.

2. **Higher productivity of the rebar pultrusion:**
- Enhanced productivity and lower costs **nano-particles** specified to this need are used. A multifunctional tool particle is created using inductively heatable magnetic particles.

3. **Corrosion resistant nano-enabled coating for RC elements**

THE SERVICES USED

1. **Rebar with enhanced mechanical performance at elevated temperatures**

+

2. **Higher productivity of the rebar pultrusion:**
- Production of magnetic particles and layered double hydroxides, as well as the combination to multifunctional tool particle.
- Process evaluation and modification of the pultrusion process with nanomodified resins
- Thermal, mechanical testing of reinforced concrete beams
- Design of fire resistance solutions for FRC reinforced concrete beams

3. **Corrosion resistant nano-enabled coating for RC elements**
- Production of nanomodified coating
- Testing of the corrosion resistance

Showcase #1 Workflow

acciona Construction

Nanoscale

Fraunhofer ISC

PL3: Magnetic nanoparticles for inductive heating

Fraunhofer ISC + tecnalia

PL3: Flame retardant nano-particles with modified surface

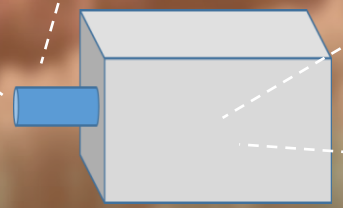
UCLM Universidad de Castilla-La Mancha CAMPUS OF INTERNATIONAL EXCELLENCE

PL1: Nanomodified agent to waterproof concrete surface

Intermediate scale

Fraunhofer IGCV

PL 12: Nano-enabled pultruded rebars for reinforced concrete



UCLM Universidad de Castilla-La Mancha CAMPUS OF INTERNATIONAL EXCELLENCE

acciona

Nanomodified coating to waterproof concrete

Component scale

cea

Nanosafety

acciona + Fraunhofer IGCV

Nanomodified reinforced concrete structures

tecnalia + acciona

Physical- and fire-testing and evaluation

Showcase #2: Structural nano-reinforced aluminium castings

THE PROBLEM

Current gaps in the technology:

1. **High Pressure Die Casting (HPDC) aluminium parts are heat treated to obtain high mechanical requirements** → heat treatment adds higher cost to the part manufacturing process.
2. **Silicon free aluminium-magnesium alloys can achieve mechanical requirements without heat treatment** → die wearing decreases die's life, increasing the overall cost of the process and decreasing productivity due to higher maintenance.
3. **Part lightweighting can be achieved with new designs that have to fulfil the castability conditions imposed by the HPDC process** → the design process is usually very laborious and the results often do not meet target requirements.

THE SOLUTION

1. Nano-reinforced alloys

- Manufacturing of nano-reinforced aluminium ingots by SIMPnano process.
- HPDC process via Met cast process.

2. High resistance die materials

- High resistance cermet coatings deposition on the die for HPDC process with high corrosive aluminium alloys.
- Materials and coating in die insert form assembly in test mould and Met cast pilot.

3. Bionic-based design

- Solution to develop new complex structural design is based on the Elise algorithm.
- Designing and modelling solution based on a bionic database
- Validation of the design and in Met cast pilot.

THE SERVICES USED

1. Nano-reinforced alloys

- Production of nano-reinforcements
- Production of nano-reinforced aluminium
- Reinforcement characterization
- Material characterization
- Nano-reinforced aluminium HPDC

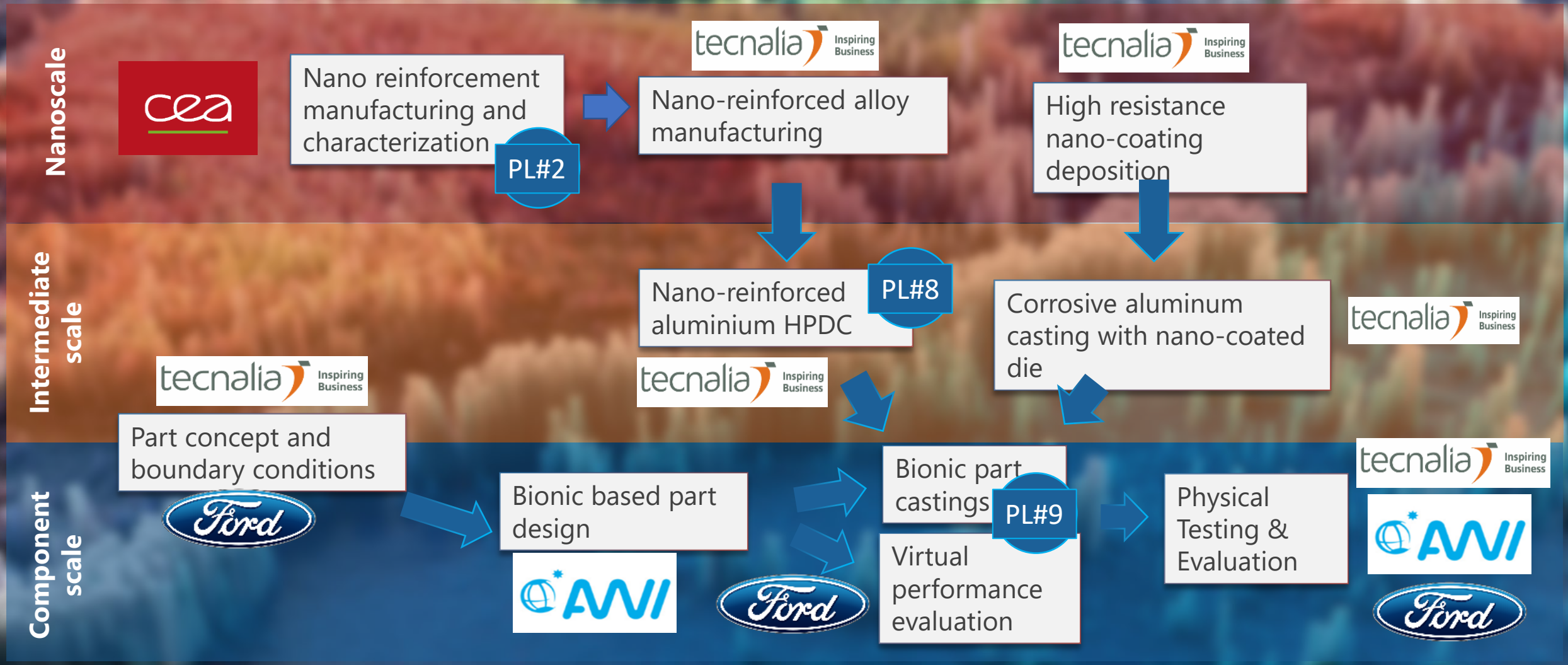
2. High resistance die materials

- High resistance die coatings
- High resistance die material and coating test

3. Bionic-based design

- Bionic –based structural part design
- Castability analysis of bionic-based designs

Showcase #2 Workflow



Showcase #3: Multifunctional RTM composite panels

VDL Fibertech Industries

THE PROBLEM

Development and manufacturing of a smart and lightweight composite panel complying with fire regulations and with the following targets:

1. Reduction of cycle time by 15%.
2. Production cost maximum: no increase.
3. Reduction of overall product weight by 10%.
4. Improvement of thermal insulation by 10%.
5. Fast verification of control monitoring.

THE SOLUTION

1. **Smart lightweight and robust composite panel.**

Redesign of the structure so as to save weight and incorporation of:

- Nano-structured fire retardants to avoid fire propagation.
- Carbon Nano-Tube (CNT) doped veils for surface finishing and impact resistance.
- Thermal sensors for temperature measurements and actuators.

2. **Increased thermal comfort.**
- By using aerogel foams for the insulation and buckypapers as heating elements.

3. **Smart monitoring functionality.**
- During the lifetime of the product by incorporating printed sensors and during the manufacturing process by using online control.

4. **Support for the production of nano-enabled structures.**
- In the field of processing and nanosafety.

THE SERVICES USED

1. **Smart lightweight and robust composite panel.**
- Production of nano-particles for fire retardancy.
- Production of nano-powdered dry plies with enhanced fire performance.
- Production of tailor made printed sensors/actuators.
- Production of CNT doped veils.
- Mechanical justification for reducing the weight of the panel.
- Evaluation of the fire performance of composite material with embedded nano-particles.

2. **Increased thermal comfort.**
- Production of aerogel foams.
- Production of buckypapers as resistive element.
- Thermal justification aiming at increasing the overall thermal insulation of the panel.

3. **Smart monitoring functionality.**
- Material integration and process monitoring.

4. **Support for the production of nano-enabled structures.**
- Nanosafety assessment.
- Process simulation support.

Showcase #3 Workflow

VDL Fibertech Industries

Nanoscale

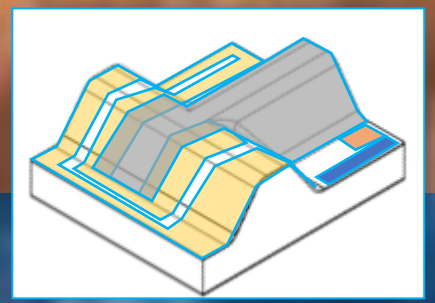
Intermediate scale

Component scale

Aerogels Material
UCLM

Flame retardant nanoparticles
Fraunhofer

Tech services:
- **UoP**: Design & FEM ; coupon scale characterisation of mech. properties
- **TEC**: Fire testing
- **CEA**: Technical support on safety & regulation compliance (processing nano)
- **IPC**: Processing support



Dry plies with nanopowder
Adamant

Printed sensors / Actuators
CEA

Impact resistance & surface finishing
TMBK

Heating elements
TEC

Other goods

Material integration & process monitoring
IPC

Showcase #4: Smart battery casing in nanocomposites

THALES

THE PROBLEM

Development of a smart, lightweight and robust nano-enabled composite casing for an avionic battery module with the following targets:

1. Increased gravimetric energy density of the battery module by 10-20%.
2. Resistance to thermal runaway of one cell in the battery module reducing the risk of fire propagation.
3. Reduction of thermal runaway risk by anticipated detection.

THE SOLUTION

1. **Smart lightweight and robust casing for battery module**
   - Selection of the right polymer matrix that will resist thermal, mechanical and chemical constraints.
   - Inclusion of nano-structured fire retardants to avoid fire propagation.
2. **Smart monitoring functionality**
   - Printed sensors incorporated in the casing structure or on the cells

THE SERVICES USED

1. **Smart lightweight and robust casing for battery module**
   - Definition of specifications for casing materials
   - Thermal and mechanical testing of materials
   - Thermal, mechanical and combined modelling
   - Design of battery casing
   - Process adjustment and casing production
2. **Smart monitoring functionality**
   - Design and production of printed sensors
   - Sensors integration into casing
   - Sensors characterization

Showcase #4 Workflow

THALES

Nanoscale

Intermediate scale

Component scale

Battery WP

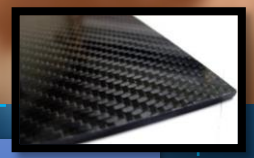
Battery Design
CEA

Battery Assembly & Test
CEA

Not OASIS PL

Sensors Design and Realization
CEA (PL#7)

Sensors WP



Material WP

Material Choice based on Spec written by CEA/TAS.
IPC (PL#11)

Casing Design tuning
IPC (PL#11)

Casing Moulding
IPC (PL#11)

Casing WP

Material Flux

Design Flux

Showcase #5: Multifunctional nanobased layers

AIRBUS

THE PROBLEM

Repairing defects or damages occurring in composite structure of aircrafts.

Current methods are limited in size and shape:

- Not flexible enough (thermal blankets)
- Not effective over 100% of the surface (hot air boxes)
- The complete composite part has to be heated when curing (production and repairing), which makes it costly.

Requirements and specifications

1. External flexible heater blanket
2. Integrated heater element for curing offering additional functionality, e.g. Structural Health Monitoring (SHM) capabilities.

Technical requirements

- Processing parameters
  - Curing temperature: 180°C ± 5°C for 2-3 hours
  - Heating rate: 0.5-2.5°C/min
  - P: 7 bars for fresh prepreg curing. 3 bars for bonding of precured panels.
- Integrated solutions, system weight <100gsm.

THE SOLUTION

1. External flexible heater blanket

Based on buckypapers (BP).

- For part curing
- For repair curing

2. Integrated heater element

Based on buckypapers.

- For part curing
- With additional functionality (e.g. SHM)

THE SERVICES USED

1. External flexible heater blanket

- Production of BPs
- BPs as external resistive heating system for autoclave part curing and repair curing
- Thermal, mechanical and combined modelling
- Characterization of repaired and cured composites by BP

2. Integrated heater element

- Production of BPs
- BP as integrated resistive heating system for curing and multifunctional layer
- Thermal, mechanical and combined modelling
- Characterization of cured BP composites with multifunctional properties

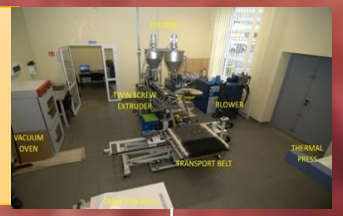
Showcase #5 Workflow

AIRBUS

Nanoscale

Production of thermoplastic veils of BPs as external flexible heater blanket for autoclave repair and curing

TMBK (PL#5)

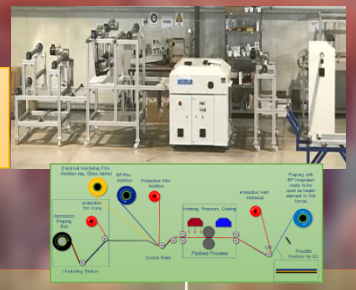


Production of BPs to be used as a resistive heating element

TEC (PL#4)

Roll-to-roll processing

ADA (PL#6)



Intermediate scale

Thermal, mechanical and combined modelling for external and integrated heating systems

UoP, TEC

BP encapsulation for external and integrated heating systems manufacturing

TEC, TMBK, ADA

Resistive Heating curing and repair for autoclave part using BP as external and integrated system

TEC

Characterization of composites cured by BP based external and integrated resistive heating system

UoP, TMBK, TEC

Component scale

Tech services:

- **UoP**: Modelling; coupon scale characterisation
- **ADA**: Pilot line for large scale BP encapsulation. Production of nanotreated prepregs
- **TMBK**: Production of thermoplastic veils; BP encapsulation trials using veils; coupon scale characterisation
- **TEC**: BP manufacturing; BP encapsulation trials; Modelling; Resistive Heating tasks; coupon scale characterisation

Manufacturing of DEMO using BP based resistive heating system

AIR, TEC

BP encapsulation for external and integrated heating systems manufacturing

TEC, TMBK, ADA

Showcase #6: Energy storage in prefabricated walls

THE PROBLEM

Development of a prefabricated lightweight wall with integrated energy storage capabilities and advanced functionality (environmental sensing and safety). Li-ion energy storage systems (Li-ion batteries) are problematic in the long run, with the key issues being:

- High cost
- Limited durability of all batteries (< 6000 cycles)
- Performance degradation (50% in first 3-5 years)
- Not environmentally friendly

Requirements and specifications

1. Li-ion battery and/or supercapacitor cell
2. Prefabricated walls (Smart Environmental System Development)
3. Prefabricated wall demonstrator development (including fire retardancy)

Technical requirements

Electrode: Specific gravimetric capacity (mAhg-1) > 350

Cell: Cell capacity (mAh): 500-1000; specific gravimetric energy density (Wh/kg): > 100

Module: Capacity (Ah): 2-5; specific gravimetric energy density (Wh/kg): > 100; power density (W/kg): 2000-3000; leakage current (mA): 50-70

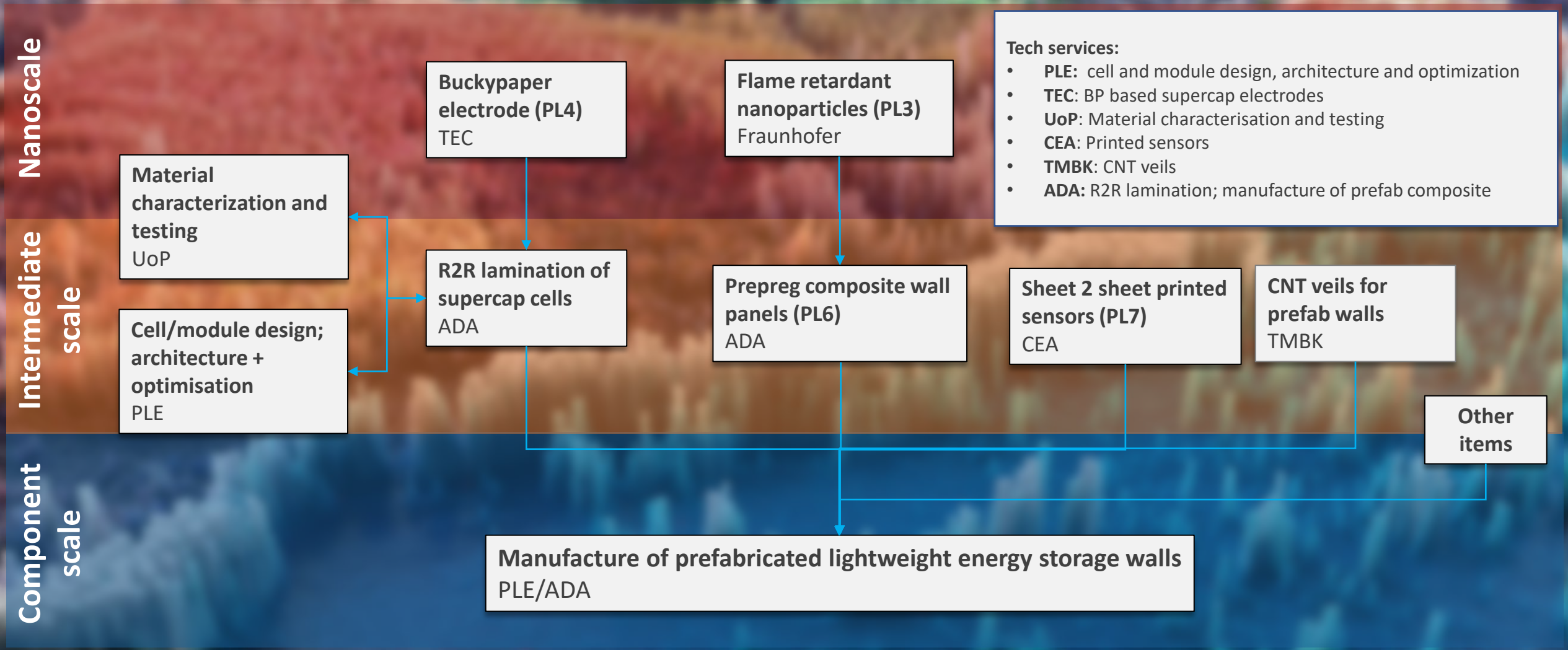
THE SOLUTION

1. **Li-ion battery and/or supercapacitor cell**
   - Buckypaper (BP) based energy storage system designed for safe and compact integration in building's inert elements
     - Electrode materials | BPs
     - Packaging | Pouches, Cases
     - Electrolyte
     - Separators | PE, PP
     - Binders
     - Cell casing | Copper, Nickel, Aluminium
2. **Smart environmental system**
   - Successful integration of the developed modules in a system (prefabricated energy storage walls) together with proper electronics and smart environmental sensors
3. **Prefabricated wall demonstrator**
   - Prefab energy storage walls including fire resistant nano-particles

THE SERVICES USED

1. **Li-ion battery and/or supercapacitor cell**
   - Production of BPs with/without modifiers (e.g. Metallic oxides) for energy storage electrodes
   - Roll-to-roll lamination process for manufacturing of BP based electrodes for high-end battery/supercapacitor cells
   - Electrochemical testing and morphological characterization of novel nano-based electrode materials
2. **Smart environmental system**
   - Sheet to sheet smart printed sensors for integration in prefabricated lightweight walls
3. **Prefabricated wall demonstrator**
   - Fire retardant nano-particles
   - Carbon Nano-Tube (CNT) based veils
   - Eco-friendly/recyclable fibre reinforced composite materials with integrated sheet to sheet smart printed sensors

Showcase #6 Workflow



Pilot line products
Subcategory: Nano-materials

SiO_2 nano-reinforced aerogel panels		
Functionalities	**Technical specifications**	**Examples**
High thermal insulating and low density materials	• 0.76 m^2 to 2 m^2 aerogel / batch • Thermal conductivity values are between 0.028 and 0.052 $W \cdot m^{-1} \cdot K^{-1}$ • Density values are in the range of 46 to 118 $g \cdot L^{-1}$.	SC3 - Highly insulating and low density aerogel for use in smart lightweight composite panels.

Pilot line products
Subcategory: Nano-materials

Wet chemical nanoparticles and nanomaterials syntheses for nano-reinforcements		
Functionalities	**Technical specifications**	**Examples**
• Tracing • Thermal/electrical conductivity • Mechanical strength	• Large scale nanoparticle synthesis, separation and purification processes (example: AlSi10MnMg nano-reinforced) • Up to 25 L/day semi-continuous processes • Particle separation by centrifugation/nanofiltration (5 /10 L) implying several g to kg scale production	SC2 - Synthetic nanoparticles and nanomaterials for nano-reinforcements

Pilot line products
Subcategory: Nano-materials

Magnetic and flame retardant nanoparticles and nanocomposites		
Functionalities	**Technical specifications**	**Examples**
• Inductive heat • Flame retardant • Corrosion-inhibition	Continuous and batch wet chemical synthesis of nanoparticles up to a 100l scale. Combination of nanoparticles to nanostructured microparticles via spray drying.	1. SC6 - Prefabricated lightweight walls based on eco-friendly / recyclable fibre reinforced composites materials with integrated sheet to sheet smart printed sensors, flame retardant nanoparticles and Carbon Nano-Tube veils 2. SC1/SC3 - Flame-retardant material for building applications or applied to smart lightweight composite panels 3. SC1 - Fast induction heating for thermoset composite rebars

Pilot line products
Subcategory: Nano-intermediates

Buckypapers (BP) - self-supporting sheets comprised of entangled carbon nano-tubes (CNT)		
Functionalities	**Technical specifications**	**Examples**
• Enhanced mechanical and electrical properties	• CNT based continuous sheets, “Buckypapers" • Lengths up to 100 m • Widths up to 300 mm • Thickness – down to 10-30 microns (for supported BPs) and between 30-200 microns (for supported and/or free-standing BPs) • Weights between 30-200 $g.m^{-2}$ • Capacity up to 1000 m^2 per year	1. SC6 - BP-based electrodes for high-end battery/supercapacitor cells, integrated resistive heating system 2. SC5 - BP as external resistive heating system for autoclave part repair and curing 3. SC5 - BP as integrated resistive heating system for autoclave part curing and multifunctional layer 4. SC3 - Production of BP as cable wiring and/or resistive element

Pilot line products
Subcategory: Nano-intermediates

Carbon Nano-Tube (CNT) doped veils - lightweight and thermoplastic nonwovens based on copolyimide/copolysters/polyamides containing CNTs		
Functionalities	**Technical specifications**	**Examples**
• High flexibility and lightweight • Improvement of electrical conductivity and mechanical properties • Resistive heating	• CNT-doped veils based on low temperature copolyamides • CNT content up to 3.5% w/w • One-step melt-blown technology with semi-automatic mode • Areal weight can be as low as 10 $g.m^{-2}$ • The veil thickness is 150 µm (for 20 $g.m^{-2}$) • The average fibre diameter is 50 µm.	1. SC6 - Prefabricated lightweight walls based on eco-friendly / recyclable fibre reinforced composites materials with integrated sheet to sheet smart printed sensors, flame retardant nanoparticles and Carbon Nano Tube veils 2. SC5 - Production of thermoplastic veils as external flexible heater blanket for autoclave repair and curing or as integrated resistive heating system for autoclave curing 3. SC3 -Enhancement of the impact resistance & surface finishing

Pilot line products
Subcategory: Nano-intermediates

Production of customized nano-reinforced aluminum alloys		
Functionalities	**Technical specifications**	**Examples**
High performance mechanical, thermal and wear resistance properties	• Nanoreinforced metal alloy ingot production • 100 kg batches	1. SC2 - Nano-reinforced alloy manufacturing

Pilot line products
Subcategory: Nano-intermediates

Sheet to sheet electronic printed devices		
Functionalities	**Technical specifications**	**Examples**
Smart functions, e.g. printed sensors and actuators	• Maximum size of substrates is 320 x 380 cm^2 • Main materials used to elaborate these sensors are inks with the several following functionalities: - Conductive metal inks (Ag, C) - Conductive polymer inks (PEDOT - poly(3,4-ethylenedioxythiophene)) - Dielectric formulations - Organic semiconductor ink - Electro Active Polymer (EAP) inks (PVDF-based)	1. SC3/SC4 - Sensor design and integration

Pilot line products
Subcategory: Nano-intermediates

Nano-enabled prepregs and dry fabrics for composite products		
Functionalities	**Technical specifications**	**Examples**
• Standard formulations for Mechanical, Electrical and Thermal Properties of polymer composites • Customization of formulations for tailored properties (fire, vibration, acoustic, …) • Nano-products integration in prepregs and dry fabrics	• Tailoring of composite properties through the nano-enabling of commercial prepregs and dry fabrics. • Product performance with standard formulations: - Mechanical: Fracture toughness up to 100% increase - Electrical: Conductivity through thickness up to 1 order of magnitude increase - Thermal: Conductivity through thickness up to 40% increase, In-plane up to 150% increase • Product Specifications: - Prepreg Roll width up to 600 mm - Prepreg Roll outer diameter up to 600 mm - Thickness adjustment: 0-25 mm • Semi automatic Roll to Roll (R2R) process - Lamination Temperature up to 200°C - Capacity: max 1000 m^2/day	1. SC3 - Production of nano-powdered dry plies with enhanced fire performance for smart lightweight composite panels. 2. SC5 - Production of Nano-treated aerospace prepregs according to application requirements of BP as integrated resistive heating system for autoclave curing 3. SC6 - Production of prefabricated lightweight walls based on eco-friendly / recyclable fibre reinforced composites materials.

Pilot line products
Subcategory: Nano-enabled products

High-Pressure Die Casting (HPDC) applied to nano-reinforced aluminium		
Functionalities	**Technical specifications**	**Examples**
High performance mechanical, thermal/electrical and wear resistance properties	• Pilot plant for HPDC of nano-reinforced aluminium parts composed by: - 950 Tm HPDC machine allowing large series of light metal alloy casting parts (ex: automotive structural and engine aluminium alloy parts) - Tiltable furnace with ultrasonic treatment and degassing systems. - Integrated chemical composition. - Vacuum assisted casting	1. SC2 - Nano-reinforced aluminium HPDC 2. SC2 - Corrosive aluminium casting with high resistance die coatings 3. SC2- High performance aluminium components

Pilot line products
Subcategory: Nano-enabled products

Nano-enabled composite plates for lightweight and multifunctional applications		
Functionalities	**Technical specifications**	**Examples**
Plates with improved Mechanical, Electrical and Thermal Properties	• Tailored cut-to-shape composite products incorporating nano-enabled intermediates. • Plate Product Performance: - Mechanical: increased damage tolerance - Electrical: antistatic and EM shielding applications - Thermal: thermal dissipation and compact heat generating applications • Standard thicknesses: 1mm, 2mm, 3mm + (other thicknesses on-request) • Sizes: - Max Length 2000mm (Raw Plate) - Max Width 900mm (Raw Plate) - Max dimensions 600x900mm (Cut-to-Shape via CNC)	

Pilot line products
Subcategory: Nano-enabled products

Stamping/overmoulding process for thermoplastic nano-enabled and/or smart composite products		
Functionalities	**Technical specifications**	**Examples**
Lightweighting and function integration	• 800T horizontal press • Reinforcement: glass, carbon, basalt or natural fibre. • Organic matrices: PP, PA, PEI, PPS, PEEK • Cycle time ~ 1 min / max. part size 1.5 m • On-line process monitoring and quality control using infrared camera and terahertz technology	1. SC4 - production of a smart, ligthweight casing for a battery module made of PPS/Carbon material

Pilot line products
Subcategory: Nano-enabled products

Resin Transfer Moulding (RTM) process for nano-enabled and/or smart composite products		
Functionalities	**Technical specifications**	**Examples**
Lightweighting and function integration	• 300T vertical press (platen size: 3.0 m x 2.5 m) • Bi-component injection machine • Thermoset composite parts with complex shapes and surfaces up to 3 m^2. • Maximum temperature is 400°C • Most of the thermoset and thermoplastic resins can be processed on this pilot line.	1. SC3 - production of a smart lightweight composite panel.

Pilot line products
Subcategory: Nano-enabled products

Pultrusion process applied to Nano-enabled Aluminium/composites hybrid products		
Functionalities	**Technical specifications**	**Examples**
Lightweight and smart structures	• 10 t Pultrusion line: • Controlled heating: Induction, infrared and electric • Closed injection systems and open bath • Data acquisition • Thermal camera • Thermocouples • Dosing units: Polyurethane and Amine based epoxy	1. SC1 - Nano-enabled pultruded rebars for reinforced concrete

Product process engineering

Industrialization – process development		
Functionalities	**Technical specifications**	**Examples**
Complete definition of how the process should be	• VSM (Value Stream Mapping) • Load – capacity calculation • Layout definition • Logistics definition • Machines and auxiliary installations functional specs development • Process control definition • Manufacturing cost calculation	

Product process engineering

Technology development (definition of new technology requirements and processing parameters)		
Functionalities	**Technical specifications**	**Examples**
Ability of manufacturing at the right cadence with the proper parameters and the necessary knowledge	• Conceptual design of the technology • Prototypes construction • Run process tests and characterization of processing parameters • Design of the final improved concept • Develop functional specs of the final improved technology	

Product process engineering

Piloting service for novel polymer-based products & technologies		
Functionalities	**Technical specifications**	**Examples**
From LAB to FAB, industrial perspective to material technologies to increase the TRL of their material technologies providing flexible and modular manufacturing pilot lines	• A highly modular Roll2Roll Pilot line, equipped with a powder scattering and lamination module for the processing of both thermoset and thermoplastic prepregs, dry fabrics and thermoplastic films. • A Liquid Dispersion Pilot Line equipped with ultrasonic mixing and Three Roll Milling for the batch processing of sub-micron & nano materials, resins, epoxies, pastes, silicones, polymers, inks, paints and many more. • A Film coating Pilot line, where both doctor blade and spray coating process are available for the batch production of coated surfaces and films.	

Product process engineering

Composite Parts Prototyping		
Functionalities	**Technical specifications**	**Examples**
End-to-end services of processing and manufacturing of standard and nano-enabled composite products	From wet-layup and vacuum bagging to Autoclave/Prepreg and RTM-based techniques: - Processing room with controlled environment - Processing of space approved materials (Epoxies, Cyanate Esters, Adhesives, etc.) - Autoclave curing up to 200˚C - Autoclave dimensions Φ 1000mm, L 2000mm - Curing & Post-curing oven - Quality inspection for Product Assurance - Production Design & Process Development	

Product process engineering

High resistance die coatings		
Functionalities	**Technical specifications**	**Examples**
Die coating for service life improvement of casting dies	• Cermet coatings deposition by thermal spray • Core pins and slender insert protection • Extended and tailored coating catalogue	1. SC2 - High resistance die material and coating test

Design, modelling and simulation
Subcategory: Design

Bio-inspired structural part design		
Functionalities	**Technical specifications**	**Examples**
New lighter designs with higher performance, e.g. in terms of mass, stress and/or deformation	• Designing, modelling and optimization service based on bio-inspired lightweight structure database. • Bio-inspired lightweight designs will be generated following the boundary conditions and mechanical requirements of the customer.	1. SC2 - design optimization of a structural automotive part submitted to crash impact

Design, modelling and simulation
Subcategory: Design

Product design and material selection based on customer's specifications		
Functionalities	**Technical specifications**	**Examples**
Customized design that best suits to the customer's specifications	Design of composite and polymer products using Solidworks CAD software	1. SC4 - design of a composite casing for aerospace battery modules

Design, modelling and simulation
Subcategory: Modelling and simulation

Thermal, mechanical and multi-physics and multi-scale modelling		
Functionalities	**Technical specifications**	**Examples**
Virtual performance evaluation based on thermal and/or mechanical criteria	• Composite structure with embedded nanomaterials performance modelling. • Joule effect prediction modelling of nano-enabled materials. • Finite element modelling of the product thermal/mechanical performances	1. SC5 - Design of Buckypaper-based external heating system 2. SC5 - Integrated Buckypaper-based heating system 3. SC3/SC4 - Design of product (Battery Casing or composite panel) 4. SC3 - Increase of the overall thermal insulation of a smart lightweight composite panel

Design, modelling and simulation
Subcategory: Modelling and simulation

Process simulation		
Functionalities	**Technical specifications**	**Examples**
Design of the process for limiting the risk of generating defects in the production	• Modeling of the stamping/overmoulding process • Modeling of the RTM process, including the draping, impregnation, and curing of the resin	1. SC3 - Assessment of flow propagation scenarios for the RTM process of glass/polyester composites 2. SC4 - Process justification for the stamping/overmoulding process of carbon/PPS prepregs

Testing and characterization

Fire engineering		
Functionalities	**Technical specifications**	**Examples**
• Design of Fire reaction/resistance solutions. • Design of ad-hoc fire performance protocols from small scale to medium, large scale. • Screening of solutions. • Compliance with fire testing standards/regulations	• Design of fire performance solutions • Ad-hoc protocols. • Reaction to fire: cone calorimeter, smoke density chamber coupled to FTIR, Oxygen index (L.O.I), UL 94, radiant panel, tubular furnace, flammability test, calorimeter bomb, non-combustibility test, TGA-EGA. According EN standards (Euroclasses system), IMO, ASTM, ISO, EN 45545-2 between others. • Resistance to fire: - Vertical, horizontal & experimental furnaces. - Possibility to test according UL, ASTM, EN 45545-3, RWS standards between others - Propagation of facades BS 8414-1. • Toxicity of fire effluents - NF X70-100 (tubular furnace and NBS Smoke chamber) - ISO 5659-2 + FTIR (annex C EN 45545-2) test	1. SC1 - Definition of test criteria for reinforced concrete beams 2. SC1 - Design of the fire resistance solutions for fibre reinforced composites concrete beams 3. SC1 - Correlation of fire performance of materials at small scale with large scale resistance test.

Testing and characterization

Corrosion resistance assessment		
Functionalities	**Technical specifications**	**Examples**
Synthesis, characterization and application of nanocoatings for corrosion resistance of concretes in adverse climate conditions	• Artificial weathering in a 6 weeks cycle run (modified from an ASTM D5894 test): - Salt chamber fog at 35 °C for three weeks - UV VA 340 chamber (cycle of UV at 60 °C with 0.65 W/m2 for 4 h) • Adhesion strength by pull off test before and after ageing, (ASTM 4541 and UNE 1062 tests). • Measuring the water absorption (UN3 1062-3 test) • Determining the abrasion resistance (EN ISO 5470-1 test).	1. SC1 - Production of nanomodified release agent 2. SC1 - Testing of the corrosion resistance

Testing and characterization

Material characterization (mechanical, thermal and chemical)		
Functionalities	**Technical specifications**	**Examples**
Microstructure / performance relationship analysis	• General equipment for material characterization is available. • More information is available on request.	1. SC2 - Reinforcement characterization 2. SC2 - Material characterization 3. SC5 - Characterization of composites repaired and cured by buckypaper based external heating system 4. SC5 - Characterization of composites cured by integrated buckypaper based heating system with multi-functional properties 5. SC6 - Electrochemical testing of novel nano-based electrode materials

Testing and characterization

Durability test		
Functionalities	**Technical specifications**	**Examples**
Mechanical performance	• 950 Tm HPDC machine • Thermal fatigue test system • Molten aluminium corrosion and soldering test system • Surface characterization laboratory • Tensile • Flexural • ILSS • (and other test facilities upon demand)	1. SC2 - High resistance die material and coating test 2. SC4 - Mechanical testing of materials

Sustainability

Nano-safety		
Functionalities	**Technical specifications**	**Examples**
Support for the use of nanoforms and the technology transfer	Risk assessment and measurement according to EN17058	1. SC1 – Nano-safety assessment 2. SC3 – Nano-safety assessment

Sustainability

Standardization		
Functionalities	**Technical specifications**	**Examples**
Guide for the use of standardization by test bed users		

Business supporting services

Business support and coaching		
Functionalities	**Specifications**	**Examples**
A tailor-made support service to maximize business value	• Defining the value proposition and Unique Selling Points • Market overview, competition and segments • Prioritization of segments • Identification of key customers and their feedback • Identification and qualification of supply chain and logistics • Distribution channels and agreements • Financial analysis and projection (cost analysis, manufacturing)	

Business supporting services

Access to private/public finances		
Functionalities	**Specifications**	**Examples**
A tailor-made support service to identify and access funding	• Public funding analysis • Investor pitch deck preparation • Liaison with investors	

Business supporting services

Dissemination and marketing		
Functionalities	**Specifications**	**Examples**
A tailor-made support service to maximize outreach and creation of new leads	• Creation of marketing materials • Video shooting • Workshops (meetings, contacts) with selected customers • Combination of customer specific and OASIS tools and channels	