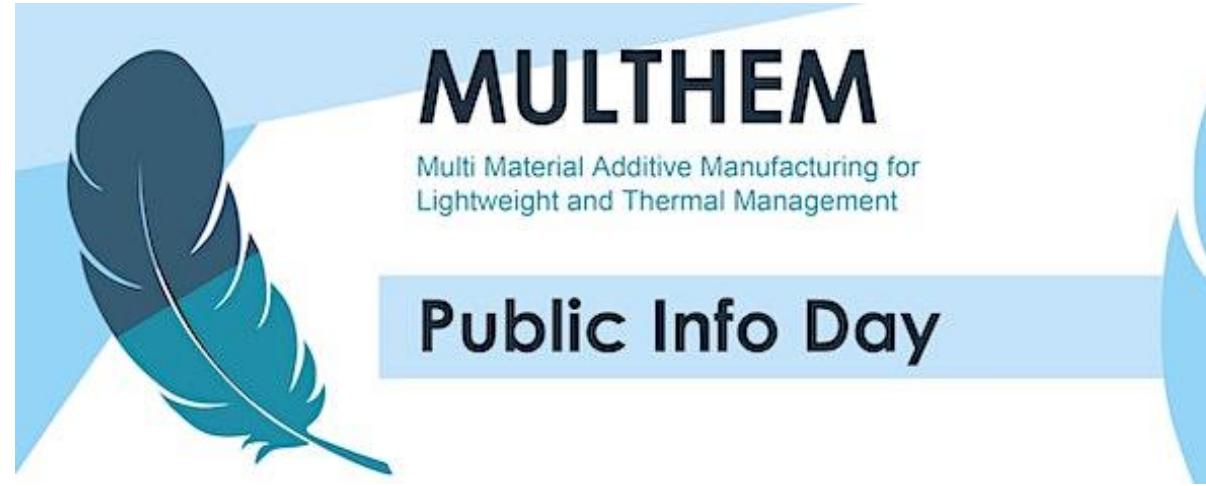


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MULTHEM
Multi Material Additive Manufacturing for
Lightweight and Thermal Management



Thursday, 22nd June 2023 | 10:00 – 11:30 (CET)



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This project has received funding from the European Union's Horizon Europe Research & Innovation programme 2021 -2027 under grant agreement number:101091495

Public Info Day

Thursday, 22nd June 2023 | 10:00 – 11:30 (CET)

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Content

1. **Introduction to the MULTHEM Project.** | **Presenter** Dr. Marta Álvarez Leal (coordinator of the project)
2. **CETEMET (coordinator)** | Fundación Centro Tecnológico Metalmecánica y del Transporte (**Spain**) | **Presenter** Dr. Marta Álvarez Leal
3. **FRAUNHOFER (partner)** | Fraunhofer Gesellschaft Zur Förderung Der Angewandten Forschung EV (**Germany**) | **Presenter** M.Sc. Aybike Yalçınüz
4. **LIST (partner)** | Luxembourg Institute of Science and Technology (**Luxembourg**) | **Presenter** Dr. Joamin Gonzalez Gutierrez
5. **TNO (partner)** | Nederlandse Organisatie Voor Toegepast Natuurwetenschappelijk Onderzoek TNO (**Netherlands**) | **Presenter** Dr. Tessa Ten cate
6. **AIR (partner)** | Solmatek Solutions SL (**Spain**) | **Presenter** Mr. José Soler
7. **EIRE (partner)** | Eirecomposites Teoranta (**Ireland**) | **Presenter** Dr. Vedant Modi
8. **PADD (partner)** | Prima Additive SRL (**Italy**) | **Presenter** Mr. John Stavridis
9. **THA (partner)** | THALES (**France**) | **Presenter** Mr. Gabriel Foyer
10. **BUL (partner)** | Brunel University London (**UK**) | **Presenter** Dr. Eujin Pei



What is MULTHEM?



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MULTHEM
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Presenter: Project Coordinator
Dr. Marta Álvarez Leal

Date: 22nd June 2023



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What is MULTHEM?

Content

1. Origin

2. Main features of the applied call

3. Specific needs

4. Partners

5. Funding details

6. Vision

7. Pillars

8. New multi-materials development

9. Our expected outcomes

10. Work packages structure

11. First steps performed towards the use cases

Let's go!





What is MULTHEM?

Origin

MULTHEM has emerged in response to the demanding needs of the international industry.

Different entities and companies are working across Europe to enhance the competitiveness of our industry towards environmental improvement.





What is MULTHEM?

Main features of the applied call

Programs:

HORIZON.2.4 - Digital, Industry and Space (MAIN PROGRAMME)

HORIZON.2.4.4 - Advanced Materials

Topic:

HORIZON-CL4-2022-RESILIENCE-01-12 - Functional multi-material components and structures (RIA)

Call for the proposal:

HORIZON-CL4-2022-RESILIENCE-01

Type of action:

RIA - Research and Innovation action

Technology Readiness Level (TRL):

Start TRL 3 → End TRL 6

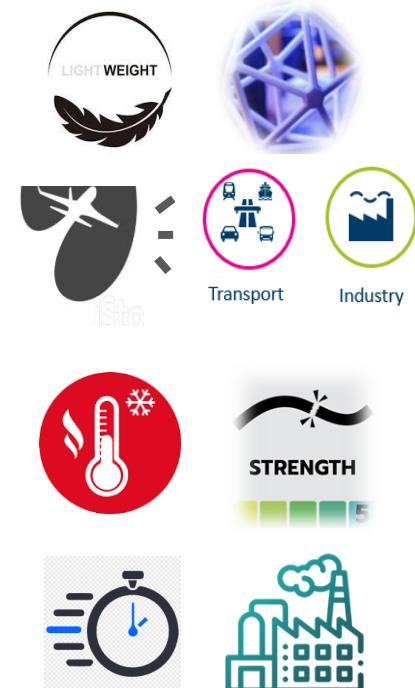




What is MULTHEM?

A project born from the following specific needs:

- 1. Light-weighting of complex shaped components:** current lay-up composite does not allow complex shaped components manufacturing cost effectively, especially in medium or low series production in aerospace or automotive sectors.
- 2. Improved heat dissipation of light-weight structure:** composites have high mechanical strength, but poorer thermal conductivity compared to metals. Heat dissipation is critical in many applications.
- 3. Reduction of lead times (weeks-months) for industrial processes involving composites:** long time and laborious method of producing prototypes.





What is MULTHEM?

Partners

1. **CETEMET** | Fundación Centro Tecnológico Metalmecánica y del Transporte (**Spain**)
2. **FRAUNHOFER** | Fraunhofer Gesellschaft Zur Förderung Der Angewandten Forschung EV (**Germany**)
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7. **PADD** | Prima Additive SRL (**Italy**)
8. **THA** | THALES (**France**)
9. **BUL** | Brunel University London (**UK**)

Coordinator

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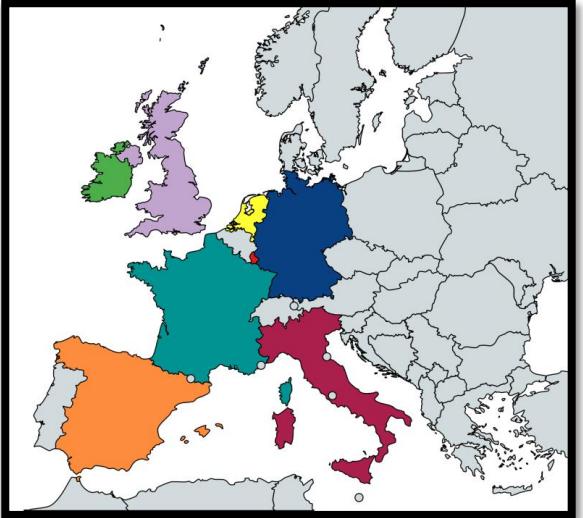
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What is MULTHEM?

9 partners from 8 countries





What is MULTHEM?

Funding

DOI

[10.3030/101091495](https://doi.org/10.3030/101091495)

Start date

1 December 2022

End date

30 November 2025

Funded under

Digital, Industry and Space

Total cost

€ 4 071 977,50

EU contribution

€ 4 071 977



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2021 -2027 under grant agreement number:101091495





What is MULTHEM?

Vision

The vision of MULTHEM is to use the advantages of metals and CFC materials to develop and validate new reliable additive manufacturing processes together with new metal-polymer multi-materials of structural and cooling functionalities through a more cost-effective approach than traditional methods.





What is MULTHEM?

Pillars



Carbon Fibre Composites (CFC)

Carbon Fibre Composite (CFC) is used in construction and manufacturing. They are known for their lightweight and high strength-to-weight ratio, making them ideal for use in aircraft, satellites, and sporting goods.



Weight Reduction

Weight reduction refers to the process of decreasing the weight of an object or system, often by removing excess material or improving its design. This can be done to improve efficiency, performance, and reduce costs.



Nanotechnology

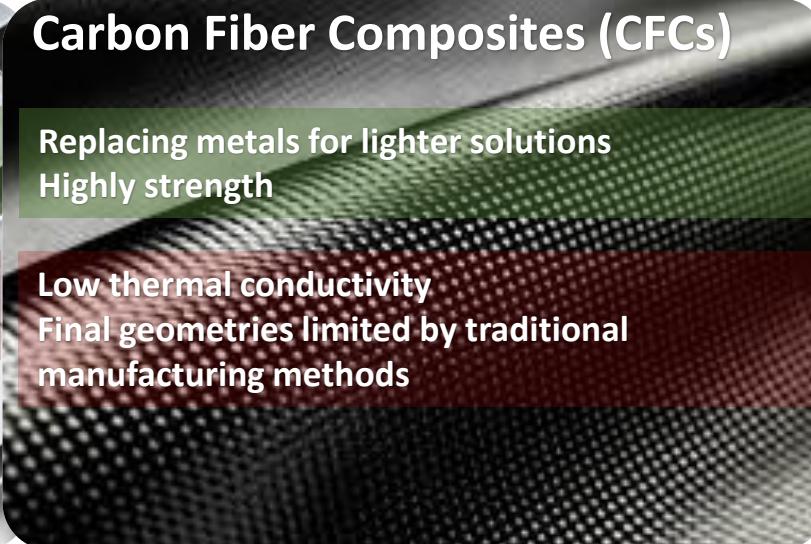
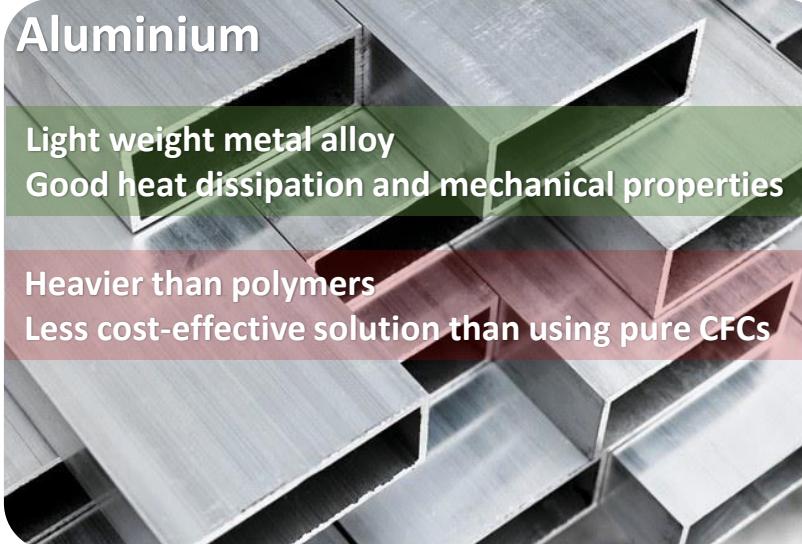
Nanotechnology is the science of manipulating matter on an atomic, molecular, and supramolecular scale. Integration of both these domains can create wide variety of materials for new and innovative applications.





What is MULTHEM?

New Multi-materials development



MULTIMATERIAL SOLUTIONS



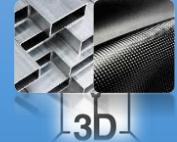


What is MULTHEM?

Our expected outcomes



To implement
Multi-
material
Additive
Manufacturing



Weight reduction
by 50 %



Decreasing
lead time
by 25 %



Implementation
in EU
industries



Reproducibility
and
quality



To increase
performance
 $> 30 \%$



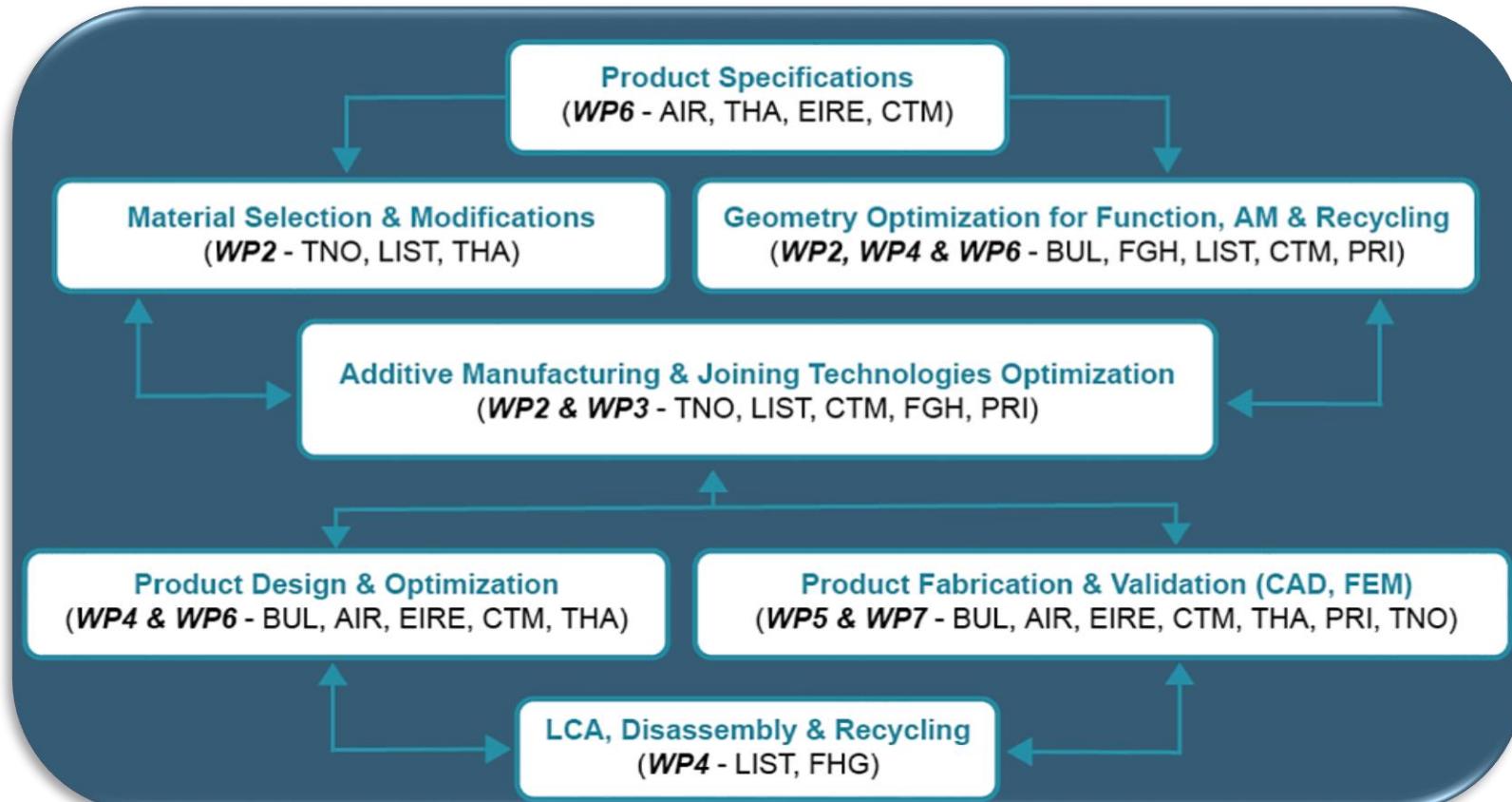
Dissemination
of the Multi-
material
developed





What is MULTHEM?

Work packages Structure





What is MULTHEM?

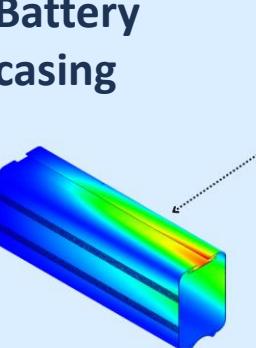
First steps performed towards the use cases... >>

- Defining all the material requirements for the three Use Cases. **WP6**
- Selection of the best ALUMINIUM alloys and REINFORCED POLYMERS materials according to materials requirements for the three Use Cases. **WP2**
- Selection of the most suitable AM technologies for developing these new metal-polymer multi-materials. **WP2**
- First trials to start developing and processing new metal-polymer multi-materials. **WP2 and WP3**

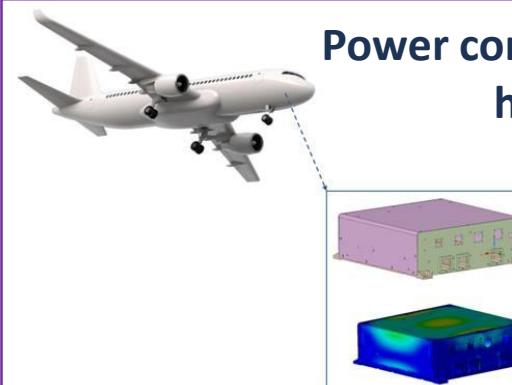
Electrical motor housing



Battery casing



Power converter housing





Contact us today

Project coordinator
Dr. Marta Álvarez Leal
m.alvarez@cetemet.es

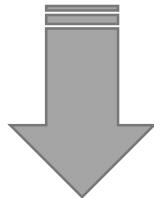
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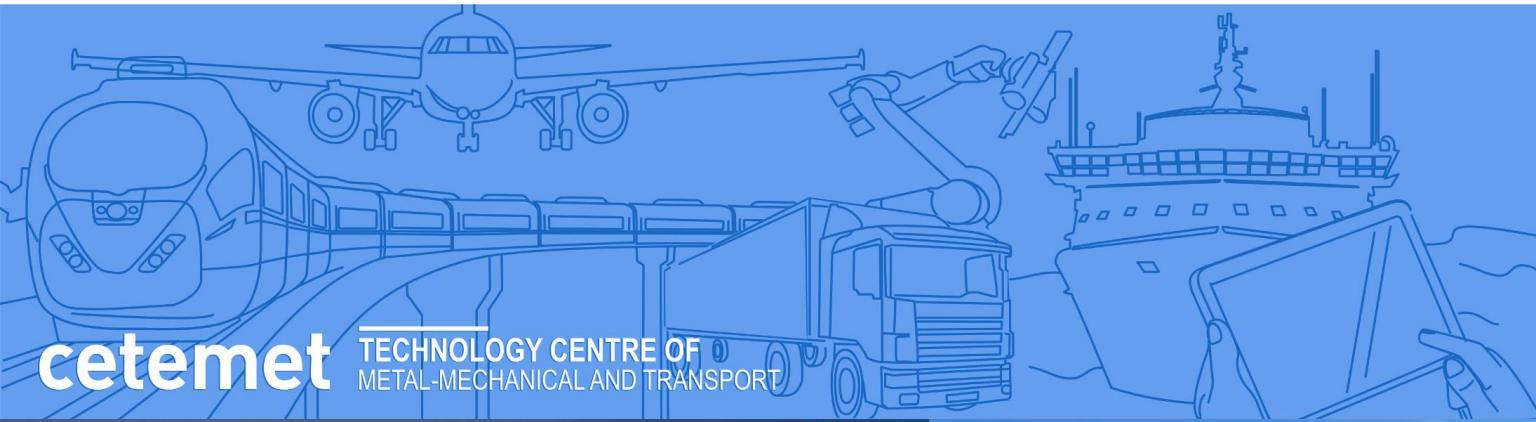
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Date: 22nd June 2023



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What we do?

Applied research, technology and innovation



Transport



Materials



Industry



Aerospace



Agrotech



Robotics & Automation



Energy Efficiency



Digitalization



MAIN HEADQUARTER: Parque Empresarial Santana, Avda. 1º de Mayo, s/n

23700 Linares (Jaén) Spain

Headquarters: Córdoba, Zaragoza and Benavente





Our R&D&I Areas of Knowledge

Expertise:



Project Team: Dr. Marta Álvarez Leal



+34 605 92 62 99



m.alvarez@cetemet.es



[Marta Álvarez Leal](#)



European Project Manager and Researcher (Since 2019)



PhD in Materials Science and Engineering from Complutense University of Madrid (2019). International PhD Thesis mention with research stays abroad. Cum-Laude.
MSc in Geological Sciences. Complutense University of Madrid (2014).
BSc in Geology, crystallography specialization. Complutense University of Madrid (2012).



Research involved in FSW, severe plastic deformation (SPD), superplasticity in metals, Crystallography, crystal structure, Physical Metallurgy, Metallography, Mechanical Properties, and Mineralogy.



R&D Projects involved in:

PROSOLTIVA

Project leader of a robotic FSW innovation project.



Researcher in a Factories of the Future (FoF) project of the H2020 European Programme.



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Project Team: Dr. Julia Ureña Alcázar



j.urena@cetemet.es



[Julia Ureña Alcázar](#)



Project Manager and Researcher (Since 2018)



PhD in Materials Science and Engineering from University Carlos III of Madrid (2018). International PhD Thesis mention with two research stays abroad. Cum-Laude.
Assistant Professor Doctor accredited by ANECA (2018)
MSc in Teaching in Secondary Education and Baccalaureate from University of Jaén (2014)
BSc in Chemistry from University of Jaén (2012)



Research involved in development, processing and characterization of metals, polymers and multi-materials processed by LMD, EBM, SLM and SLS Additive Manufacturing technologies. Powder Metallurgy.



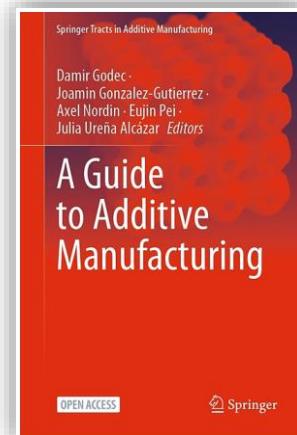
R&D Projects involved in:

TECMADIVA



Multimat 3D

Project Leader of Metal Additive Manufacturing and Multi-material. Torres Quevedo main Researcher.



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University London

Project Team: Ms. Ana Fraile Martin



af.martin@cetemet.es



[Ana Fraile Martin](#)



Project Engineer (Since 2022)



BSc in Mechanical Degree from University of Jaén (2023)



Research involved in joining techniques, hardness testing, 3D scanning.



R&D projects involved in:



PROSOLTIVA

Robotic FSW innovation project



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Project Team: Dr. Anand Raj Doraisingam



International Project Manager (Since 2022)



Ph.D. in Industrial Engineering under a joint Engineering and Physical Sciences Research Council (EPSRC) and Knowledge Transfer Partnership (KTP) studentship award from **Northumbria University in Newcastle (UK)** and **Bahco Metal Saws/Snap-On** (Sweden), specializing in developing cutting tool materials (2004)
BEng (Hons) in Mechanical Engineering from University of Northumbria (1996)
Chartered Engineer (CEng) from the Engineering Council (UK)



Research involved in product and technology development of machinery and vehicles for the transport industry.



R&D projects involved in:



a.doraisingam@cetemet.es

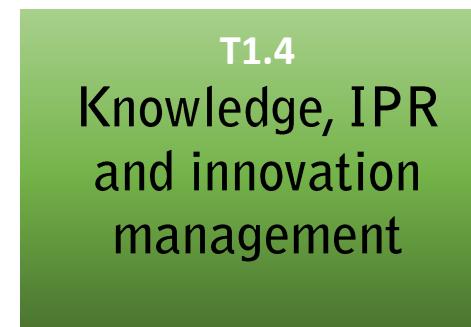
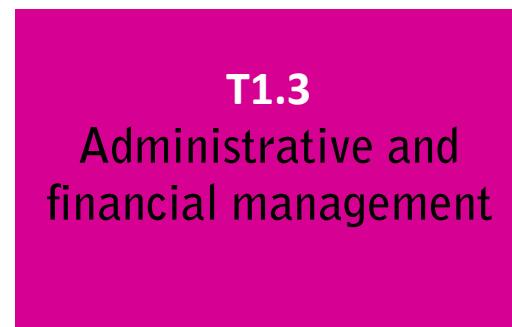
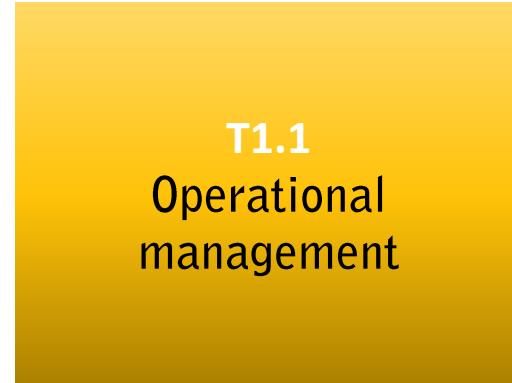


[Anand Raj Doraisingam](#)



WP1 Leader for WP1

Project management and coordination



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WP2 and WP3

To develop new aluminium structures and process parameters

Main technology for WP2
Laser Metal Deposition (LMD) wire based

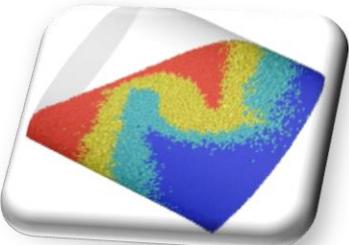


Main technology for WP3
Robotic Friction Stir Welding (R-FSW)

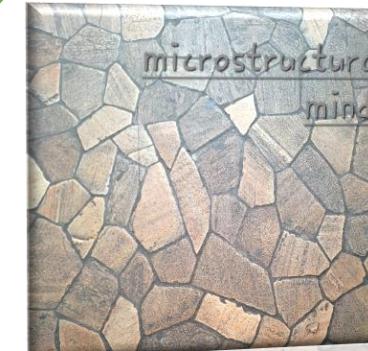


Joining dissimilar materials (metal-polymer)

Transversal capacity for WP2&3
Computational Simulation



Transversal capacity for WP2&3
Material characterization



To ensure high quality of the part and material performance

Leader for T2.2
Multi-material AM Modelling and Simulation



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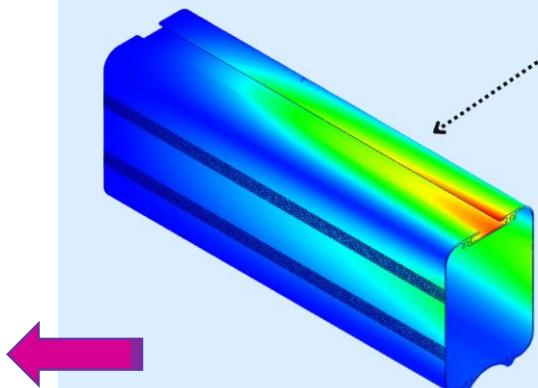
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WP6 and WP7

Leader for T6.2
Battery casing design optimization and performance maximization using new multi-materials approach

Use Case: Battery casing
In collaboration with EIRE



Involved in T7.2
Battery package manufacturing and test

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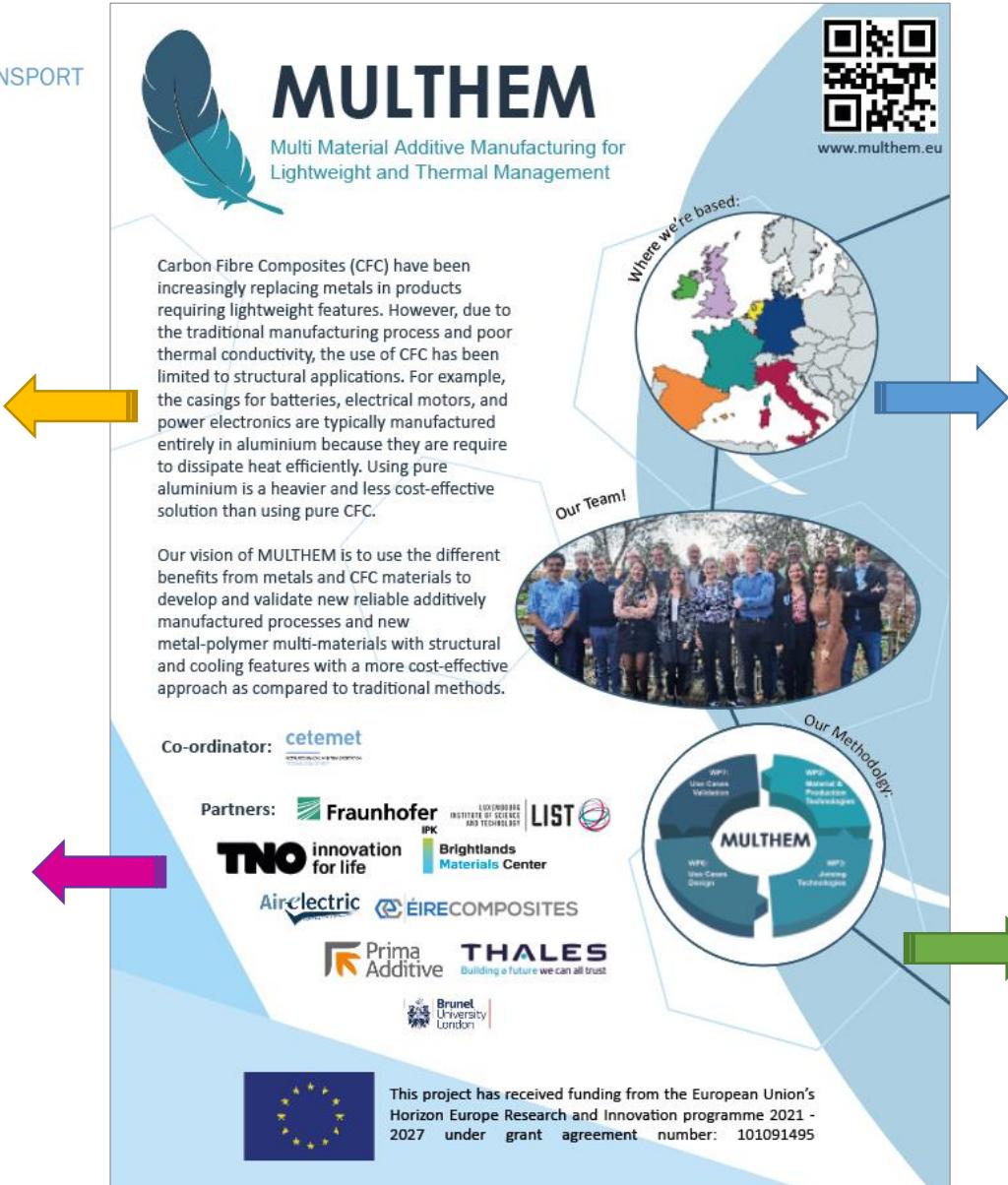


Involved in T8.1

Communication, Exploitation & Dissemination Plan

Involved in T8.2

Implementation of Communication and Dissemination activities



Leader for T8.4 Exploitation and EU project collaboration

Involved in T8.3 Development of methods and tools for training

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m.alvarez@cetemet.es

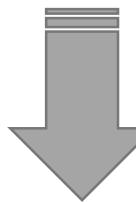
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Fraunhofer IPK

Joining and Coating Technology

Aybike Yalçınüz, M.Sc.

Meeting: MULTHEM – Public Info Day
Organiser: Cetemet
Location: Online
Date: 22.06.2023

Visit us at: multhem.eu



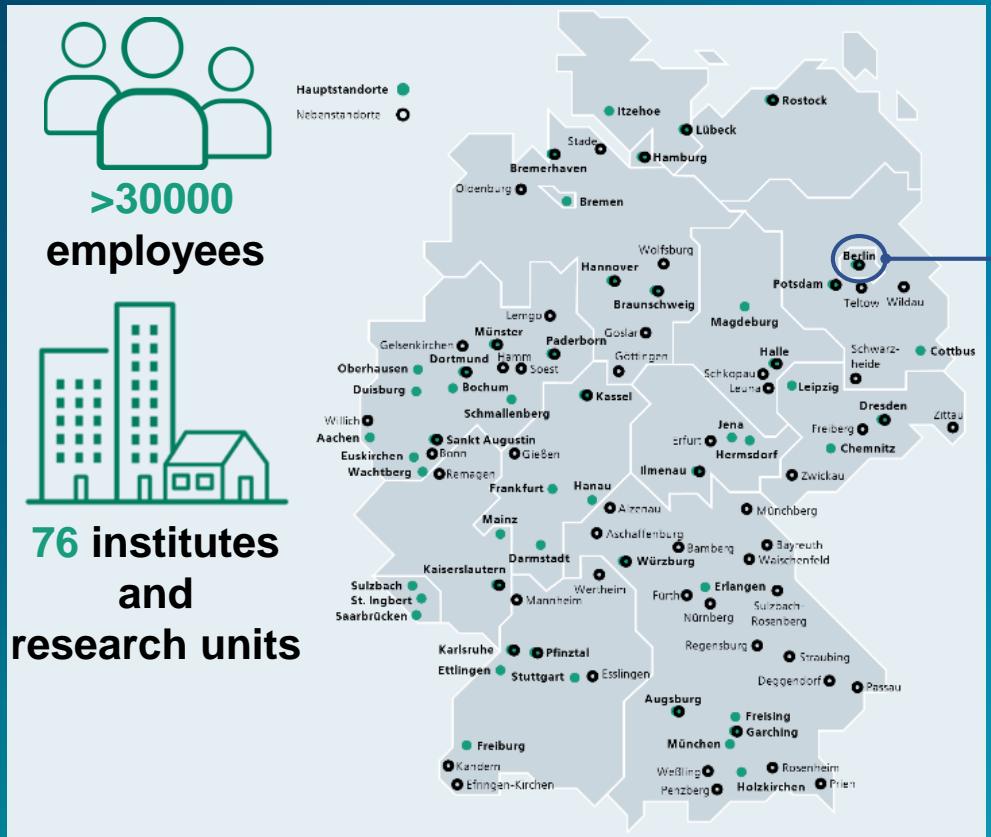
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Systems and Design Technology IPK



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Joining and Coating Technology



Optimal Welding using AI

Signal Processing, Quality Assurance, Process Monitoring

Welding Simulation

Structure Simulation, Distortion Optimization,
Crack Avoidance, Strain Compensation

Digital and Experimental Process Assurance of Joining and Coating Technology

Directed Energy Deposition (DED), Electric
Arc-, Resistance Spot-, Submerged Arc-,
Hybrid-, Laser and Electron Beam Welding

Process Development and Optimisation

CAD/CAM, DoE, Parameter Development, Production Start-up

Material Qualification

Weldability Research, Feasibility Studies



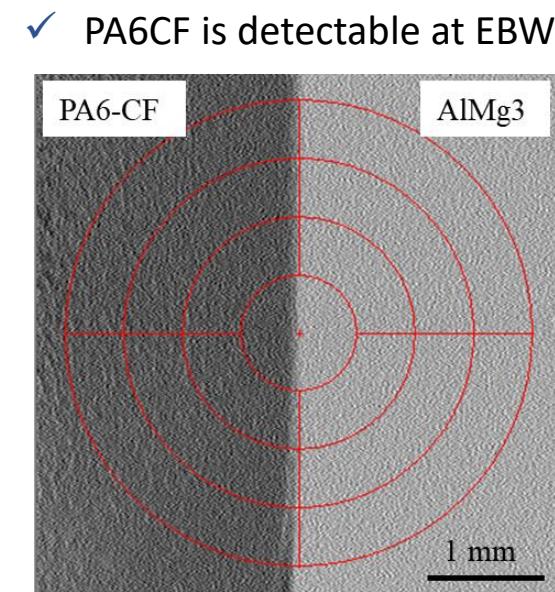


Fraunhofer IPK in MULTHEM-Project

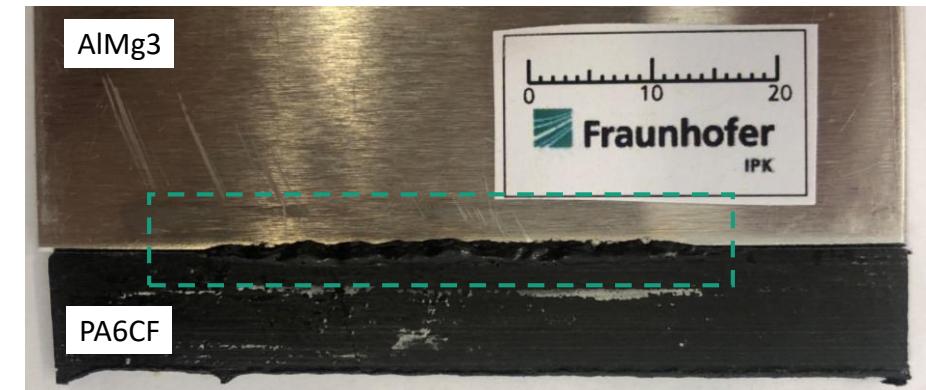
Leader for WP3 Joining Technologies

- Development of joining concepts for the manufacture of multi-materials using innovative joining technologies, as laser and electron beam, friction stir welding
- Determination and modelling of the heat distribution during the joining process by the structural simulation
- Manufacturing of test coupons for proving joining technologies

Electron Beam Welding (EBW)
at Fraunhofer IPK



✓ Joining of AlMg3 and PA6CF by EBW



PA6CF: Carbon Fibre-Reinforced PA6 (Nylon 6)

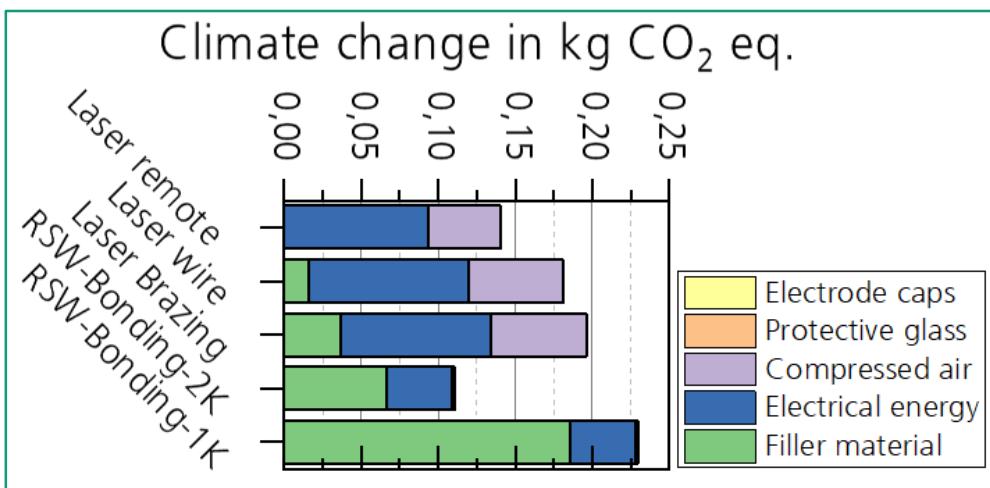




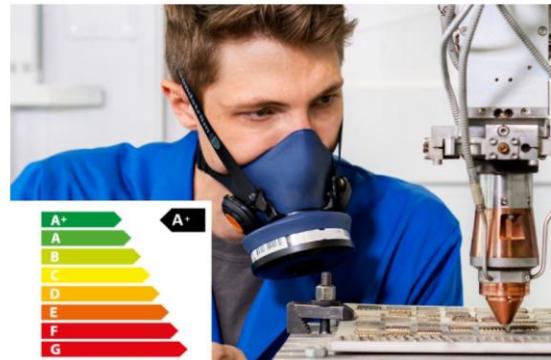
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Task Leader for Life Cycle Assessment in WP4

- Calculation of environmental impact associated with the products being redesigned and validated in MULTHEM and compare them to products manufactured by conventional methods
- Life cycle assessment (LCA) according to ISO 14040 is a process for recording and evaluating environmentally relevant processes.
- Example LCA-Analyse for electric vehicles battery case using with different joining processes



Life Cycle Assessment of your manufacturing processes



Your benefits

- Life cycle assessment of welding, coating and additive manufacturing processes for a well-founded technology selection and investment decision.
- R&D for your company
 1. You receive an independent evaluation and classification of the results in the context of your production.
 2. We provide you with individual assistance on optimization measures for your processes.

TECHNISCHE SPEZIFIKATION		
	DIN/TS 35235	DIN
ICS 25.160.10		
Nachhaltigkeit in der Schweißtechnik – Ökobilanzierung von Schweißverfahren – Anleitung und Beispiele		
Sustainability in welding technology – Eco-balance of welding processes – Guidelines and examples		
Développement durable dans le soudage – Analyse du cycle de vie des modes opératoires de soudage – Lignes directrices et exemples		



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Multi Material Additive Manufacturing for
Lightweight and Thermal Management



Fraunhofer Institute for Production
Systems and Design Technology IPK

Contact

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Research Associate

Joining and Coating Technology

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aybike.yalcinyuez@ipk.fraunhofer.de

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10587 Berlin



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Presenter: Dr. Joamin Gonzalez-Gutierrez

Date: 22nd June 2023



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Project Team: Joamin Gonzalez



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joamin.gonzalez-gutierrez@list.lu

[Joamin Gonzalez-Gutierrez](https://www.linkedin.com/in/joamin-gonzalez-gutierrez/)

R&T Associate (Since June 2021)

PhD in Mechanical Engineering (2014)

Functional & responsive polymers for additive manufacturing

48 peer reviewed journal papers

Horizon EU projects involved in:



Project Team: Tim Huber



+352 275 888 3575



tim.huber@list.lu



[Tim Huber](#)



Senior R&T Associate (Since January 2022)



PhD in Materials Engineering (2013)



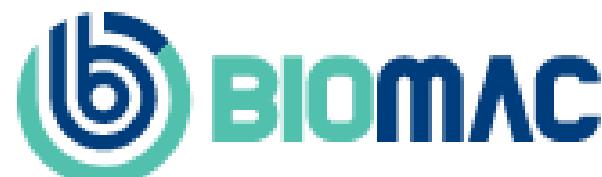
Bio-based sustainable polymers for additive manufacturing



27 peer reviewed journal papers & 1 Patent



Horizon EU projects involved in:



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Project Team: Mariapaola Staropoli

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Junior R&T Associate(Since July 2021)

PhD in Physical Chemistry (2017)

Polymer chemistry, rheology and spectroscopy

15 peer reviewed journal papers

Horizon EU projects involved in:



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mariapaola.staropoli@list.lu



[Mariapaola Staropoli](#)



Project Team: Harshada Chothe



PhD candidate (since April 2023)



MSc in Materials Engineering (2023)



Polymer composite processing & characterisation



2 peer reviewed journal papers



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harshadarchothe@gmail.com



[Harshada Ravindranath Chothe](#)

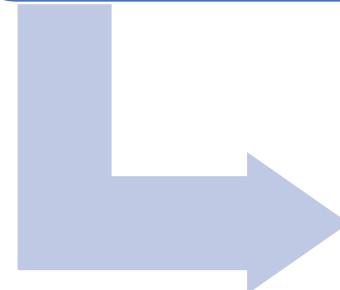




WP2 – Conductive polymer compound development

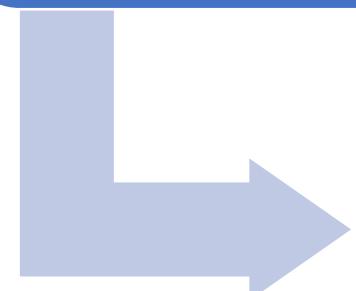
Material selection

- Lightweight thermoplastics
- Conductive fillers



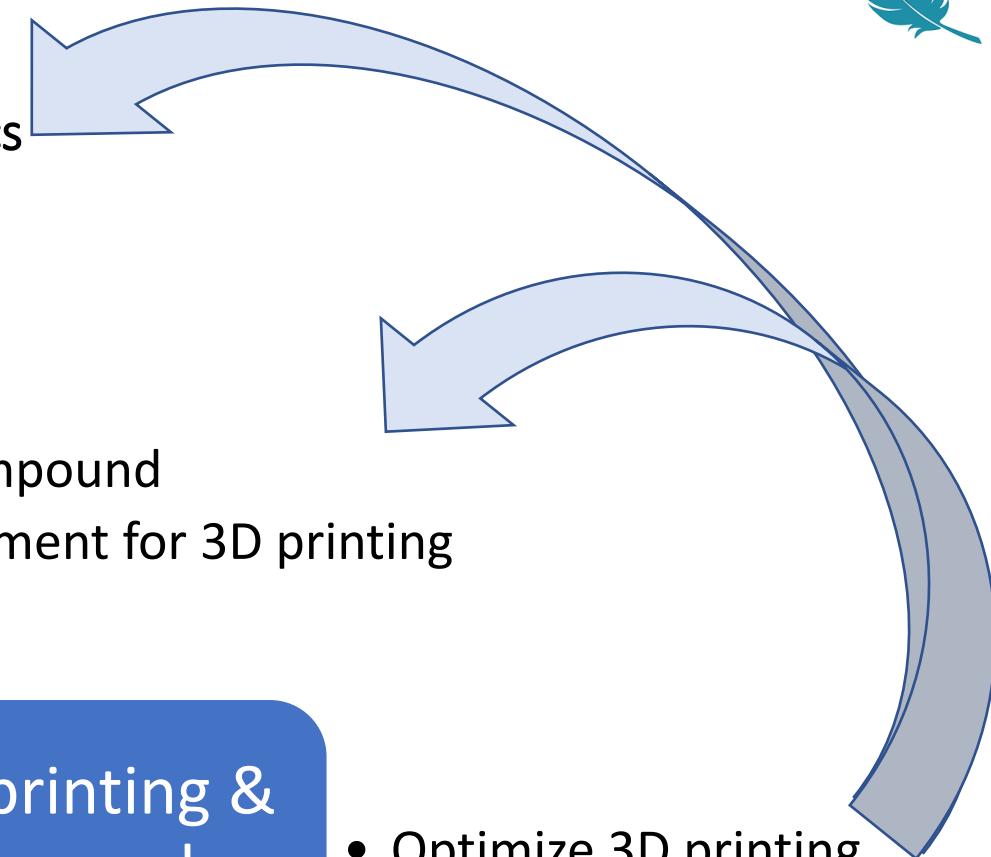
Compounding & extrusion

- Compound
- Filament for 3D printing



3D printing & thermal conductivity

- Optimize 3D printing
- Maximize thermal conductivity



WP4 – LCA & recycling



LCA

Material data

Energy data

Recycling

Design for
disassembly
and recycling

Reprocess
thermoplastic
composites



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Presenter: Dr. Tessa ten Cate

Date: 22nd June 2023



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Brightlands Materials Center



- Independent R&D Center in the field of polymeric materials
- Established in March 2015 by TNO and the Province of Limburg
- Located at the Brightlands Chemelot Campus in the south of the Netherlands
- Application-driven R&D supported by basic academic knowledge in 3 research programs:

Sustainable Mobility



Sustainable Buildings



Circular Packaging



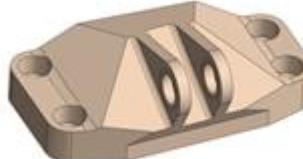
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Our activities

3D printing using continuous fiber – Complex composite products

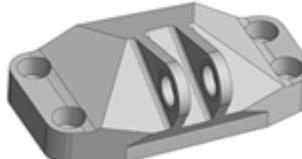


Traditional metal bracket



Relative weight 100%
Strength/weight 100%

Composite bracket

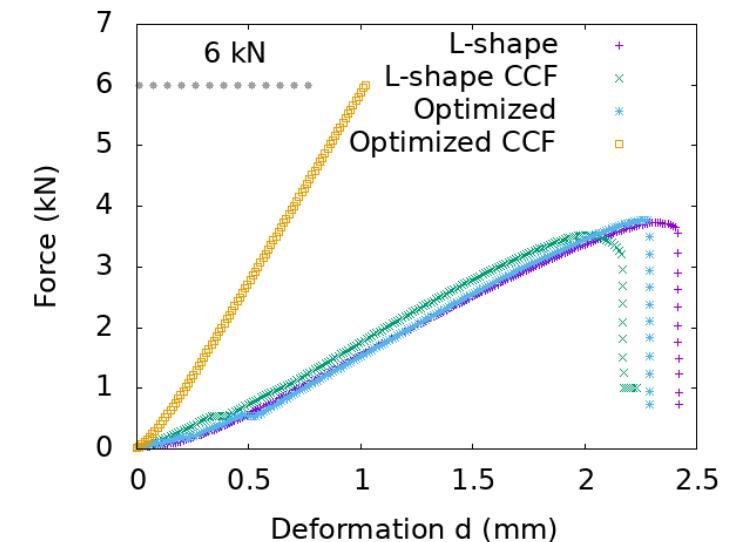


Relative weight ~40-50%
Strength/weight 200-250%

Composite lightweight design



Relative weight ~20-30%
Strength/weight 350-500%



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Who am I?



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tessa.tencate@brightlands.mc.com

[Tessa ten Cate](#)



Senior Scientist Materials for Additive Manufacturing & Program Manager Sustainable Mobility



PhD in Chemistry (2004) from Eindhoven University of Technology

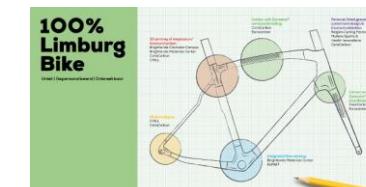


> 15 yrs experience in development for AM of polymers

Research topics: processing & properties of functional polymers, thermoplastic composites, design for AM



Other collaborative R&D projects involved in:



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Project team members



Fidel
Valega Mackenzie

Scientist
AM



Yorgia
Pappas

Researcher
Composites



Willem
Seuren

Researcher
AM



Richard
Janssen

Business
Development



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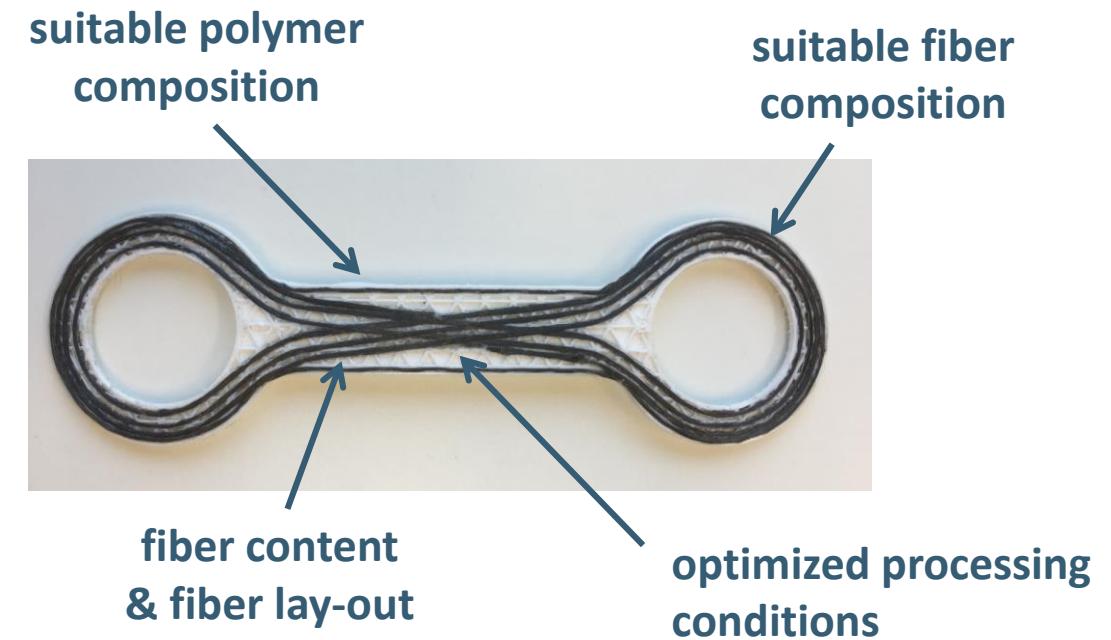
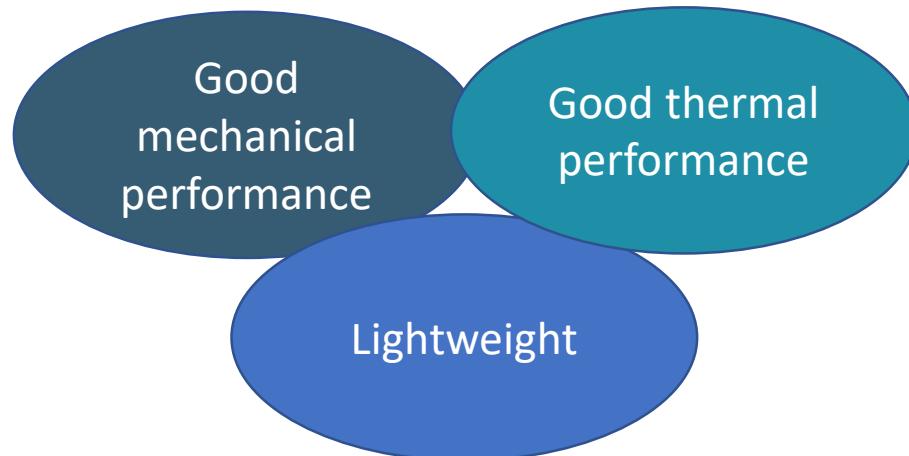
WP2 – Material & Production Technologies



Leader for WP2

Task leader for 2.1 : Material selection & production technologies

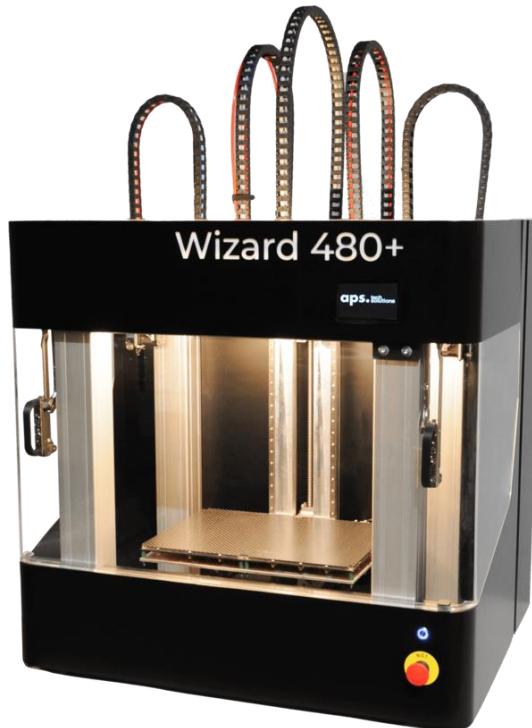
Material & process development for AM using continuous carbon fiber



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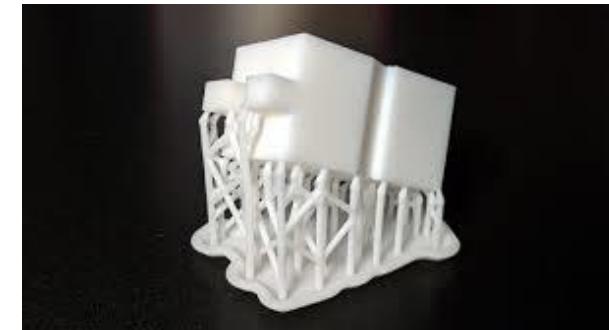
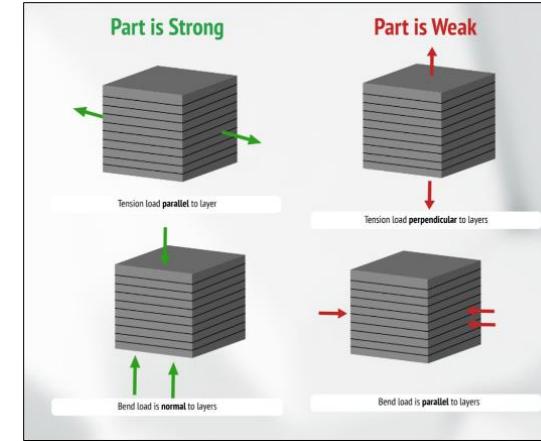
WP6 – Use cases design

Design for additive manufacturing



Linking material & process characteristics to use case design

- Build orientation
- Feature sizes
- Infill strategies
- Support structures



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Multi Material Additive Manufacturing for
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Presenter: Jose Soler

Date: 22nd June 2023



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Who we are

- **AIRELECTRIC** is a startup specialised in the design and manufacturing of high-performance electrical propulsion motors for the UAV, drone and aerospace sectors
- We are located in Madrid, an area with a highly developed aerospace supply chain.
- **Our Philosophy**
 - Innovation and continuous improvement
 - Sustainable use of materials
 - Made in Spain



What we do

- Design of high-performance electrical machines
- Advanced FEA Analysis
 - Electromagnetic
 - Thermal
 - Mechanical
- In-house manufacturing capability
- Test and validation
- Research & Development



Project Team: Dr. Jaime Maravi



Electromagnetic Engineer



PhD in Electric Motor design from University of Sheffield (2020)



Research involved electromagnetic and mechanical performance of electric motors used in wind power and aerospace industries.



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Project Team: Mr. Jaime Solleiro Rodríguez



Mechanical Engineer



BSc in Mechanical Engineering (2013), MSc Industrial Design (2016) and Project Management (2019) & PHD student



Research involved in Biomechanics



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Project Team: Mr. Jose Soler



Technical Director & Project Manager



Bsc + Msc in Mechanical Engineering and Power Electronics



Research involved electromagnetic and mechanical performance of electric motors used in Automotive and Aerospace industries.



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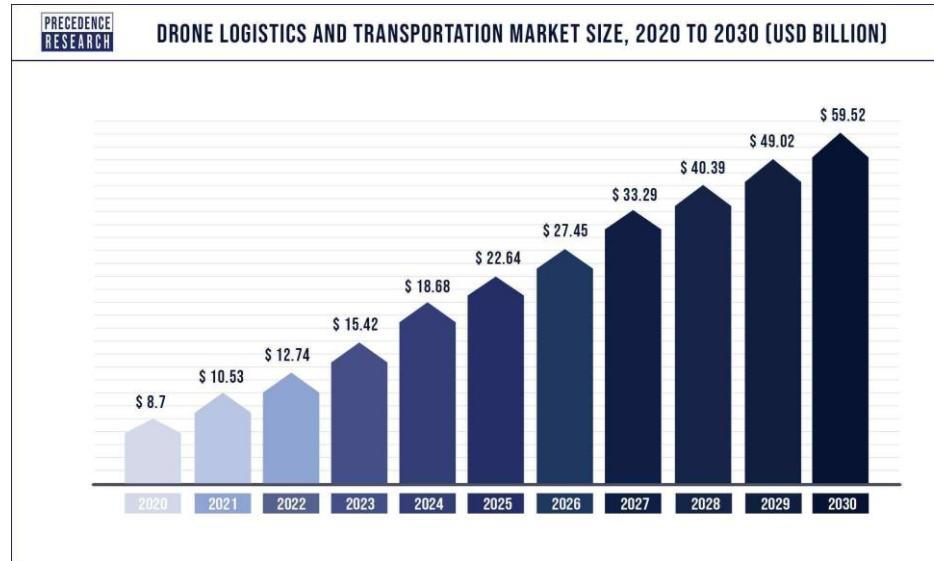
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Business case



There is a need for:

- More powerful electrical propulsion systems
- Lighter solutions to improve range and payload capability
- More agile supply chains



Use Case: Electrical Motor housings



Key Performance Indicators (KPI):

- Housings weight reduction **by 50%**
- Improve product performance **by 20%**
- Lead time reduction **by 35%**



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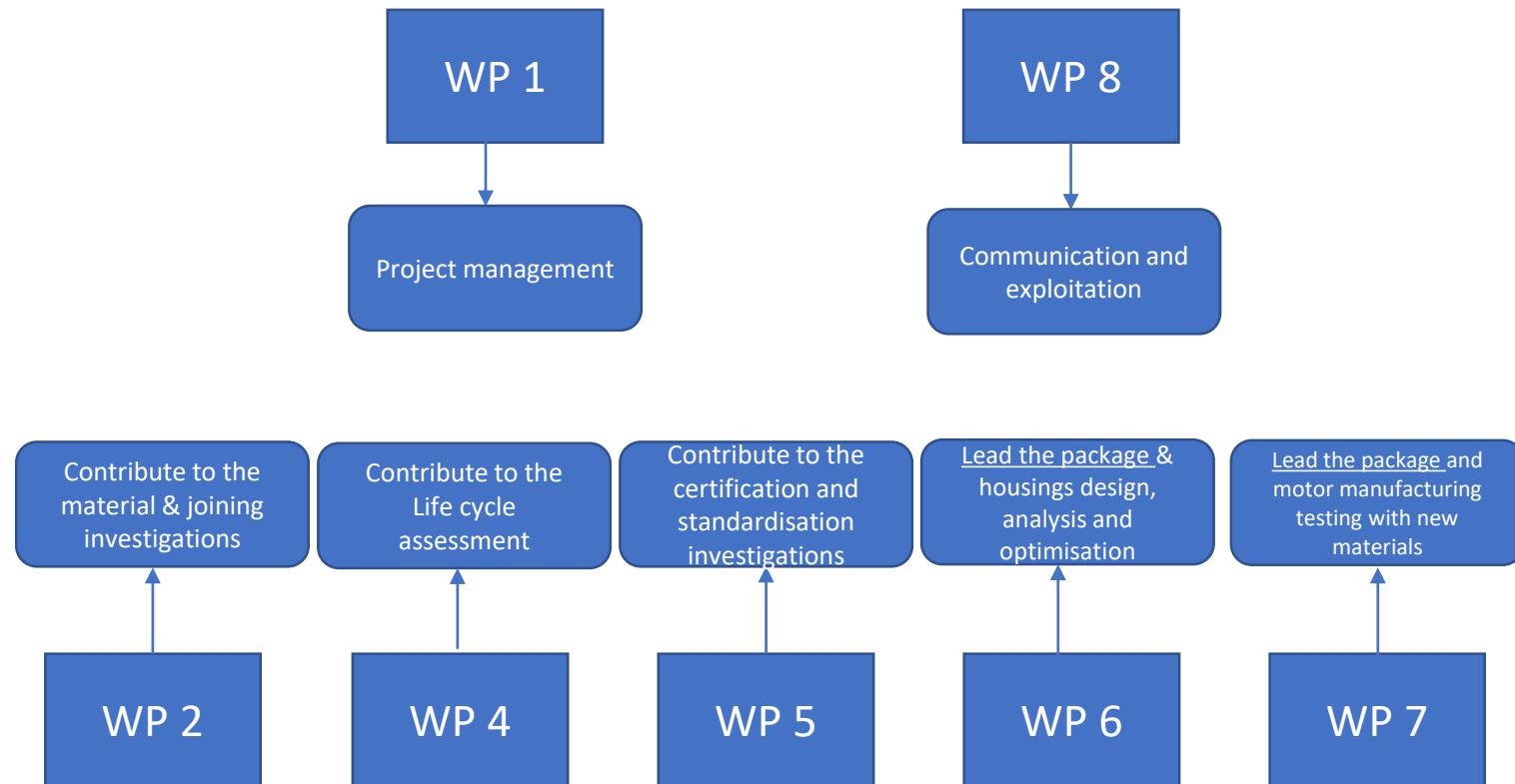
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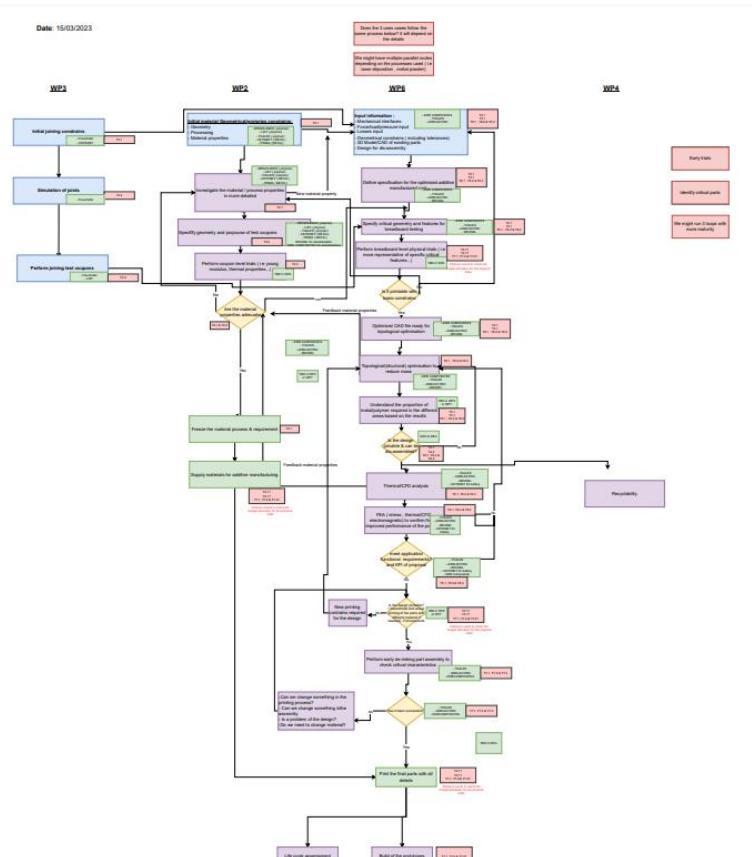
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Tasks in work packages (WP)

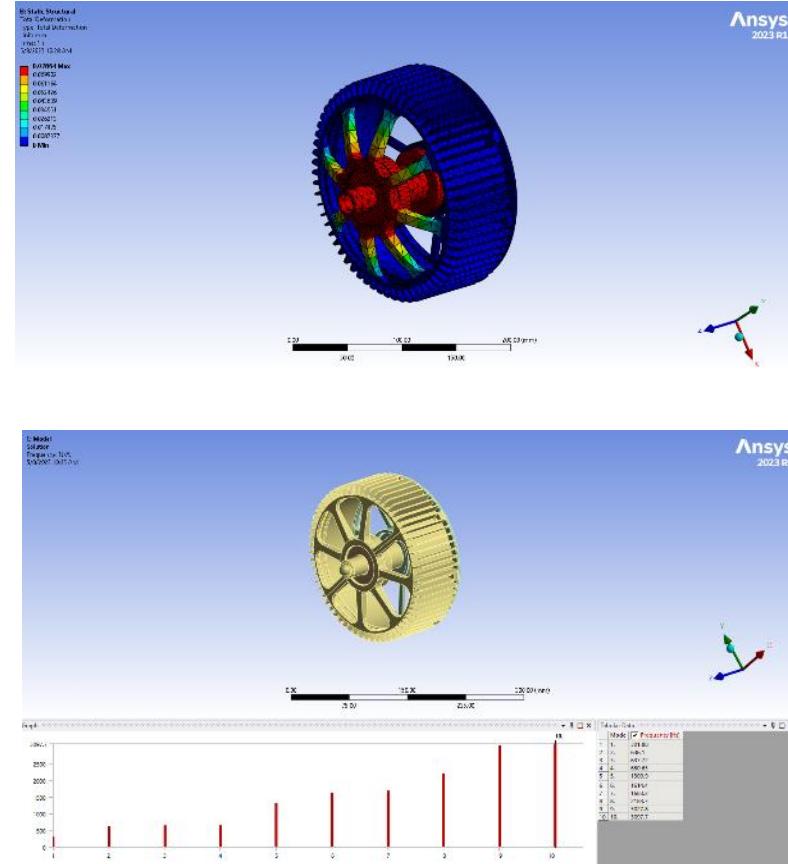


WP6 – Work already performed

Process creation for the design, analysis and test of multi-material components



Initial assessment of multi-material properties in electrical motor mechanical performance



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Presenter: Dr. Vedant Modi

Date: 22nd June 2023



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RENEWABLE ENERGY



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TECHNOLOGY



RESEARCH &
DEVEOPMENT



SPORT



TESTING



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Project Team: Ms. Rebecca McLoughlin



Sales and Marketing (Since 2019)



BSc in International Commerce and **MSc** Business Analytics from University of Galway (2020)



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[Rebecca McLoughlin](#)



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Project Team: Mr. Conor Kelly



Project Engineer/Team Lead (Since 2020)



MEng in Mechanical Engineering from University of Limerick (2020)



Horizon EU projects involved in:



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[Conor Kelly](#)



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Project Team: Dr. Vedant Modi



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v.modi@eirecomposites.com

[Vedant Modi](#)



Project Engineer (Since June 2022)



PhD in Composite Materials from University of Limerick (2023)



Research involved mechanical testing, non-destructive testing and fusion joining.



Peer reviewed journals in Composites Part A and Journal of Intelligent Manufacturing



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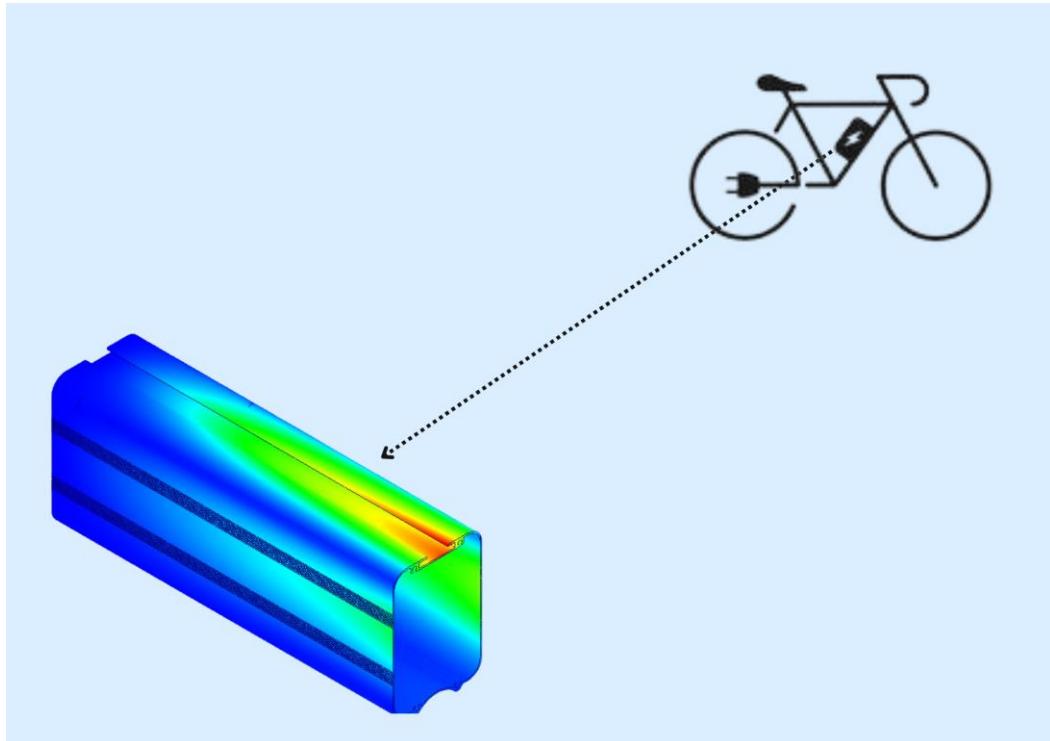
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Use Case: Battery casing



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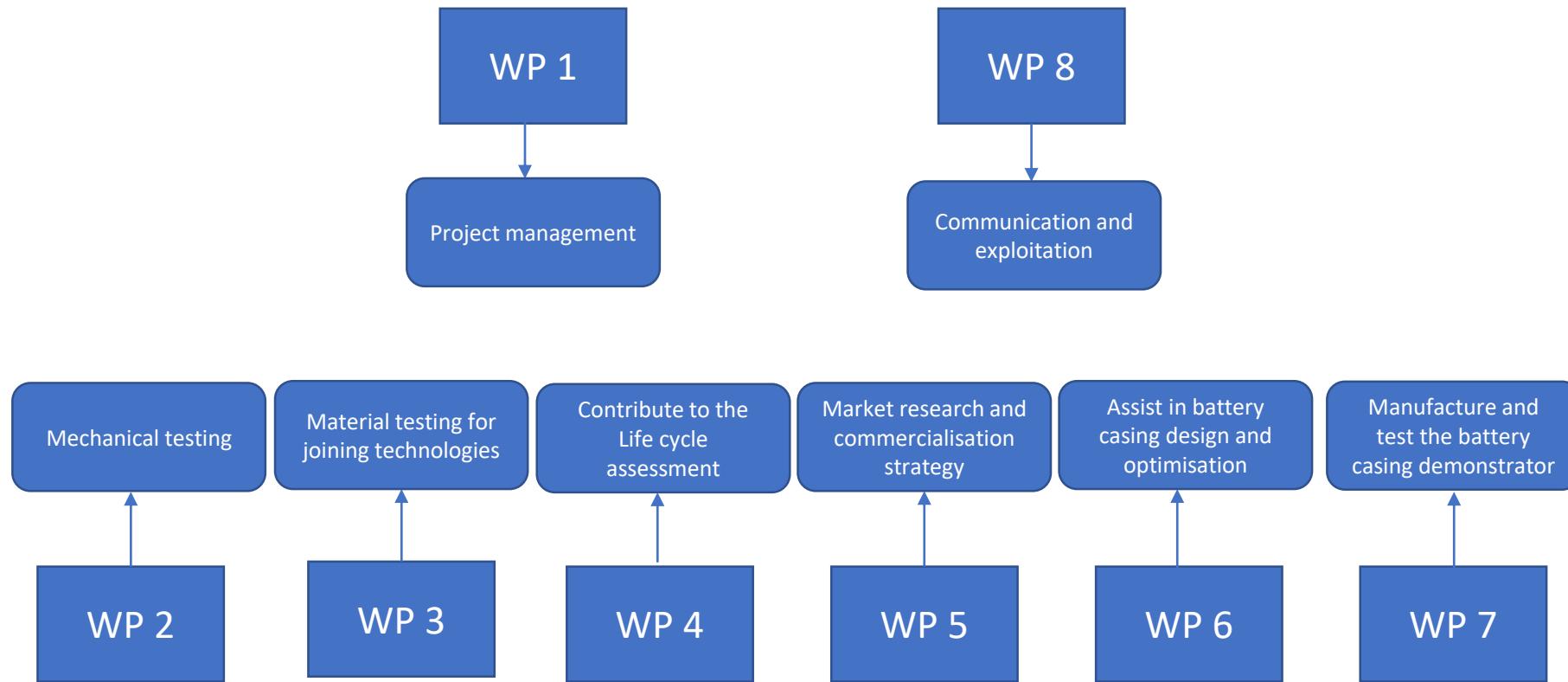
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Tasks in work packages (WP)



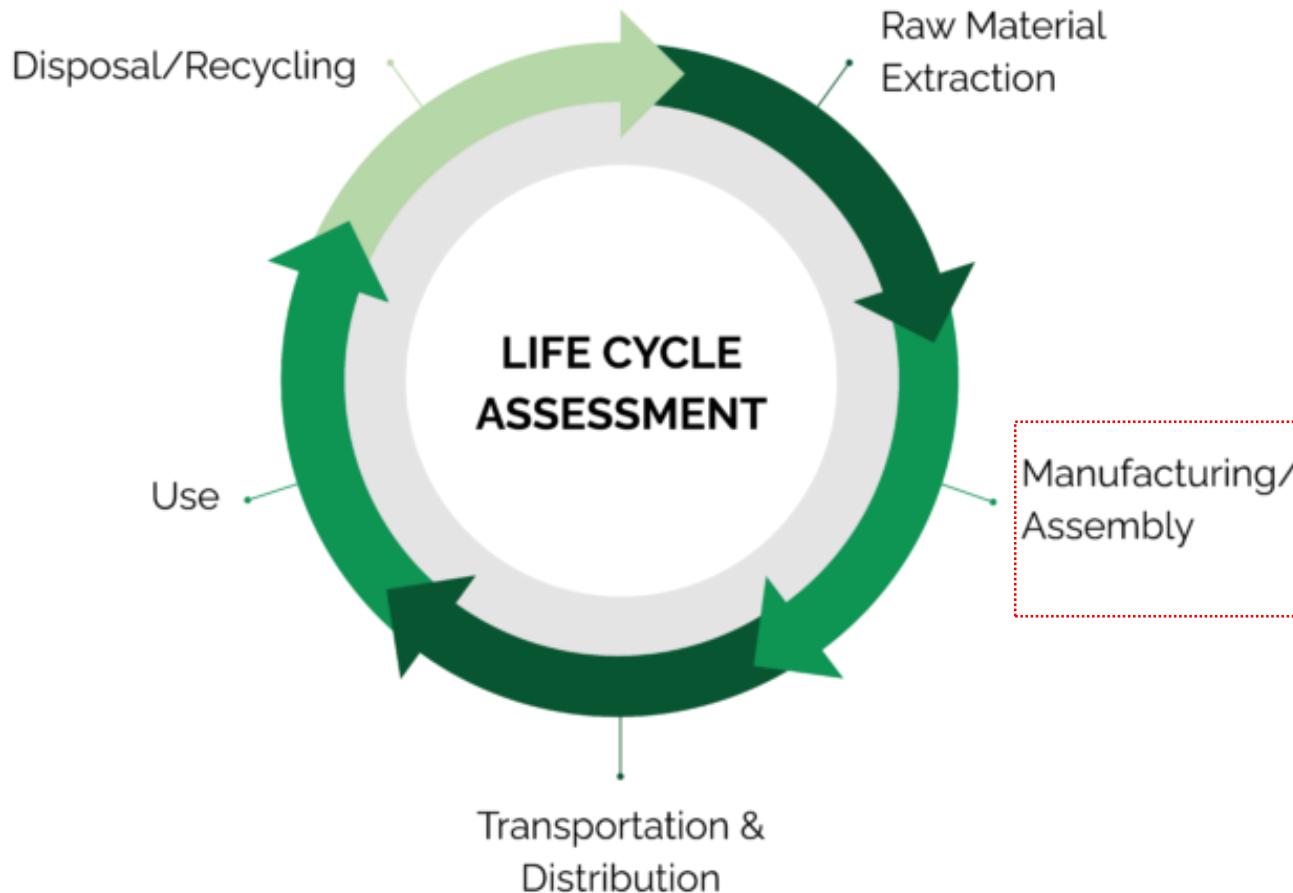
WP2 and WP3

Test family	Test type
Tension	Tensile strength and modulus
	In-plane shear
	Lap shear
Compression	Compression strength and modulus
	Combined loading and compression
Compression after impact	Compression after impact- Impacting
	Compression after impact- Mechanical
Fibre volume fraction	
Microsections	Microsection analysis



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WP4



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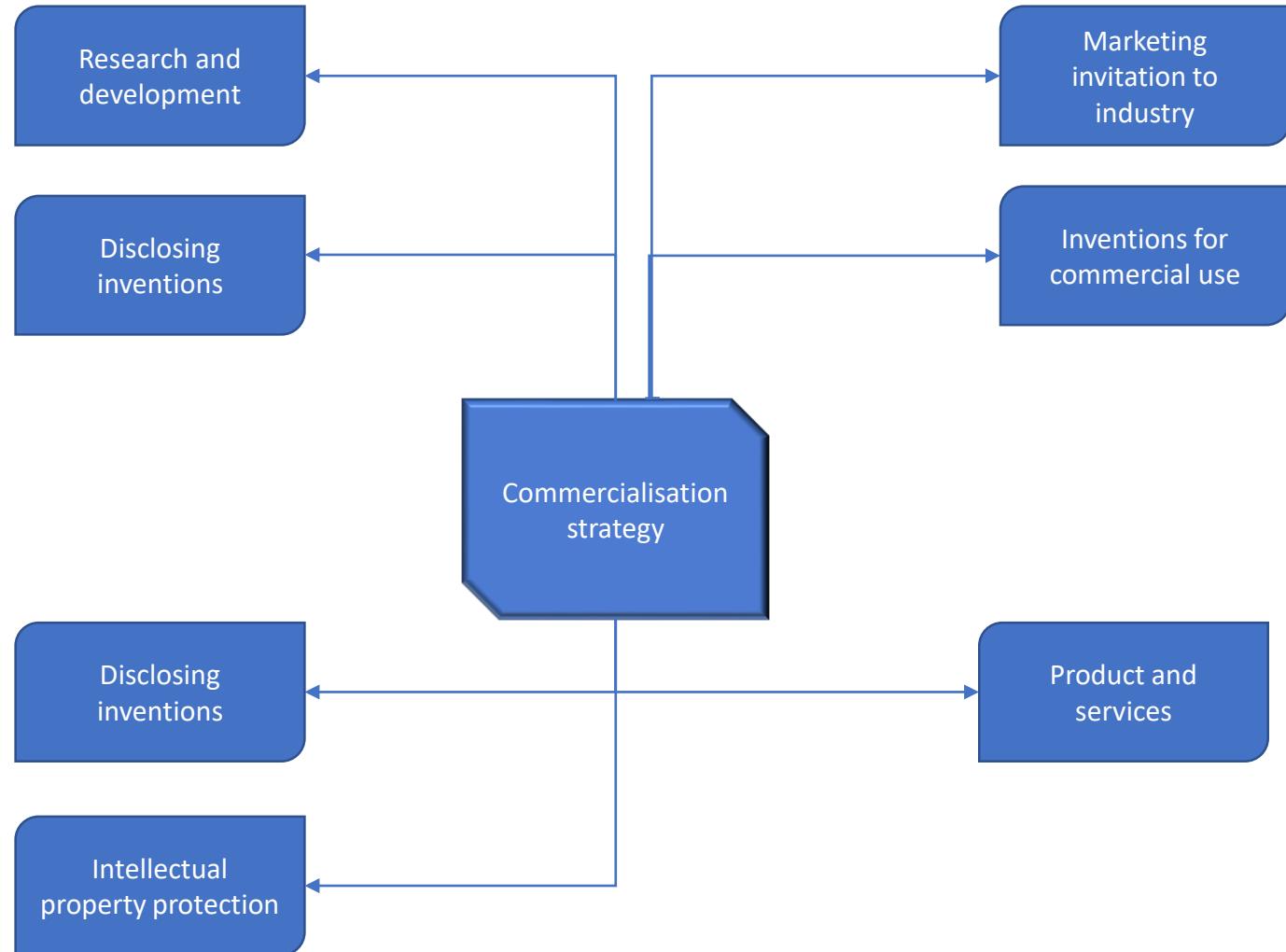
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WP5



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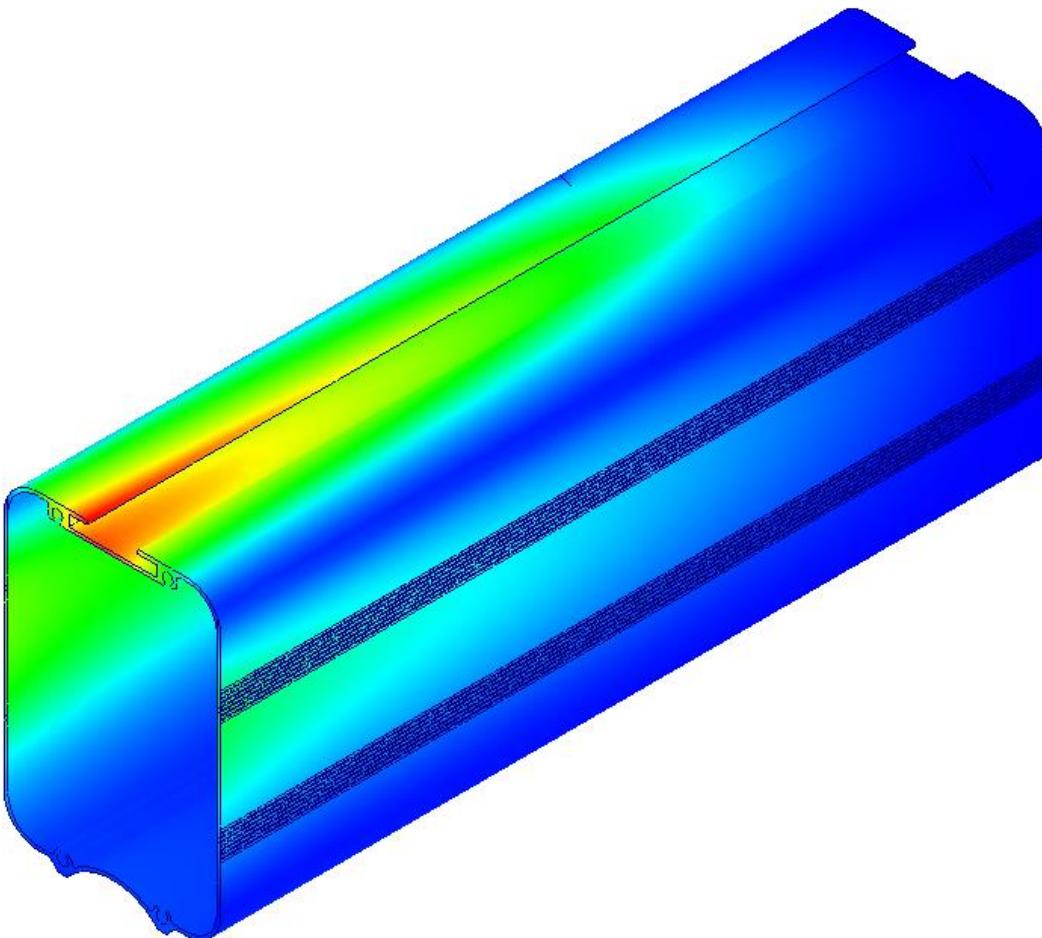
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WP6 and WP7



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Ireland H91Y923

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Prima Additive

- Presenter: Mr. John Stavridis

Meeting: Public Info-day
Organiser: CTM
Location: Online
Date: 22 June 2023



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The Prima Industrie Group today

Prima Industrie is one of the world's leading groups in **laser and sheet metal working machinery, industrial electronics, laser sources and additive manufacturing**. It boasts a total annual turnover of **over €400 million** in 2021, more than 1,700 **employees** worldwide, **8 plants** on three continents, a global presence in **more than 80 countries** and over 14,000 installed systems.

The group is divided into 4 Business Units: **Prima Power, Prima Electro, Prima Additive** and **Convergent Photonics**.

- ▶ **45 YEARS**
- ▶ **23 YEARS LISTED**
- ▶ **406 €M SALES**
- ▶ **1735 PEOPLE**
- ▶ **8 PLANTS**
- ▶ **8 R&D CENTERS**
- ▶ **14,000+ INSTALLATIONS**
- ▶ **80+ COUNTRIES**



Additive is competitive

Prima Additive was born in 2018 within the Prima Industrie group. Given the specific nature of the business, the choice was to create a separate business unit from the existing ones. Prima Additive has managed in a short time to present itself on the market.



What do we do



We create **industrial systems for metal additive manufacturing** with two different technologies based on the use of lasers: **Powder Bed Fusion** and **Direct Energy Deposition**.

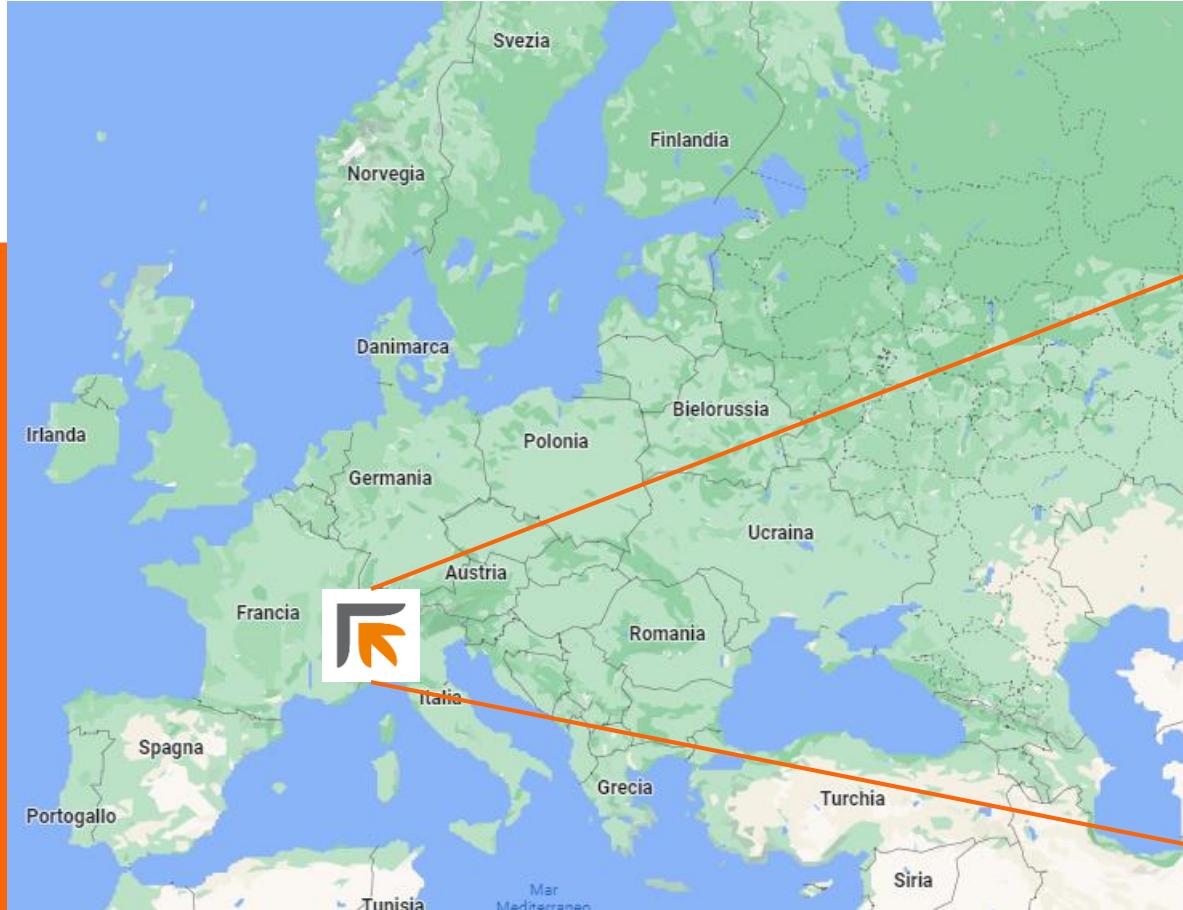
In addition to the machines, we provide **consultancy and support** to our customers, accompanying them throughout the process of adopting the technology in their production context: from design optimization to the choice of materials, to the study of the business case up to the choice of most suitable machine.

Where we are

Prima Additive has the Headquarter in Torino (Italy) in the same site of Prima Industrie S.p.A.

In the headquarter are located the R&D departments, the application groups and all the administrative offices.

The operational headquarter is in Solbiate Olona (Italy), close to Milano.



SS 24 Via Torino – Pianezza 36 B, 10093 Collegno (TO), Italy



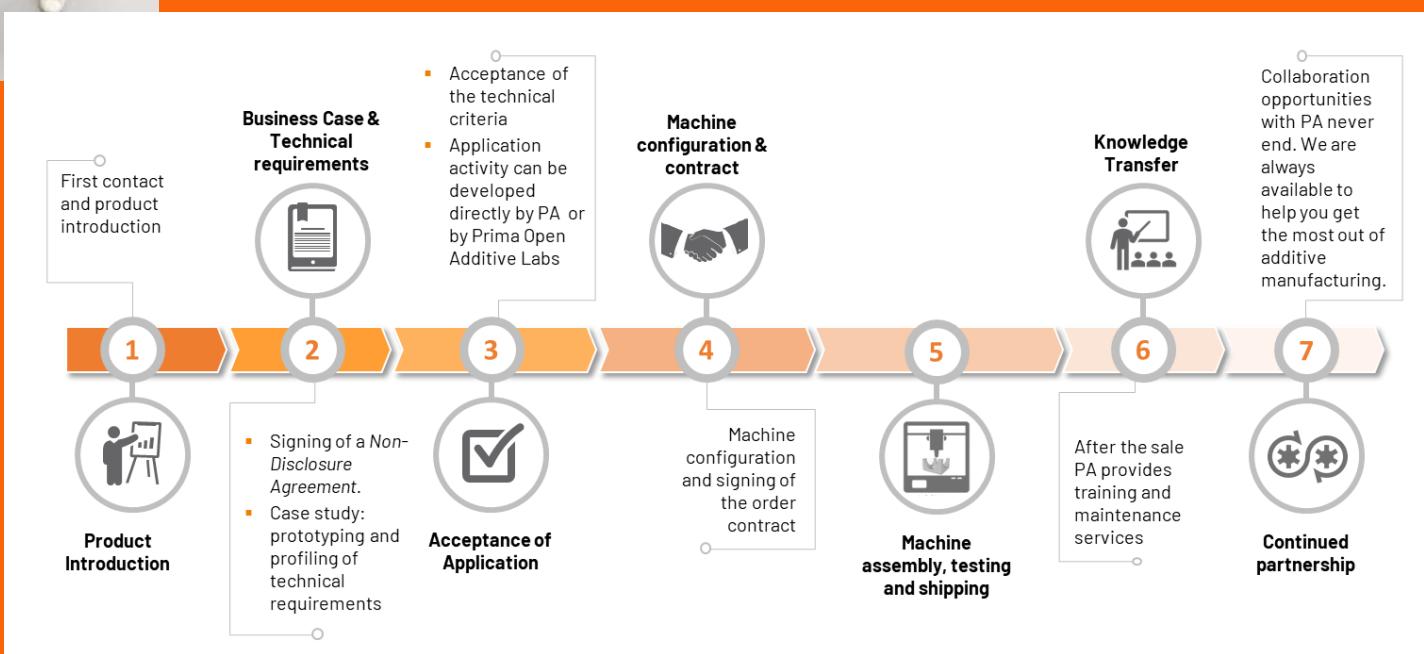


Application driven

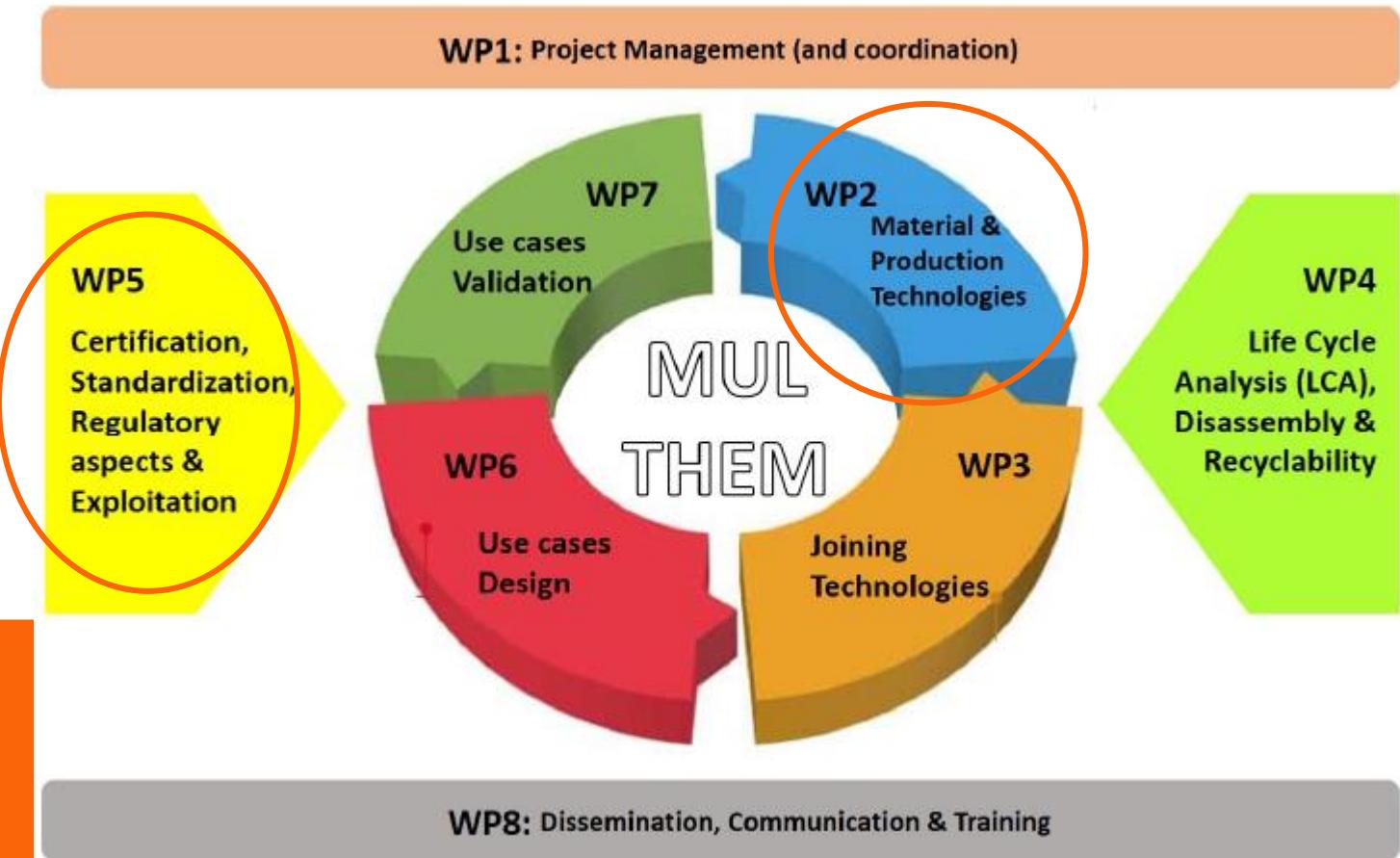
Additive manufacturing today is still predominantly **application-driven** and the key factor for its adoption is the **validation of applications**. One of Prima Additive's strengths is the ability to **support its customers** in understanding whether additive manufacturing is the right solution for them and **how to make the most of this technology**.

Technology focused

Constant research on development of new processes and complex solutions to satisfy the requirement of the industrial market.



MULTHEM project



- Selection of the material for the realization of metal parts of case studies with LMD technology.
Optimization of the process parameter for the metallic base
- Collaboration with expert of polymeric compounds
- Coordination for the certification and standardizing of production process



THALES RESEARCH AND TECHNOLOGY

- Presenter: Dr Gabriel FOYER



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Multi Material Additive Manufacturing for
Lightweight and Thermal Management



Meeting: Public Info-day
Organiser: CTM
Location: Online
Date: 22 June 2023



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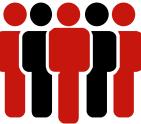
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London

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Over **77000***
employees



* Excluding ground transportation

€1 bn 
Self-funded R&D**

** Does not include externally financed R&D

68
Countries
Global presence



Sales in
2022
€17,6 bn



From the Bottom of the Oceans... to the Depths of Space & Cyberspace



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- A worldwide network

5 TRT France, UK, Netherlands, Canada, Singapore	400 R&T staff	50 PhD students
20% of Group R&T activity	7 joint labs	

- Excellence
 - External recognition
 - Senior experts
- Partnerships
 - Embedded at the heart of innovation ecosystems
 - Joint laboratories
- High visibility
 - Strongly present within national & European R&D networks



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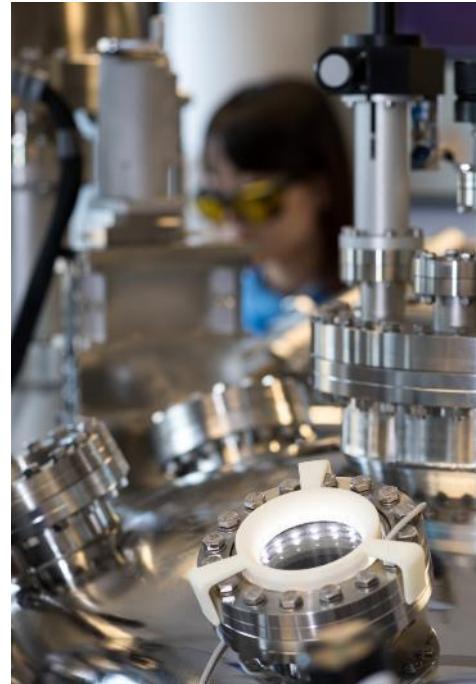
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A key role for THALES

- Identification of technological breakthroughs which can impact future business of Thales
- Development of key technologies (advanced materials, devices and concepts)
- Implementation of functional demonstrators (jointly with Thales GBUs)



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Research areas - Technology and Materials

- Materials Modelling & Engineering
- Materials Chemistry
- Micro & Nano Technologies
- Energy & Thermal Management
- Smart Optics & Photonics
- Antenna & Novel RF Concepts
- Multi-Scale & Multi-Physics Modelling
- Failure Analysis
- Reliability Assessment
- Heterogeneous integration



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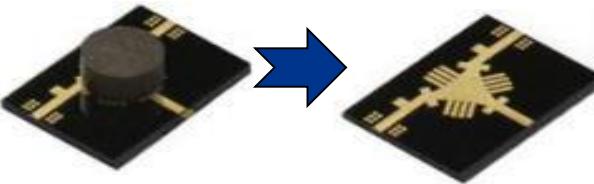


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Research topic examples

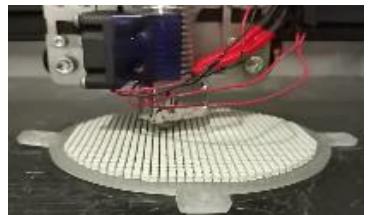
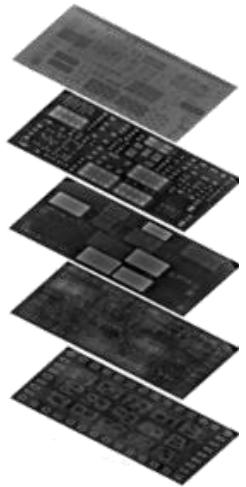


Optical design
concepts for
SMART OPTICS

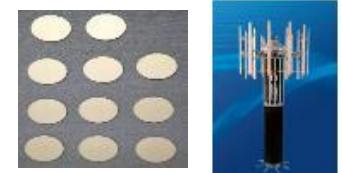


Novel RF concepts
for future T/R
Modules

Expertise in
Advanced
characterization
& Reliability



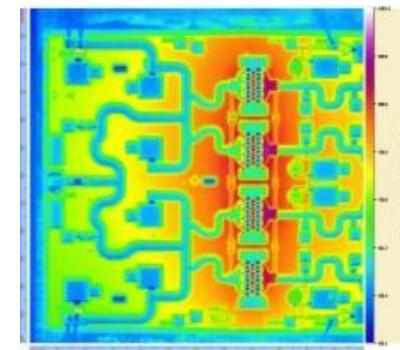
Lead-free ceramics for
SONAR applications



New Antenna concepts for
SATCOM applications



Advanced Packaging for Size,
Weight and Power
optimization



Material Engineering for energy
storage & thermal management

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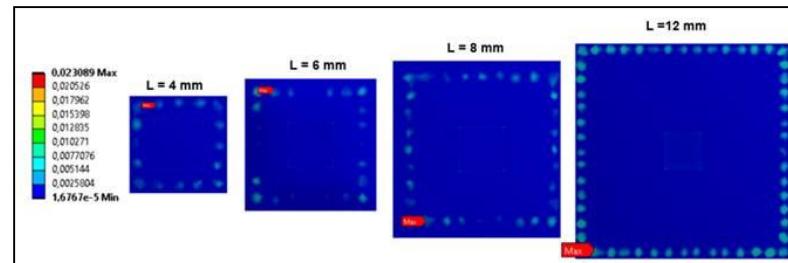
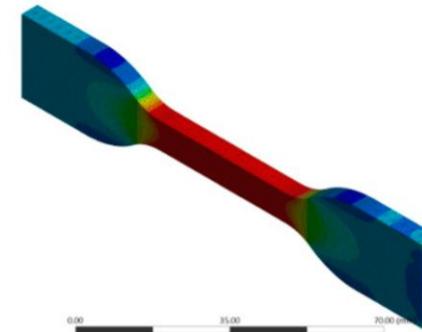


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Material & Production Technologies

- Nanomaterials development (thermally conductive thermoplastic filaments)
- Thermal characterization
- Thermo-mechanical modeling of 3D printed composites



Design of experiments by simulation



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Joining technologies

- Thermal interface optimization and characterization
- Development of thermal interface models for design
- Durability under thermal cycling



Thermal interface resistance analyzer



Thermal cycle chamber



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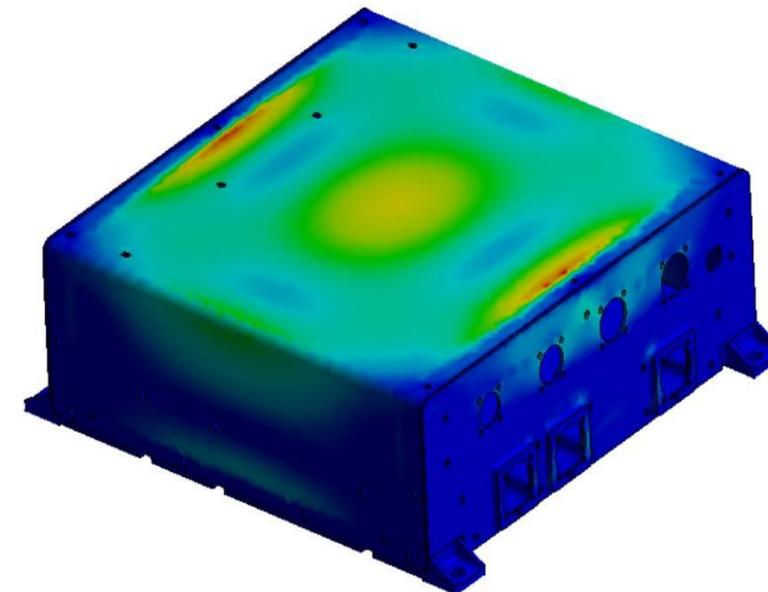
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- Use case : Casing of electrical power converter



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Thank you

Presenter: Gabriel FOYER (THALES)

gabriel.oyer@thalesgroup.com



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Brunel University London

- Presenter: Dr Eujin Pei

Meeting: Public Info-day

Organiser: CTM

Location: Online

Date: 22 June 2023





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- About Brunel University London
- Our Location
- Our Research Areas
- The Research Team
- Main Activities in MULTHEM



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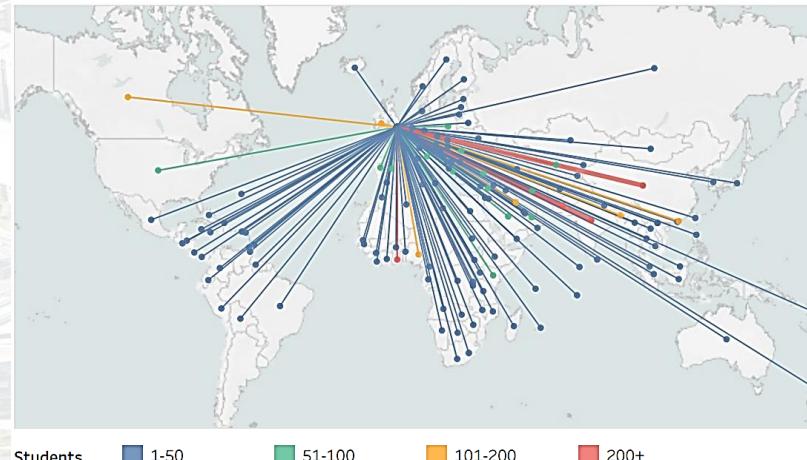
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Founded in 1966 and named after the Victorian engineer Isambard Kingdom Brunel. In June 1966, Brunel College of Advanced Technology was awarded a royal charter and became Brunel University London.

Countries represented by Brunel Students



Population Characteristics

Staff	Students
51%	49%
44%	56%

Student numbers

International students	Countries represented by Brunel students
8,034	151



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A dynamic institution of over 18,000 students and 2,500 academic staff operating in a vibrant culture of research excellence. The institution comprises of three colleges and five Specialist Research Institutes.



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Society



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Institute of Health,
Medicine &
Environments

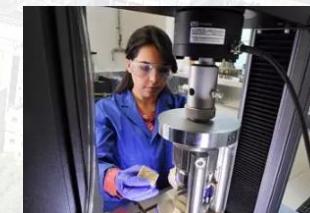


Institute of Energy
Futures



Institute of Materials
& Manufacturing

Education and student experience
Our students will be taken to the cutting edge of their subject through research-led teaching and experiential work-based learning



Our research
Our research will focus on those areas in which we can integrate academic rigour with the needs of governments, industry and the not-for-profit sector



Global impact
We will build strategic partnerships with overseas universities and businesses to expand our research and education, and deliver impact through knowledge transfer



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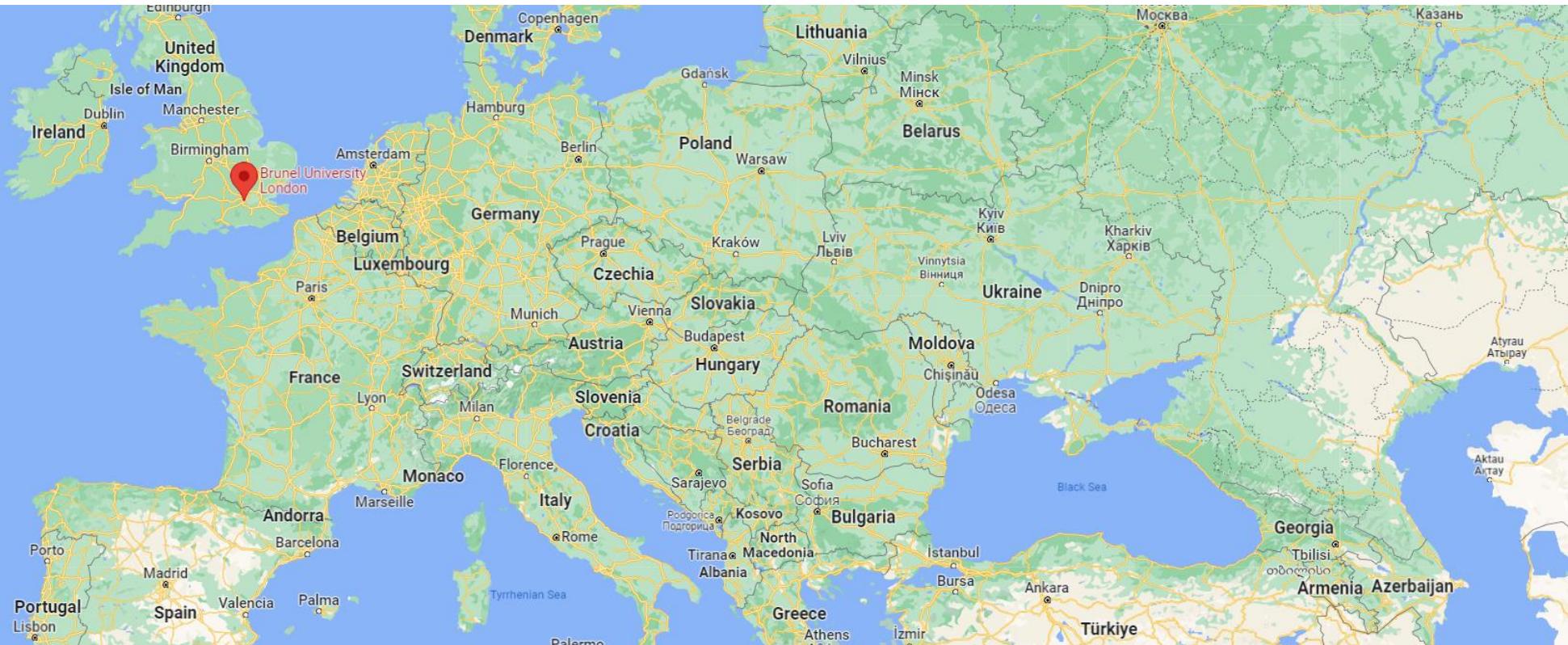
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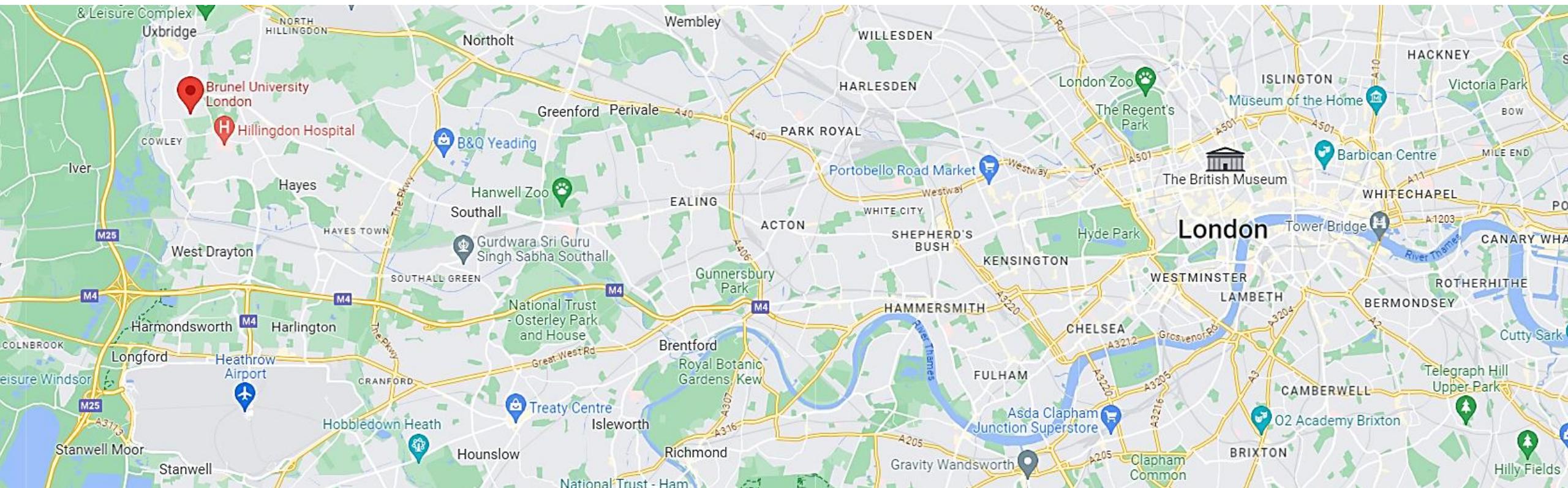
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Biography - Eujin Pei



- Associate Dean for College; Director, Product Design Engineering at Brunel University London;
- Convenor, International Organization for Standardization ISO/TC261/WG4 for Additive Manufacturing Data and Design;
- Chair, British Standards Institute AMT/8 National committee for Additive Manufacturing, UK;
- Editor-in-Chief, Progress in Additive Manufacturing Journal (SpringerNature)





Biography - Eujin Pei

- Became interested in Additive Manufacturing since **1997**: Produced my first Vat Photopolymerization (VP) prototype in 1997.
- Research focus on Design for Additive Manufacturing (**DfAM**) and on 4D Printing
- Teaches Product Development

Antenna fastener

Internal battery housing

Hi-resolution logo

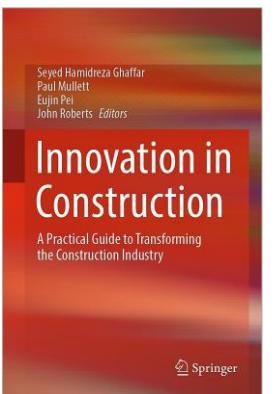
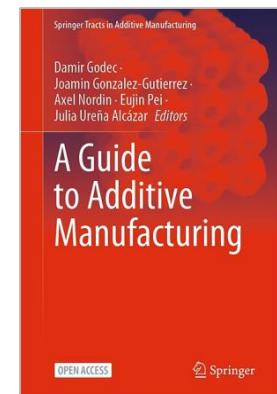
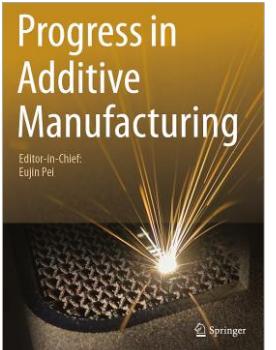
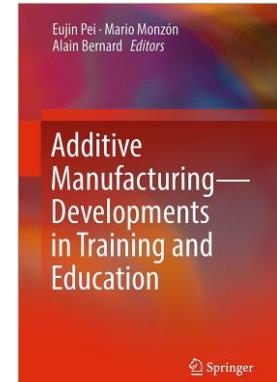
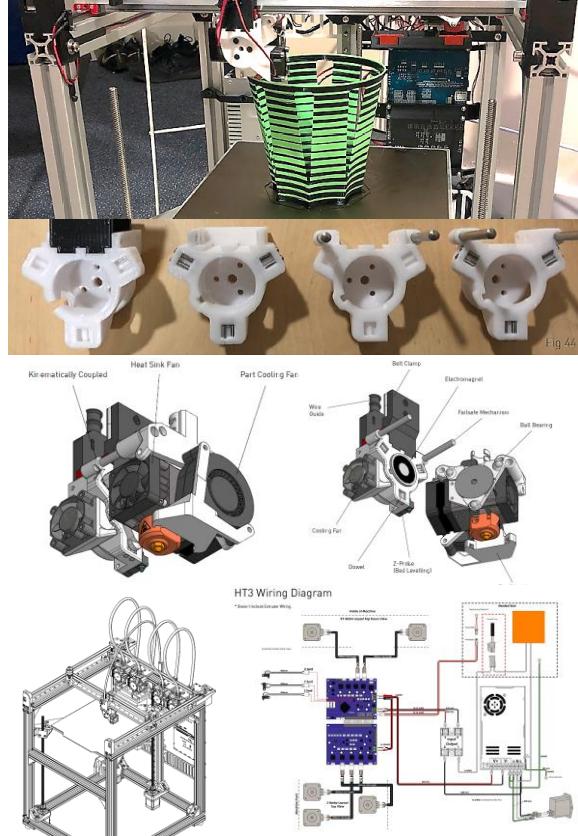
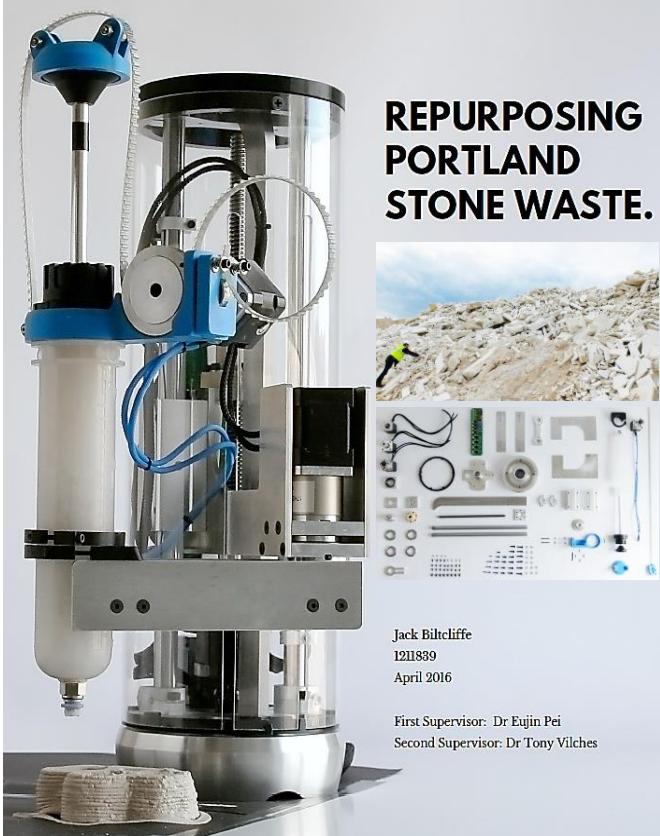
Three part assembly

Outer battery casing





Our Research Group





Involvement in Standards

International Organization for Standardization ISO TC261/WG4 meeting - 14 July 2015 in Berlin, Germany





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ISO Standards About us News Taking part Store

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ISO/ASTM TR 52912:2020

Additive manufacturing — Design — Functionally graded additive manufacturing

Abstract

[Preview](#)

The use of Additive Manufacturing (AM) enables the fabrication of geometrically complex components by accurately depositing materials in a controlled way. Technological progress in AM hardware, software, as well as the opening of new markets demand for higher flexibility and greater efficiency in today's products, encouraging research into novel materials with functionally graded and high-performance capabilities. This has been termed Functionally Graded Additive Manufacturing (FGAM), a layer-by-layer fabrication technique that involves gradually varying the ratio of the material organization within a component to meet an intended function. As research in this field has gained worldwide interest, the interpretations of the FGAM concept require greater clarification. The objective of this document is to present a conceptual understanding of FGAM. The current-state of art and capabilities of FGAM technology will be reviewed alongside with its challenging technological obstacles and limitations. Here, data exchange formats and some of the recent application is evaluated, followed with recommendations on possible strategies in overcoming barriers and future directions for FGAM to take off.

General information

Status : Published Publication date : 2020-09
 Edition : 1 Number of pages : 27
 Technical Committee : ISO/TC 261 Additive manufacturing
 ICS : 25.030 Additive manufacturing

BSI Standards Publication

Additive manufacturing — Design — Functionally graded additive manufacturing

PD CEN/TR/ISO/ASTM 52912:2020
 ISO/ASTM TR 52912:2020(E)

TECHNICAL REPORT

ISO/ASTM TR 52912:2020(E)

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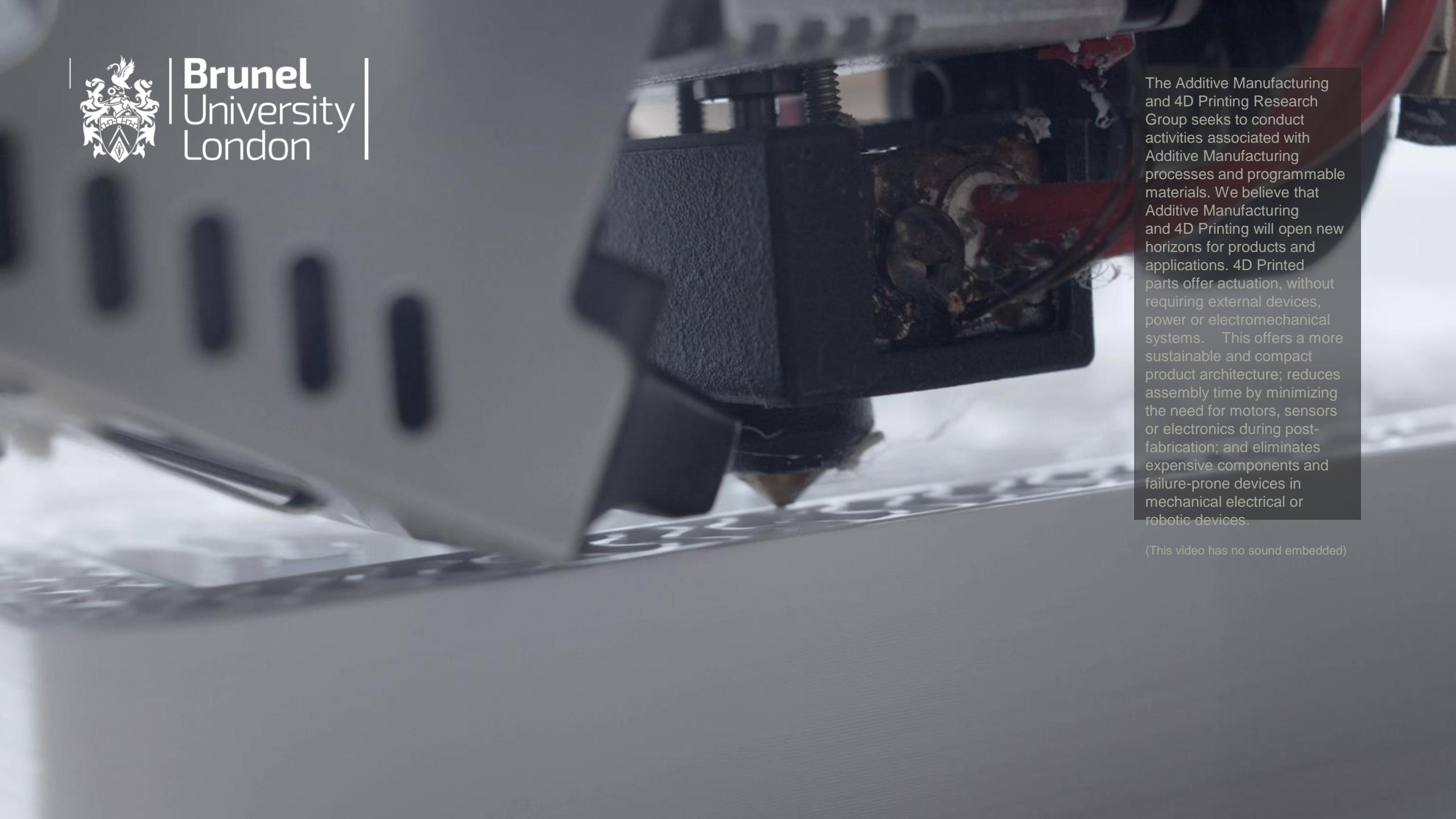
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The Additive Manufacturing and 4D Printing Research Group seeks to conduct activities associated with Additive Manufacturing processes and programmable materials. We believe that Additive Manufacturing and 4D Printing will open new horizons for products and applications. 4D Printed parts offer actuation, without requiring external devices, power or electromechanical systems. This offers a more sustainable and compact product architecture; reduces assembly time by minimizing the need for motors, sensors or electronics during post-fabrication; and eliminates expensive components and failure-prone devices in mechanical electrical or robotic devices.

(This video has no sound embedded)

Main Activities in MULTHEM - Leader for WP8



- To formulate a Communication, Exploitation & Dissemination Plan (T8.1);
- To implement and carry out the planned activities regarding communication and dissemination (T8.2);
- Developing suitable methods and utilizing effective tools to deliver consistent and regular communication of the project, leading to meaningful dissemination with a viable exploitation strategy including a hackathon (T8.3);
- To exploit outcomes of this project and seek collaboration with other relevant EU projects that are closely aligned to the scope of MULTHEM (T8.4).



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Manufacturing - Linares, Jaén - 146 followers

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Posts

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Great minds at work! Today, **MULTHEM** partners discussed key activities related to the Work Packages for materials, design and processes. We didn't forget the importance of sustainable solutions and we included the need to consider 'disassembly' in our discussions! The development of this work plan has been useful to continue with our **MULTHEM** partnership. #MULTHEM #additivemanufacturing #bruneluniversity #3dprinting #composites #carbonfiber #carbonfibre

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Eujin, explore relevant opportunities
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Today, Marta Álvarez Leal, coordinating **MULTHEM**, discussed about our planned General Assembly meeting coming up in summer. Some of us will be attending "LightMe", an International Conference on Lightweight materials. Will you be ...see more

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MULTHEM Partners involved in the 'design' of industry use-cases met today to discuss proposed tasks and activities. We folded our sleeves and had a good brainstorming session. Watch this space to see how our use-cases will un ...see more

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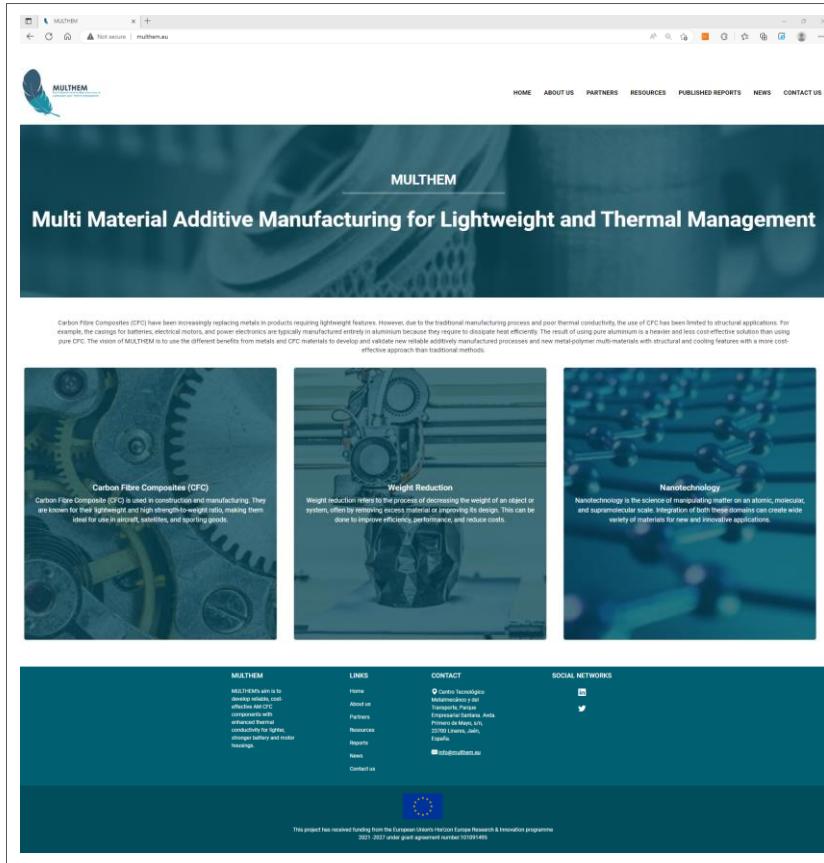
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Main Activities in MULTHEM - Leader for WP8



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Thank you

Presenter: Eujin Pei / BUL



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