

### Foreword by Coordinator



It is a pleasure for me to take over from Arnaud Witomski to coordinate this project. I thank him warmly for the constitution of this consortium and the driving he has done brilliantly during the first year. I am aware of the magnitude of my task, but will do my best to ensure that the project achieves the ambitious goals we have set ourselves.

Since the previous letter, we have organized three meetings; the six-month consortium meeting was organized by GKN Sinter Metals in Radevormwald (Germany), which allowed the consortium to visit a pioneering site in Europe in terms of additive manufacturing from metal powders. The 9-month meeting was organized by telephone with the WP leaders. The 12-month review meeting was held at Renishaw, a Laser Powder Bed Fusion machine producer, at Stone (United Kingdom); for several partners it was the opportunity to discover a nugget developing machines and associated software in constant improvement with a declared desire to reduce the environmental impact.

In this second edition of our letter, we decided to present the demonstrators that were selected during this first year of the project.

**Dr Thierry Baffie**  
SUPREME project coordinator

### Introduction

SUPREME aims at optimising powder metallurgy processes throughout the supply chain. It will focus on a combination of fast growing industrial production routes and advanced ferrous and non-ferrous metals. By offering more integrated, flexible and sustainable processes for powders manufacturing and metallic parts fabrication, SUPREME enables the reduction of the raw material resources (minerals, metal powder, gas and water) losses while improving energy efficiency and thus carbon dioxide emissions, into sustainable processes and towards a circular economy. To achieve this goal an ambitious cross sectorial integration and optimisation has been designed between several powder metallurgy processes; gas and water atomisation as well as ball milling for metal powder production, laser based additive manufacturing and near-net shape technologies for end-parts fabrication. A consortium of 17 partners has been gathered on this purpose under the coordination of the Commissariat à L'Energie Atomique et aux Energies Alternatives (CEA), France. The Supreme Project kicked off on 21 September 2017 with a meeting taking place in Brussels.

### The SUPREME Consortium

The Supreme Consortium sees a mixture of organisations covering the full value chain from mineral to end parts applications: Atomising Systems Ltd (United Kingdom), CEA (France), Centro Ricerche Fiat (Italy), Dellas Srl (Italy), European Powder Metallurgy Association (Belgium), GKN Sinter metals (Germany), Innovation Plasturgie Composites (France), IRIS (Spain), MBA Incorporado SL (Spain), MBNnanomaterialia (Italy), Outotec (Finland), Prismadd (France), Prodintec (Spain), Renishaw (United Kingdom), RHP Technology GmbH (Austria), Tecnalía Research and Innovation (Spain) and TWI Ltd (United Kingdom)



## Promotion

The Supreme Project, has continued to be promoted through EPMA events and by other consortium partners gathering much attention for the progress of the project. Promotional materials were available at several international exhibitions that EPMA have exhibited at such as MACH, Birmingham, Titanium Expo, Seville and Medtech in Germany.

Dr Olivier Coube has also promoted the Supreme Project at the 'Systematic Approach to Quality Seminar' in Seville in May to over 30 delegates as well as during his special EuroAM Meeting in Lubeck in May in which 22 delegates were in attendance.



EPMA's Andrew Almond at MEDTec 2018 in Stuttgart

## Supreme Review Meetings

The T0+6 review meeting was held on the 24 & 25 April 2018 at GKN Radevormwald, Germany. The meeting proved highly beneficial to all the partners in attendance with discussion concerning future progressions and work packages.

The meeting was concluded by an interesting tour of the GKN site.



Participants of the T0+6 meeting at GKN

The T0+12 review meeting was held on the 25 September at Renishaw, UK.

In the T0+12 meeting the progress of the different work packages was reviewed and technical workshops organised in parallel between the lead beneficiaries. At the end of the meeting, a RENISHAW site tour and software demonstration were organised.



Participants of the T0+12 Meeting at Renishaw

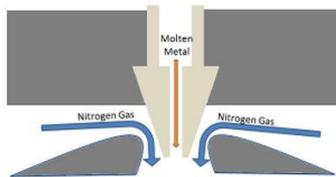
## Demonstrator Update

The overall objective of SUPREME is to optimize ferrous and non-ferrous metal PM processes, currently individually available at TRL7 and beyond, by cross-sectorial improvements in material and energy efficiency throughout the value chain, from raw materials (fluids, solids or gases, including minerals and water) to finished products in a range of different end-applications (automotive, cutting tools, aeronautics, medical and tooling). The goal is then to demonstrate a new integrated and optimized approach of a set of PM production routes in real industrial settings, from TRL5 to TRL7, i.e. ready for adoption on the PM market. This will enable a significant reduction in the total cost breakdown as well as in the environmental footprint towards a more sustainable industry, and therefore to reinforce PM industry competitiveness in Europe to maintain and develop jobs.

The SUPREME project is covering the whole value chain from raw material extraction to end-user demonstrators. For each step, a demonstrator has been selected, in order to demonstrate the savings (energy, fluids and raw materials) achieved during the project (Figure 1).

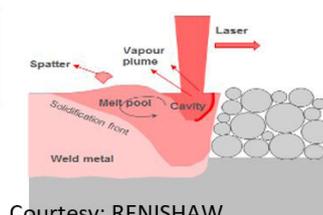


Demonstrator #1 on a mine site



Courtesy: ASL

Demonstrator #2 in an atomization plant



Courtesy: RENISHAW

Demonstrator #3 on L-PBF machine



Demonstrator #4 on an automotive part

Figure 1: A demonstrator planned at each step of the value chain

Demonstrator #1 targets the minerals extraction efficiency improvements; it will be located on a mine site and will monitor three steps of the process: Fe-ore grinding, Fe-ore flotation and water management (Figure 2a). Demonstrator #2 targets the powders manufacturing efficiency; it will be located in an atomization plant and will gather power measurement data, (Power consumption, see Figure 2b), run records (Length of run, mass of powder), PLC (Nitrogen consumption) and powder analysis (Powder size). Power Consumption per kg of different cuts, power used to produce N2 gas and comparison between water-atomised and gas-atomised will be also monitored.

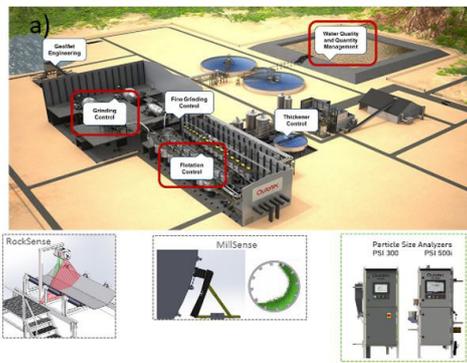


Figure 2: Demonstrators on a) Mine site; b) Gas Atomisation plant and corresponding powder

Demonstrator #3 targets the L-PBF manufacturing process efficiency; it will be located on a high power laser machine and will allow measuring the increase in L-PBF productivity, thanks to upgraded optics, new scan strategy, automatic powder removal system, new waste management and AM production system model (Figure 3a). Data from powders re-use study will also be taken into account.

Demonstrator #4 targets the savings (energy & resources) given for each application covered by the project industrial partners; demonstration on a Hard-Carbon steel automotive part will consist of comparing Key Process Indicators (KPI) obtained from L-PBF process to the KPI of traditional processes and determine the gain percentage (Figure 3b).

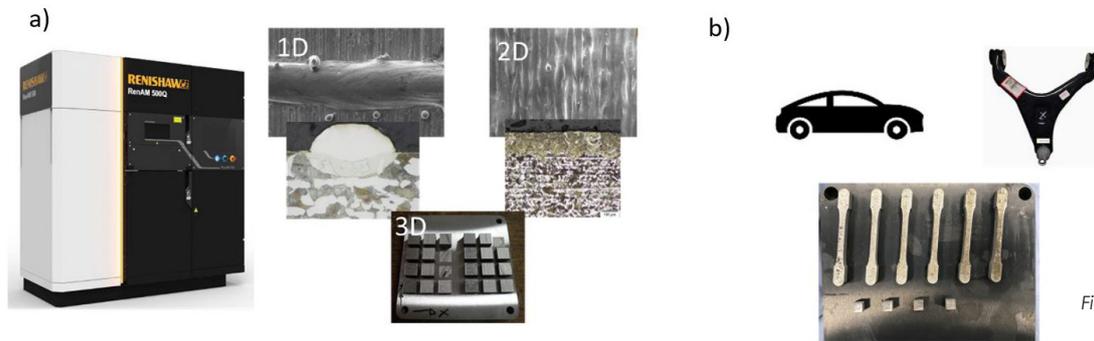


Figure 3: Demonstrators on a) L-PBF machine and b) Automotive part

## Meet the Demonstrator partners

### ASL

Atomising Systems Limited (ASL) specialises in the technology of powder or granule production by the atomisation of melts. Established in 1992, the company and its founder have 40 years' experience of the technology and have delivered more than 140 plants for metal powder atomisation in 35 countries across six continents.

ASL not only builds plant, but operates gas and water atomisers in its comprehensive powder production facility in Sheffield, England, with capacities of:

- 2000t/annum water atomising
- 600t/annum gas atomising
- 30kg batch R+D atomisers

All of these is serving niche markets.

This gives ASL an unrivalled practical experience of plant operation and the ability to train our client's operators in-house, from melting to packing, including safety, environmental protection, etc. Working in close partnership with our customer and listening to them allows ASL to respond to their requirements by supplying tailor-made solutions.

This wide experience, supported by continuous investment in R&D, makes ASL the leading supplier of atomising technology and equipment to the global metal powder industry, with an unrivalled range of technologies, equipment sizes, and powders produced.

With its experienced technical team, ASL offers a range of services from contract R&D and consultancy through to turn-key systems, often with innovative high efficiency solutions.

Atomising Systems Limited has a comprehensive range of atomising equipment to provide a very flexible special powder service. A 200 kilo melt size atomiser with ASL's Anti-satellite and Hot Gas technology allows the production of free flowing high quality gas atomised powders, servicing a wide range of industry sectors. Water atomising systems produce lot sizes between 30 and 750 kilos. Smaller system produces powder for Dental, precious metal and specialised trial production. The larger water atomising system produces a range of powders for the PM and other industry sectors. Other atomising technology such as Centrifugal and Ultrasonic atomisation can be utilised to benefit specific industry sectors.

### GKN

GKN Powder Metallurgy is a full metal shapes solutions provider, shaping powder metal into high performance and high precision components. GKN provide leading powder metal expertise and process experience to transform ideas into production. The company consists of GKN Hoeganaes, GKN Sinter Metals, and GKN Additive to provide powder materials, conventional components, and Additive Manufacturing production. We combine three focused businesses under one brand. Together we are over 7,400 problem solvers over 34 locations, setting our global engineering network at the highest standard.

## Meet the Demonstrator partners (continued)

### GKN Sinter Metals Engineering GmbH, Radevormwald

Advanced Engineering is a central service function within the GKN Powder Metallurgy division and part of GKN Sinter Metals Engineering. Besides the Development of enabling technologies and equipment to keep our competitive edge the department covers various research topics focusing on material, product and process. An excellent network with GKN operations, Hoeganaes Corporation joining in powder development projects, other GKN divisions as well as external institutes, suppliers and customers helps to face global challenges. Furthermore, Advanced Engineering covers a lot of central functions and services such as laboratory investigations; FEA, modelling and simulation, components testing as well as IP management. The European Advanced Engineering is situated at the GKN Sinter Metals InnovationCenter at Radevormwald in Germany. The Advanced Engineering Laboratory Radevormwald provides support for a large variety of investigations. The modern equipment includes SEM with EDX, chemical analysis, mechanical testing, metallography and microscopy.

The research group of Additive Manufacturing is the strongest department in Advanced Engineering. Machines of three different machine builders in the area of selective laser melting and two machines in binder based powder bed technique are available for development tasks. At the InnovationCenter in Radevormwald, GKN Sinter Metals Engineering GmbH works. Main scope of work is on process development, and material development for LPBF and Binder jetting systems based on customer applications. Furthermore, there are engineering capacities regarding functional Design for AM, Topology optimization and FEM Simulation available. Analysis of static-mechanical and fatigue properties within an inhouse laboratory provide a high understanding of various materials and enables an evaluation of material behaviour within future application.

### Outotec

Outotec provides leading technologies and services for the Sustainable use of Earth's natural resources. As the global leader in minerals and metals processing technology, we have developed many breakthrough technologies over the decades for our customers in metals and mining industry. We also provide innovative solutions for industrial water treatment, the utilization of alternative energy sources and the chemical industry. Outotec ranked 3rd on the 2016 Global 100 Most Sustainable Corporations in the World (Global 100) Index. Outotec shares are listed on NASDAQ OMX.

Outotec has developed and supplied state-of-the-art process equipment, on-stream analyzers and automation systems for grinding and flotation circuits of concentrators since late 1960s. The company is both a market and a technology leader with more than 10 000 flotation

machines and 800 on-stream analyzer systems installed around the world. As mine project feed capacities have increased during the decades the company has followed the market trends by delivering larger flotation machines and applying advanced control systems to control more complex grinding and flotation circuits. Outotec has been in forefront by publishing recently 500 m3 TankCell in 2012 and 630 m3 TankCell in 2014. Outotec has capability to combine know-how in processes, equipment, instruments and software and achieve resource and energy efficiency targets set out in this project. Outotec has also a long history of research collaborations with university partners worldwide, especially in plant design and process automation.

### Renishaw

Renishaw is one of the world's leading engineering and scientific technology companies, with expertise in precision measurement and healthcare. The company supplies products and services used in applications as diverse as jet engine and wind turbine manufacture, through to dentistry and brain surgery. It is also a world leader in the field of additive manufacturing (also referred to as metal 3D printing), where it is the only UK business that designs and makes industrial machines which 'print' parts from metal powder.

The Renishaw Group currently has more than 70 offices in 33 countries, with around 4,000 employees worldwide. Around 2,600 people are employed within the UK where the company carries out the majority of its research and development and its manufacturing.

### CRF

CRF, founded in 1978, has the mission to develop and transfer innovative products, processes and methodologies in order to improve the competitiveness of the products of the FCA. Also through the cooperation with a pan-European and increasingly global network of more than 1700 partners from Industry and academia, CRF conducts collaborative research initiatives at the national and international levels in partnership with all the key public and private stakeholders concerned with Sustainable Mobility, targeting specifically the industrial exploitation of research. CRF develops research and innovation along the three principal axes of sustainability: Environmental Sustainability, which encompasses all aspects relating to energy efficiency as well as to the reduction of the impact on the environment over the entire lifecycle of the vehicle; Social Sustainability, focusing on the safety of transportation systems through the development of active, passive, preventive and cooperative solutions while addressing the mobility of all users irrespective of their specific needs; Economically sustainable competitiveness, oriented towards viable innovation, i.e., improving the performance and functionality of new vehicles in a cost-effective manner.

For further information on the SUPREME project please contact Sabine Hazoumé at EPMA on [sh@epma.com](mailto:sh@epma.com) or the project leader Dr Thierry Baffie at CEA at [thierry.baffie@cea.fr](mailto:thierry.baffie@cea.fr) or visit the website at [www.supreme-project.com](http://www.supreme-project.com)



This project has received funding from the European Union Horizon 2020 Programme (H2020) under grant agreement no. 78612