Specifications of pilot demonstration of WP2

Author: Lexuri Vázquez, PhD. LORTEK

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Outline

INTRODUCTION

The Work Package 2 (WP2) of the ADDISPACE project with Title: *Demonstrative pilot project of additive manufacturing technologies transfer in SMEs of the aerospatial sector* has the aim to develop and fabricate 4 pilots to transfer the AM technologies through SMEs of the aerospace sector in the SUDOE. In the Activity 2.1: *Terms of reference: specifications and pilot experiences,* LORTEK proposed a method and template for the definition of the specifications of these pilots.

OBJECTIVE

The main objective of this document is to compile all the specifications of each pilot that will be developed in the frame of the WP2 of the ADDISPACE project.

DESCRIPTION

Terms of Reference provides a clear description of the type and amount of work to be done in a project. In this sense, objectives, work planning, timeline, committee, relationships between stakeholders, reporting requirements, expected results and other critical information are specified.

This document compiles all the information for the development of each pilot by the responsible group of each pilot.

WORKING GROUPS

Before the definition of the pilots, 4 working groups were defined with a leader in each one. Each pilot has to be transnational: one or more centres and SMEs of more than one SUDOE regions. Table 1 shows the working groups of the pilots.

Table 1. Working groups with technology and leader of each group.

Pilot	1	2	3	4
Technology	SLM	LMD powder	LMD wire+powder	SLM optimization
Leader	**FADA CATEC**	**IPLeiria**	**ESTIA**	**LORTEK**
Participants	IPLeiria	ESTIA	LORTEK	FADA CATEC
	MICRONORMA	GNC	VLM	ADIRA
		ADIRA		

PILOT SPECIFICATIONS

In this section the detailed specifications for the development of each pilot are shown.

Pilot 1

Name of pilot:

SLMilling

Participants:

- FADA-CATEC (Leader of the Pilot)
- IPLeiria
- MICRONORMA

Component:

Aerospace fitting manufactured in Ti6Al4V. A preform of the part is shown in Figure 1

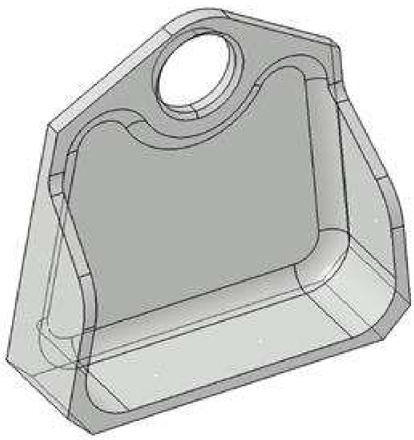

Figure 1. Target part to be redesigned built by SLM and machined.

Objective:

- Fabricate a component with SLM in Titanium 64
- Manufacturing strategy taking into account that it is going to be machined.
- Cover all the value chain of the manufacturing till final part machining.

Background:

As far as we know, there are hardly any cases of success and expertise in the field of MAM technologies where the manufacturing of the final part cover the redesign, SLM manufacturing and final milling part over the manufacturing substrate.

Relevance:

Beside the benefit in terms of weight reduction, novel design and delivery time, this application will be very interesting for the SMEs who are interested in technology and in offering a complete product for the aerospace sector. Particularly, strategies for interface machining will be analyzed.

Innovation and development grade:

The original part will be redesigned for Metal Additive Manufacturing applying the concept DfAM: Design for Additive Manufacturing. In this case the selected technology is SLM. It must be taken into account the fact that the part will be machined after the SLM process. It foreseen that the milling will be performed over the part which is still in the substrate, so the design and the part orientation in the build platform must be adapted to the final interfaces machining.

Territorial impact:

The main territorial impact SMEs relate with space and aeronautic sectors which considering MAM technologies as a disruptive technologies that it is and who could be interesting the investment in this technologies for increasing their manufacturing capabilities. Manufacturer of structural and engine parts and tooling will be the most interested.

Materials:

The demonstrator parts will be manufactured in Ti6Al4V alloy in powder form.

Technology and equipment:

Technology:

PBF-Powder Bed Fusion

SLM (Selective Laser Melting)

Equipment:

CATEC: Renishaw AM250 Build chamber: 250x250x300 mm

IPLEIRIA: MTT Build chamber: 125x125x125 mm

Quality requirements:

Different units will be manufactured in this pilot. The part will be subjected to different tests in order to assure the final quality.

- No visual defects (visual inspection)
- Geometry tolerances
- XCT- X-Ray computed tomography

Roles:

Redesign, fabrication, machining and quality assurance testing.

Participants and roles:

<u>FADA-CATEC:</u>

- **Part selection and design** according to SLM manufacturability and fabrication by SLM (Titanium 64) and components/structure requirements.
- **Fabrication by SLM** (Ti6Al4V). The size of the part could be adapted to the MAM systems capabilities of the Pilot 1 partners. Different alternatives of the part support strategy could be carried out according to the systems and alloys considered, and a comparative study could be perform.
- The final part would be subjected to a **XCT-Computed tomography inspection** in order to verify the final part dimensions.
- **Compilation** of the different results of each center to elaborate the report.

<u>IPLeiria:</u>

- **Fabrication by SLM** (Ti6Al4V), adapting the support strategy for their systems or knowledge according the manufacturing system set-up.

<u>MICRONORMA:</u>

- **Machining** of the final part. In the manufacturing stage, where the part orientation and support strategy is carried out, MICRONORMA will give their feedback as machining expert in order to perform the milling of the interface part surface correctly. It is foreseen that this post-process will be performed attached to the manufacturing substrate. If the part shape and requirement does not allow, the machining must be perform with other strategy.

SMEs eligibility for the *task 2.3 Viability:*

Specific technical eligibility criteria are set up for the Pilot:

Target SME	1.- Aerospace company producing metal components through conventional technologies. 2.- Aerospace company producing metal components through basic MAM technologies
Technology requirements	Conventional manufacturing capabilities (CNC) and/or MAM technologies if it is target SME no. 2.

Expected results:

Manufacturing feasibility of the redesigned part, supported by the final machining process.

One of the most expected results is demonstrating the maturity of performing the whole process compromising AM and machining process as well as the identification of different key point of the process chain and how to solve them.

Working plan

1 Part selection (Responsible: CATEC)

1.1. MICRONORMA Feedback and comment regarding the machining of the part over the substrate. Recommendation and limitation to perform the machining

2.-Part manufacturing

2.1.- Manufacturing in Titanium by SLM (CATEC)

2.2.- Manufacturing in Titanium by SLM (IPLeiria)

3.- Machining (Responsible: MICRONORMA)

4.- Part Quality Assurance (Responsible CATEC)

5.-Manufacturing compilation report (Leader: CATEC, required input by each manufacturer)

Coordination, meetings and deliverables

Problems and results of each task of design will be shared and discussed periodically with the rest of participants of the pilot in a meeting. The meetings will be scheduled and coordinated by the Leader and the MoM will be prepared and shared.

The leader will inform **monthly** about the progress to the Leader of the WP2.

PILOT 1	2017						2018											
	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
GT 2 Project demonstrative pilot of transfer additive manufacturing technologies in aerospace SMEs																		
Activity 2.1 Terms of reference: the pilot specifications																		
Activity 2.2 Industrial Research Phase[Partner responsible]																		
A2.2.1. Parts Selection [CATEC]																		
A2.2.2. Manufacturing strategy [CATEC-MICRONORMA]																		
A2.2.3. Part Manufacturing [CATEC/IPLeira/ADIRA]																		
A2.2.4. Part machining.																		
A2.2.4. Part Quality Assurance [CATEC-Ipleira]																		
A2.2.5. Manufacturing compilation report [ALL]																		
Activity 2.3. Viability study phase in companies																		

IP issues

No applicable.

Pilot 2

Name of pilot:

LMD-powder

Participants:

- IPLeiria (Leader of the Pilot)
- ESTIA
- ADIRA
- GNC Laser

Component:

A showroom aeronautic part to be manufactured by LMD/P. The part is an air intake vase dimensions (approx. 150mm on z axis) as can be observed in Figure 2.

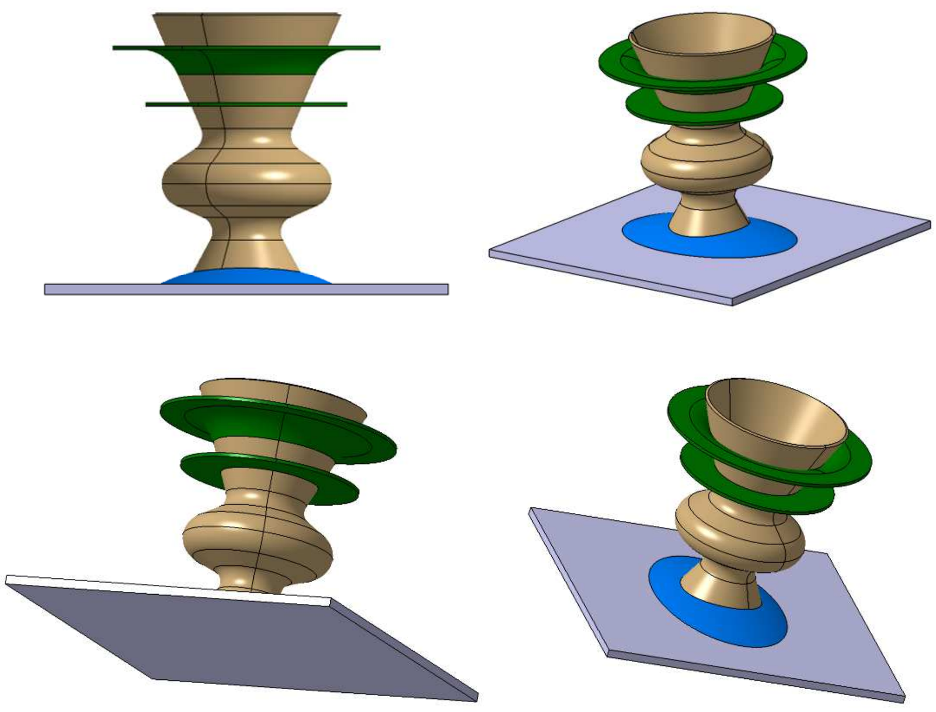

Figure 2. Aeronautic part to be built in this pilot.

Objective:

- Analysis of the entire value chain for manufacturing in LMD-Powder technology.
- Design for LMD/P, program the trajectories, manufacturing of the part (building on a surface, adding of functionalities, etc.), quality Inspection, dimensional control, NDT (tomography, ultrasounds) and visual surface inspection.
- Process experimentation with LMD/P - 3-axis from ADIRA
- Comparison between different LMD process (Time study, redesign time, setup time, manufacturing time, cost, etc.).

Background:

Currently there are few examples of the use of the MAM technologies, to build aerospace parts, as well as the knowledge to their implementation, through the technology of LMD (powder), which traverse the entire chain of production, design, LMD manufacturing process, milling and quality control (NDT tests, metallographic analysis).

Relevance:

Optimized aerospace components with new way of manufacturing (less operation, reduce price, reduce production time for the same performance) and answer the actual limitations on LMD/P manufacturing. Develop the whole the LMD technology production chain methodology applied to a component manufacturing.

Application of quality control techniques (NDT) to the components produced by LMD in order to get part certification.

These aspects can help to demonstrate the benefits and facilitate adoption of LMD technology by SME's interested in supplying components and services to the aerospace sector.

Innovation and development grade:

- Application of all value chain to aerospace metal part production using LMD technology.
- Comparison between three different LMD processing methods.
- Quality part inspection applied to MAM parts (dimensional control and NDT).

Territorial impact:

Space and aeronautic sectors and engine applications.

Materials:

Stainless Steel 316 L

Technology and equipment:

Technology:

DED - Direct Energy Deposition:

Equipment:

ADIRA: DLP (powder)

Model: Proprietary prototype

Build envelope: (3 axis) 1500x1500x200 mm (x,y,z)

ESTIA: LMD (powder)

Model: BeAM Magics 2.0

Build envelope: (3 axis) 600x800x1400 mm (x,y,z)

(5 axis) 1200 x 800 x 800 mm (x,y,z)

GNC Laser: LMD/P by robot.

FANUC Robot M-710iC50 + tilt and rotate positioner

Rofin FL 040 laser

PRECITEC YC52 125/250 90° 4 way

Quality requirements:

It will be performed dimensional tests to check the tolerances between CAD and final part. It will be also performed NDT (tomography and ultrasounds tests) to observe the internal part properties and part surface visual inspection.

Roles:

Design, manufacturing (LMD and Laser robot), machining, control inspection (dimensional control, tomography), compilation report.

Participants and roles:

IPLeiria:

- **Machining** of the final parts.
- **Dimensional control.**
- **NDT** (tomography, ultrasounds) in components made in the three machines.
- **Compilation** of the different results of each center to elaborate the report.

ESTIA:

- **Design** according DED (for ADIRA, GNC and ESTIA) manufacturability for the three machines.
- **Part build job using LMD** equipment (using the selected material Stainless Steel 316 L).

ADIRA:

- **Part manufacturing by DLP** (using the selected material Stainless Steel 316 L).

GNC Laser:

- **GNC will manufacture the part by LMD in a robot cell** (using the selected material Stainless Steel 316 L).

SMEs eligibility for the *task 2.3 Viability:*

Specific technical eligibility criteria are set up for the Pilot:

Target SME	Aerospace company producing metal components through conventional technologies. Aerospace company producing metal components through basic MAM technologies MAM company producing metal components from other industries other than the aerospace
Technology requirements	No technology requirements

Expected results:

- Manufacturing feasibility by LMD powder of the redesigned aerospace part.
- Operation reduction, reloading and adding function, manufacturing on a surface.
- Quality inspection of the aerospace parts built by LMD powder (dimensional control and NDT tomography, ultrasounds).
- Comparison between LMD powder technologies (pre-processing time, setup time, cost, properties).
- Well defined methodology for the MAM LMD/P fabrication chain (Design for MAM, manufacturing, inspection and quality analysis).

Working plan:

- Redesign for MAM (LMD powder)
- Fabrication by LMD powder
- Machining of the manufactured part by LMD
- Quality inspection

<u>GENERAL WORK PLAN OVERVIEW</u>

1. **Part selection** (Responsible: ESTIA)
   1.1. Production validation ADIRA Feedback and comment regarding the feasibility of the part production. Recommendation and limitation to perform the build job in his own prototype machine
2. **Part redesign** (Responsible ESTIA)
   2.1. Design for LMD (Responsible ESTIA)
3. **Part manufacturing**
   3.1. Manufacturing DLP equipment in Stainless Steel 316 L (ADIRA)
   3.2. Manufacturing in LMD (BeAM) equipment in Stainless Steel 316 L (ESTIA)
   3.3. Manufacturing in own integrated LMD robotic cell in Stainless Steel 316 L (GNC Laser)
4. **Manufacturing compilation report** (Leader: GNC Laser, required input by each manufacturer)
5. **Machining** (Responsible: IPLeiria)
6. **Dimensional control** and NDT tomography, ultrasounds (Responsible IPLeiria)
   6.1. Quality compilation report (Responsible IPLeiria)
7. **Comparison study**
   7.1. Between 3 LMD powder technologies (pre-processing time, setup time, cost) (Responsible IPLeiria)

7.2. Quality Compilation report (Responsible IPLeiria).

Coordination, meetings and deliverables:

A technical meeting will be scheduled by the Leader at the end of each task with MoM prepared by the Leader to be sent to LORTEK:

- End of February : Task 1
- End of March : Task 2
- End of April : Task 3
- End of May : Task 4
- End of June : Task 5
- End of July : Task 6
- End of August : Task 7

The leader will inform **monthly** about the progress to the Leader of the WP2.

IP issues:

ADIRA will use a prototype equipment in the framework of the Pilot (DLP powder, 3 axis, 1500x1500x200 mm (x,y,z)). The results of the study and manufacturing carried out in such an equipment will not be comparable to the ones developed in the commercial equipment used by other partners, so such results will remain confidential, not to be disclosed in the framework of the dissemination activities of the Pilot or with involved external entities, unless ADIRA provides explicit agreement.

Pilot 3

Name of pilot:

Large structural parts by wire deposition + Hybridization with LMD/Powder

Participants:

- ESTIA (Leader of the Pilot)
- LORTEK
- VLM

Component:

Big aeronautic structural part (>500 mm)

The selected component has been proposed by LAUAK group. The component is an original machined part from a forged titanium block. It has a high buy to fly ratio, so the manufacturing near net shape structure will reduce as much as possible the wasted material. An example of component to be manufactured can be seen in Figure 3.

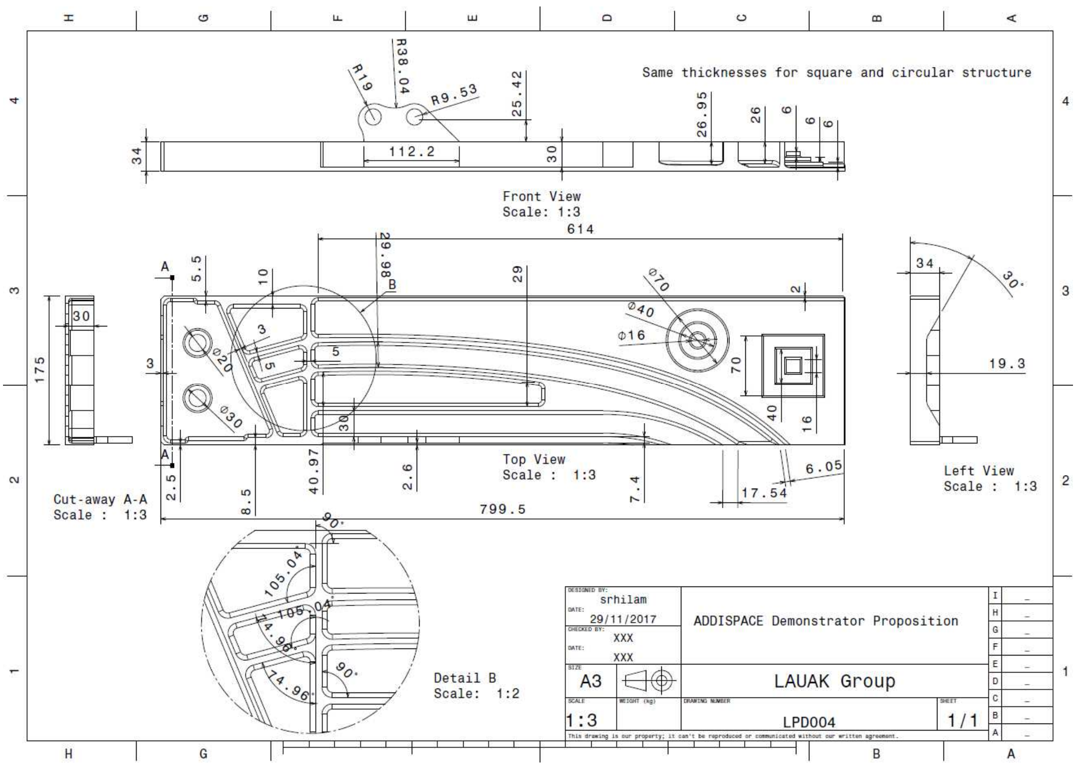

Figure 3. Plane of the demonstrator part.

Objective:

- Fabrication of a big structural aeronautic part by additive manufacturing.
- Fabrication with a robotic cell.
- Hybridization with LMD/Powder.
- Definition of control in process with a sample of the part (geometrical inspection).
- Machining of Ti64 part with a robot arm.

The goal of the project is to manufacture the selected aeronautic structural part by using different AM technologies. Due to the recent acquisition of the technologies by the partners, the first objective will be to manufacture walls, crosses, etc. to take contact with the technology and obtain the desired properties (deformation, thermal dilatation and metallographic inspection). Preliminary trials will be performed with Stainless steel 316L to define the best strategies before starting with Ti64. After that, the next goal will be to manufacture the definitive part chosen by the partners with the desired properties.

Reduce the machine cycle time by up to 40 % by the reduction of the buy to fly ratio.

The second goal is the development of an inert atmosphere chamber between Lortek and ESTIA-Addimadour. It has been proposed a collaboration for designing and manufacturing an inert chamber in order to be able to build the proposed Ti64 part. ESTIA is currently in charge of designing a little inert chamber to allow the deposition of Titanium. The size of manufacturing part is about 300x300x230 mm. LORTEK has already a little inert chamber of 250x150x150 mm. If these inert chambers allow the deposition, LORTEK and ESTIA may consider using similar processes with bigger dimensions: 900x900x600 mm. LORTEK is also regarding a trailing process for the inert chamber.

Background:

The selected pilot will respond to the need of reducing the lead time of the aerospace structural “big” parts from 55-75 weeks (typical for conventional manufacturing) to 5 weeks.

In the same way, the needed material for manufacturing the part will be drastically inferior, improving the buy to fly ratio from 16:1 in current machined parts form a block, up to 1.5:1 with the wire AM.

Seeing the difference in the Buy to Fly ratio, the reduction of the machine cycle time up to 40 %.

Relevance:

Reduce the lead time of the components from up to 75 weeks to 5 weeks, reducing the risk of the investment, the stocks and the uncertainty that the long lead times brings. In the same way, the short manufacturing period and investment in tooling will allow faster redesign of the components.

By reduction on manufacturing lead time, the design freeze time will be increased, giving much more time for the design and optimization of the component.

In the same way, the material wasted will be reduced by a factor up to 10.5, reducing a lot the investment in the material, and simplifying its recycling.

It does not have to be necessarily a costumer component, but a technological demonstrator to show the solution to the current problematic.

Innovation and development grade:

- Control in process for geometrical inspection.
- Machining a titanium part with robot.
- Process robotization.
- Development of an inert gas chamber dedicated to robotic cells.
- Geometrical constraints: crosses, variable thickness, big size with thermal dilatation, reloading of material, inerting, machining.
- Manufacturing a big part >500mm in titanium.
- If possible, hybridization of the technologies (CMT and LMD/P).
- Reduce considerably the Buy to Fly ratio.

Territorial impact:

Due to the big amount of companies (tier 1) related with the design and production of structural parts in the territory, the development of the knowhow and a posterior transfer will bring them strategic advantage. The part we will develop on this pilot will be a demonstrator that will show the advantages of Wire & Arc Additive Manufacturing in comparison with machining. This demonstrator is a general typical component which the geometry, the material and the size are similar to many structural parts of an aircraft.

Materials:

The selected material for the final part will be Ti6Al4V. Preliminary trials will be performed with Stainless steel 316L to define the best strategies before starting with Ti64.

Technology and equipment:

- CMT Fronius TransPuls Synergic 3200 (ESTIA).
- Fronius TransPlus Synergic 4000 CMT R (LORTEK).
- Machine BeAM Magic 2.0 (LMD/P) (ESTIA).
- Protective chambers of 900x900x600 mm to be designed and manufactured (ESTIA & LORTEK).
- CMT, process control technology and machining robotic cell (VLM).

Quality requirements:

Once we manufactured the part with wire deposition manufacturing, we could compare the geometry with geometrical inspection and metallographic inspection. It will be only a geometric inspection without NDT.

In order to find the best parameters of the machine to manufacture the part entirely, a representative sample of built material will be checked by microscopy to analyze the cohesion of the metal between layers, to detect crack, holes, etc.

Roles:

Design, redesign, manufacturing, heat treatment, machining, dimensional control.

Participants and roles:

<u>ESTIA:</u>

- ❖ Design of the little inert chamber or the argon flow, test the inert chamber with deposition of titanium.
- ❖ **Find the optimized parameters** to manufacture some samples (walls, crosses, etc.) and test (geometrical inspection and metallographic inspection).
- ❖ Send some samples to VLM
- ❖ **Redesign** the final part design.
- ❖ Design of the big inert chamber with LORTEK.
- ❖ Manufacture the part in the big inert chamber or under argon flow with CMT technology and reloading of the part with LMD/P technology (add the different functionalities)

- Send the part to LAUAK for machining
- Geometrical **inspection**
- **Compilation** of the different results of each center to elaborate the report.

LORTEK:

- **Find the optimized parameters** to manufacture some samples (walls, crosses, etc.) and test (geometrical inspection and metallographic inspection). Preliminary trials will be performed with Stainless steel 316L to define the best strategies before starting with Ti64.
- Send some samples to VLM
- Redesign the final part design.
- Design the big **inert chamber** with ESTIA.
- **Manufacture the part** of LAUAK with CMT.
- Send the part to VLM for machining
- Geometrical **inspection**

VLM:

- Test: Machining the samples from ESTIA and LORTEK with a robotic arm.
- Definition and development of a geometrical control in process for CMT Manufacturing: The control in process will use 2 robots: 1 for the manufacturing and 1 for the geometrical control. The Control in process will be on a sample issued from the LAUAK part and not on the entire part. It is not necessary to use Titanium material for the control in process. For reasons of limited equipment (inert chamber), the material will be a 316L stainless steel.
- Machining of the final parts manufactured.

SMEs eligibility for the *task 2.3 Viability:*

Specific technical eligibility criteria are set up for the Pilot:

Target SME	Choice n°1: Aerospace company producing metal components through conventional technologies. If not, Choice n°2: Aerospace company producing metal components through basic MAM technologies
Technology requirements	No technology requirements

Expected results:

Obtained geometric tolerances and metallurgical quality.

Demonstration of the manufacturing of big part by using a hybridization of 2 technologies: Wire & Arc Additive Manufacturing technologies (2 types of CMT) and LMD/Powder technology.

Working plan:

Task	Responsible	Planning
Part selection	ESTIA	Mid-December 2017
Manufacturing some walls, crosses, variable thickness	ESTIA & LORTEK	End February 2018
Send the CAD sample to VLM for Control in Process development	ESTIA	End February 2018
Geometrical inspection and Metallurgical inspection	ESTIA & LORTEK	Mid-March 2018
Metallurgical inspection	ESTIA & LORTEK	Mid-March 2018
Send some samples to VLM	ESTIA & LORTEK	End March 2018
Preparation of the CAD of the LAUAK Part	ESTIA & LORTEK	End April 2018
Discussion with the 2 machinists	ESTIA & LORTEK & VLM & LAUAK	End April 2018
Design of 2 big inert chambers	ESTIA & LORTEK	End May 2018

Development of 2 big inert gas chamber or 2 systems for Argon flow	ESTIA & LORTEK	Mid-June 2018
Test of the inert gas chamber	ESTIA & LORTEK	End June 2018
Manufacture with CMT + LMD/P	ESTIA & LORTEK	End July 2018
Thermal treatment for stress relief	ESTIA & LORTEK	End July 2018
Machining of manufactured final parts	VLM & LAUAK	End August 2018
Geometrical inspection	ESTIA & LORTEK	Mid September 2018
Control in Process definition and development	VLM	End September 2018
Compilation of the different results for the report	ESTIA	End September 2018

Coordination, meetings and deliverables:

A technical meeting has to be scheduled at the end of each task, it could be by Skype or face to face and always organized by the Leader. MoM will be prepared by the Leader to be sent to the LORTEK.

The leader will inform monthly about the progress to the Leader of the WP2.

IP issues:

None for the moment.

Pilot 4

Name of pilot:

SLM Opti-Lattice

Participants:

- LORTEK (Leader of the Pilot)
- FADA-CATEC
- ADIRA
- AIRBUS D&S

Component:

The proposed component is a connection system support of aerospatial sector that can be observed in Figure 4.

Figure 4. Part to be optimised and built by SLM.

The component will be redesigned by topological optimization and the addition of lattice structures in order to push the limits of design and SLM manufacturing technologies.

As aerospace component, it foreseen that the expected challenges will be very interesting for OEM such a big player in aerospace field. Thus, CASA ESPACIO as ADDISPACE associate partner which today belongs to the Airbus D & S group will follow the work and outcome resulting from this Pilot.

Objective:

- Combination of topologic optimisation with lattice structures and study of the difference for two different materials.
- Demonstration in SLM built part the possibility of combining lattice and massive zones (select the most appropriate lattice structures, transition, range of density, etc.)
- Increase the number of applications of SLM technology. Also the potential of topological optimization by SLM in multiphysic problems (mechanical and thermal) or the reduction as much as possible weights.

Background:

- There is little work about topological optimization methodology and lattice structures at the same time.
- It didn’t take advantage at all of SLM technology applied to multiphysic optimization.

Relevance:

This pilot demonstrates the weight reduction possibility due to the advantages of SLM according to the designing which can put the mass just in the necessary places to face the stresses. Also shows the possibility of introducing lattice structures to reduce weight and how the software and machine can perform them.

Innovation and development grade:

Topological optimisation (using lattice structures).

Complex designs for SLM achieving weight reduction and surface increment with topological optimization and lattice structures respectively.

Territorial impact:

The main territorial impact of this pilot is related to space and aeronautic sectors of structural field. Field that have the necessity to find advanced topology optimizations, and know all the possibilities of optimization tools and SLM machines in order to solve different problems.

Materials:

The component will be built in three different materials:

- AlSi10Mg
- Scalmalloy®
- Stainless steel

Technology and equipment:

SLM (Selective Laser Melting):

- SLM Solutions SLM 280 LH. Built chamber: 280 x 280 x 350 mm. Year: 2014
- Renishaw AM250. Built chamber: 250x250x300 mm
- Renishaw RenAM50. Built chamber: 250x250x350 mm

TLM (Tiled Laser Melting) machine prototype from ADIRA (Figure 5). Build chamber: 1000x1000x200 mm.

Figure 5. TLM machine from ADIRA.

Software:

- Design: CATIA
- Optimization: INSPIRE, Altair-Hiperworks
- Lattice structure: Optistruck, NTopology or Netfabb

Quality requirements:

The security factor has to be taken into account.

The part will be subjected to different tests in order to assure the final quality:

- No visual defects (visual inspection)
- Geometry tolerances
- Possibly XCT- X-Ray computed tomography

No mechanical properties to be measured.

Roles:

Design, optimization for different materials, fabrication and inspection.

Participants and roles:

LORTEK

- **Topological and lattice optimization** (redesign and calculation)
- **Find the optimized parameters** to manufacture the part
- **Fabrication** of the part by SLM for AlSi10Mg with lattice incorporation
- **Compilation** of the different results of each center to elaborate the report.

FADA-CATEC

- Designing of the part
- Topological optimization (redesign and calculation)
- **Find the optimized parameters** to manufacture the part
- **Fabrication** of the part by SLM for Scalmalloy®
- XCT- X-Ray computed tomography

ADIRA

- **Fabrication** of the part by TLM with one of the optimisations performed for aluminum alloys but with Stainless Steel.

AIRBUS D&S

- **Observation** of the progress of the work and feedback.

SMEs eligibility for the *task 2.3 Viability:*

Specific technical eligibility criteria are set up for the Pilot:

Target SME	Aerospace company producing metal components through conventional technologies. Aerospace company producing metal components through basic MAM technologies MAM company producing metal components from other industries other than the aerospace
Technology requirements	No technology requirements

Expected results:

Optimization potential (and software using route)

Possibility of fabrication by SLM of optimized structures with lattice (limits we can arrange)

Working plan:

1.-Design and calculation.

2.-Topology optimization for two different materials: Scalmalloy® and AlSi10Mg.

3.-Combination of lattice structures and topology optimization for light weighting.

4.-Redesign and simulation.

5.-Manufacture of demonstration parts (pushing the limits of the machine performance for lattice mixing in one part).

Coordination, meetings and deliverables:

Constant communication by e-mail or telephone will be kept.

Problems and results of each task of design and manufacturing will be shared and discussed monthly in scheduled meetings with the rest of participants of the pilot in a meeting. The meetings will be scheduled and coordinated by the Leader of the pilot and the MoM will be prepared and shared with the participants of the pilot.

- December 7th
- January 8th
- February 7th
- March 7th
- April 9th
- May 9th
- June 9th
- July 9th
- August 7th
- September 7th

IP issues:

ADIRA will use a prototype equipment in the framework of the Pilot. The results of the study and manufacturing carried out in such an equipment will not be comparable to the ones developed in the commercial equipment used by other partners, so such results will remain confidential, not to be disclosed in the framework of the dissemination activities of the Pilot or with involved external entities, unless ADIRA provides explicit agreement.

GOVERNANCE

Governance has to assure the correct logistic of information between leaders of each pilot and leader of the WP2 to fulfill all the reports in the scheduled dates. Correspondent figures have been defined in order to manage the pilot:

- **Leader of the WP2:** LORTEK

Responsibilities:

- Coordination of the leaders of each pilot
- Compilation of the results and creation of the scheduled reports

- **Leaders of each pilot:** LORTEK, ESTIA, FADA-CATEC and IPLeiria.

Responsibilities:

- Schedule the necessary meetings between the members of the working group for the correct development of the pilot.
- Inform monthly about the progress to the Leader of the WP2.

- **Members of the working groups of each pilot**

Responsibilities:

- Development of the pilots
- Participation in the meetings

- **Steering committee:** LORTEK, ESTIA, FADA-CATEC and IPLeiria and partner and associated partner SMEs.

Responsibilities:

- Participation and report in consortium meetings

MANAGEMENT

A pilot agreement template has been prepared in other to be filled and signed by each participant of each working group before starting the Task 2.2.: Research stage. This agreement is based on DESCA model Consortium Agreement and includes the definitions, purpose, duration, responsibilities, liability, governance structure, results, access rights, non-disclosure of information, miscellaneous, signatures and attachments to include the background of participants, accession, third parties and affiliated entities.

In the Figure 6 a sketch of the management of agreements can be observed.

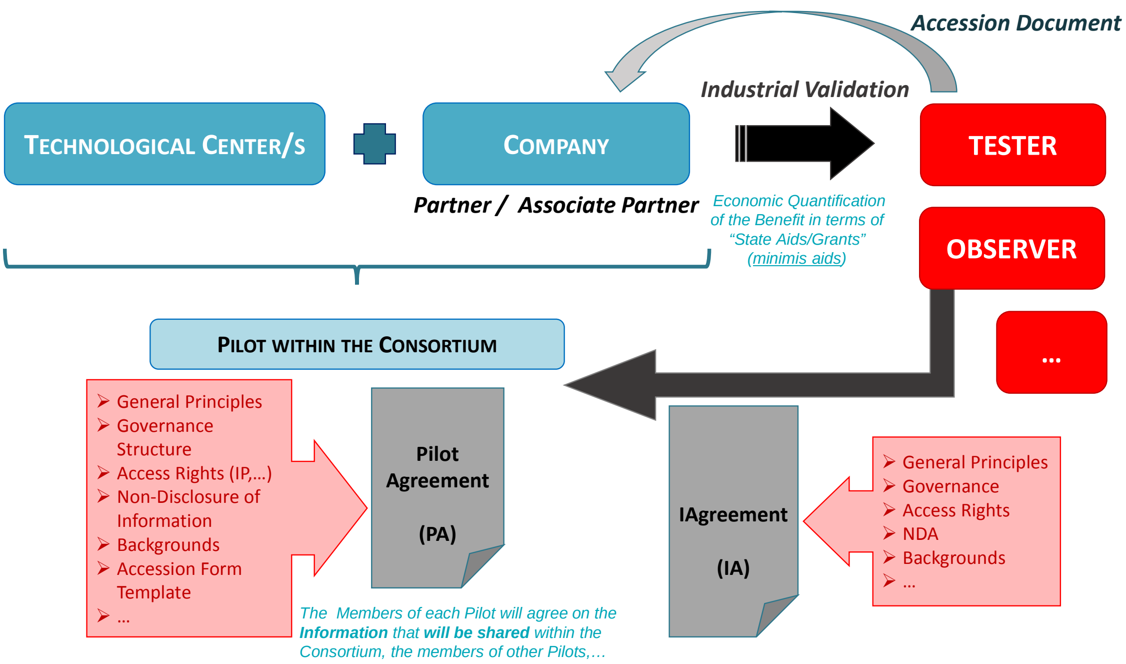

Figure 6. Sketch of the management of the WP2.

MONITORING

Each month progress of the pilots will be reported by each pilot leader to LORTEK. Periodical meetings between members of each pilot will be performed organized by each leader and reporting the MoM.

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