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EUROPEAN UNION

**ADDISPACE**

European Regional Development Fund

**WP4**

## **Proposal of training offers (France, Spain and Portugal)**

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## Introduction

Thanks to the opportunity study of WP1 of the Addispace project, there was a significant lack of training on such a complex subject as Metallic Additive Manufacturing.

However, the challenges of additive manufacturing involve the sharing of knowledge and the necessary support for the exploitation of this technology, over the different sectors.

Indeed, the needs in this field are varied, ranging from basic knowledge to advanced specializations, from design to manufacturing, from materials to certifications, and so on. It opens new design methodologies and new means of manufacturing.

Despite the appearance of some training modules on these new processes, new competence profiles must be specified for all the domains that this technology implies.

In fact, the project consortium has organized 6 different training modules for different audiences:

- Pilot 1: Higher Formation – ESTIA / IPLEIRIA – Introduction to MAM
- Pilot 2: Vocational Formation – LORTEK / Don Bosco – Introduction to MAM
- Pilot 3: Continuous Formation – IPLEIRIA – Level introductory
- Pilot 4: Continuous Formation – ESTIA – Level advanced
- Pilot 5: Continuous Formation – FADA CATEC – Level advanced
- Pilot 6: Continuous Formation – LORTEK – Level introductory

Given the results of these different modules (all modules were 100% recommended), we consider it important to make the training offers available even after the end of the ADDISPACE project.

## Pilot 1: Higher Formation – ESTIA / IPLEIRIA – Introduction to MAM

### Actualization

Given the different results of the Pilot 1: Higher Formation, and that 100% of the student recommend this offer, this module will be reconducted and each partner of Addispace could reuse the support to do the training in their own facilities after few modifications / adjustments with their equipment.

For ESTIA and IPLEIRIA, after some minor modifications / adjustments, the format will remain the same namely 1 week at ESTIA and 1 week at IPLEIRIA and the program will remain almost identical:

Day 1: ESTIA	
Time	Item
08:30 – 12:30	Introduction to MAM
14:00 – 16:00	Visit of Addimadour
16:00 – 18:00	Materials & Metallurgy

Day 2: ESTIA	
Time	Item
08:30 – 12:30	Design Rules for MAM (LBM, LMD/P, WAAM)
14:00 – 18:00	Topology Optimization

Day 3: ESTIA	
Time	Item
08:30 – 12:30	G-Code Programming for MAM
14:00 – 18:00	Introduction to PowerClad – PowerMill

Day 4: ESTIA	
Time	Item
08:30 – 12:30	Group 1: Assignment Group 2: LMD/P Manufacturing
14:00 – 18:00	Group 2: Assignment Group 1: LMD/P Manufacturing

Day 5: IPLEIRIA	
Time	Item
09:30 – 11:00	Introduction to LBM Technology
11:00 – 13:00	Part Manufacturing using LBM equipment (part 1)
14:00 – 17:30	Part Manufacturing using LBM equipment (part 2)

Day 6: IPLEIRIA	
Time	Item
09:30 – 10:00	Part Manufacturing using LBM equipment (part 3)
10:00 – 13:00	Dimensional Control / NDT
14:00 – 17:30	Visit to FAMOLDE

Day 7: IPLEIRIA	
Time	Item
09:00 – 13:00	Post-Treatment / Surface finishing + Thyssen Steels presentation
14:00 – 17:30	Structural Simulation + Practical application of software for AM simulation / optimization

Day 8: IPLEIRIA	
Time	Item
09:00 – 13:00	Visit of the University of Coimbra
14:00 – 17:30	Visit to ADIRA + CEIIA

## Level acceptance

100% of the students have recommended this module. A survey conducted at the end of the week at IPLeiria indicated a very high rate of acceptance from the students (81.25%).

## Sustainability of the module

Due to logistical and budgetary constraints, it is difficult to integrate this training module into the current engineering curriculum and to find 2 consecutive weeks available.

On the other hand, in the same way as a Summer Camp, we consider that it would be relevant to integrate this module during the summer, during school holidays.

The format would be the same, ie 1 week at ESTIA and 1 week at IPLEIRIA and the budget would be around 2 000 € per person to take into account travel, lunch, etc.

Also, we limit the number of places to 20 people for reasons of safety in the workshops, professional software licenses, etc.

## Certification

At the end of this summer transnational cam, ESTIA and IPLEIRIA will issue 4 ECTS credits and a training certificate (Training attestation).

## Profiles

Given the different concepts discussed during the 2 weeks, we recommend this kind of profiles to assist the transnational Summer Camp:

- Engineering students (Bac +5 / Bac +5) with a sensibilization in at least one of these areas: mechanic, industry, automatic, metal production, welding, mechatronics, robotics, metallurgy, materials.
- University student (Bac +4 / Bac +5) with a sensibilization in at least one of these areas: mechanic, industry, automatic, metal production, welding, mechatronics, robotics, metallurgy, materials.
- Unemployed people looking for work or retraining: In this case there is the need to assess the person's background training, or else they may have difficulties following the contents of the course.



## Pilot 2: Vocational Formation – LORTEK / Don Bosco – Introduction to MAM

### Actualization

Given the different results of the Pilot 2: Vocational Formation, and that 100% of the student recommend this offer, this module will be reconducted.

The format will remain the same for LORTEK and Don Bosco and they could reuse the support to do the training in their facilities for the following years.

Day	Students	Topic	Time (h)	Entity
1	All	History, Additive Manufacturing. Low Cost 3D Machines	0,5	TKNIKA
		Parts of a 3D printer.	0,5	
		Printing process. File formats.	0,5	
		Software used (Cura, Repetier Host)	1,5	
2	All	Printing Parts	1	
		Repositories.	0,5	
		Change of filament.	0,5	
		Printing with support.	1	
3	All	Part design	1,5	
		Optimization, internal channels, weight reduction.	0,5	
		Cuts and joints. Repair parts...	1	
4	All	Metallurgy, materials and powder used in MAM	0,5	LORTEK
		MAM technologies	0,5	
		Real applications	0,5	
		Post processes, NDT	0,5	
		Visit to the facilities	1	
5,6,7	Group 1	Introduction to the processes by electric arc with contribution of wire	0,5	TKNIKA
		Software used for the robotic cell	0,5	
		Practices with WAAM technology	2	
	Group 2	Use of supports	0,5	LORTEK
		Software used (Materialise Magics)	1	
		Practices with SLM technology	1	
	Group 3	Metallographic characterisation	1	
		Software used	0,5	
		Practices with LMD technology	1	
7	All	Evaluation of the pilot and acquired knowledge	0,5	LORTEK & TKNIKA

## Level acceptance

100% of the students have recommended this module.

## Sustainability of the module

This vocational training doesn't require any logistics or budget constraints contrary to the transnational pilot 1. In fact, the module can be reused in the same condition and could be inserted in the Don Bosco program.

## Certification

At the end of this training module, all the centers which are realizing this training have to deliver a training certificate (Training attestation).

## Profiles

Given the different concepts discussed during this module, we recommend this kind of profiles to assist the vocational module:

- Technicians with a sensibilization in at least one of these areas: mechanic, industry, automatic, metal production, welding, mechatronics, robotics, metallurgy, materials.
- Students from college / high school with a sensibilization in at least one of these areas: mechanic, industry, automatic, metal production, welding, mechatronics, robotics, metallurgy, materials.
- Unemployed people looking for work or retraining

## Pilot 3: Continuous Formation – IPLEIRIA / IEPF – Level Introductory

### Actualization

The module is not finished yet given that this module is integrated in the IEPF program and is during more than around one year. The actualization will depend on the future results.

Module	Duration (hours)
Introduction to Direct Digital Manufacturing	25
Materials for direct digital manufacturing	25
Additive and subtractive manufacturing technologies	25
Design and direct digital manufacturing	50
Direct digital manufacturing of polymers	50
<b>Direct digital manufacturing of metals</b>	<b>50</b>
Direct digital manufacturing of ceramics	25
Reverse Engineering	25
Post-processing of direct digital manufacturing parts	25
<b>Total</b>	<b>300</b>

### Level acceptance

Waiting for the evaluation.

### Sustainability of the module

Waiting for the evaluation.

### Certification

Waiting for the evaluation.

## Profiles

Given the different concepts discussed during this module, we recommend this kind of profiles to assist the continuous module:

- Unemployed people looking for work or retraining

## Pilot 4: Continuous Formation – ESTIA Addimadour – Level Advanced

### Actualization

Given the different results of the Pilot 4: ESTIA Continuous Formation, and that 100% of the people recommend this offer, this module will be reconducted.

The format will remain the same for ESTIA and they could reuse the support to do the training in their facilities for the following years.

Day 1 : ESTIA	
Time	Item
09:00 – 09:30	History of MAM: A new market
09:30 – 12:00	Presentation of all the technologies (LBM, EBM, LMD/P, WLAM, WAAM (MIG, MAG, CMT, TIG, Plasma), EBAM, Cold Spray, MELD
12:00 – 12:45	Visit of Addimadour
14:00 – 15:00	General Design Method / Value Chain for LBM Technology
15:00 – 16:00	LBM: Design Rules / Business Rules
16:00 – 17:00	Costs for LBM

Day 2 : ESTIA	
Time	Item
09:00 – 10:00	General Design Method / Value Chain for LMD/P Technology
10:00 – 12:00	LMD/P: Design Rules / Business Rules
12:00 – 12:30	Costs for LMD/P
14:00 – 15:00	General Design Method / Value Chain for WAAM / WLAM Technology

15:00 – 16:00	WAAM / WLAM: Design Rules / Business Rules
16:00 – 17:00	Costs for WAAM / WLAM + Summary of the training module

## Level acceptance

100% of the students have recommended this module.

## Sustainability of the module

This continuous training doesn't require any logistics or budget constraints contrary to the transnational pilot 1. In fact, the module can be reused in the same condition and could be inserted in the Addimadour training offer.

Also, ESTIA and Sigma Clermont are co-organizing a "Mastère Spécialisé" about Processes of the future and robotization in order to:

- Train specialists in the implementation of manufacturing processes in the field of Composite materials and Metal Additive Manufacturing
- Tackle the material, processes and their robotization
- Give students a directly applicable skill in industrial setting

This Mastère will tackle 6 themes:

- **Implementation of the processes (35h)**
- **Robotization of Advanced Manufacturing Processes (49h)**
- Innovative Materials (42h)
- Methods (84h)
- Simulation of Manufacturing Processes (28h)
- Industry 4.0 (154h).

Thanks to the Addispace project, a very large part of the ESTIA Addimadour continuing education module will be able to be reused to be integrated in this master's degree.

## Certification

At the end of this training module, all the centers which are realizing this training have to deliver a training certificate (Training attestation).

## Profiles

Given the different concepts discussed during this module and the level advanced, we recommend this kind of profiles to assist the continuous module:

- Engineer / Technicians with a specialization in at least one of these areas: mechanic, industry, automatic, metal production, welding, mechatronics, robotics, metallurgy, materials.
- Unemployed people looking for work with a previous experience on Additive Manufacturing
- PhD student with a specialization in at least one of these areas: mechanic, industry, automatic, metal production, welding, mechatronics, robotics, metallurgy, materials.
- Post-doc with a specialization in at least one of these areas: mechanic, industry, automatic, metal production, welding, mechatronics, robotics, metallurgy, materials.
- University or engineering school teacher with a specialization in at least one of these areas: mechanic, industry, automatic, metal production, welding, mechatronics, robotics, metallurgy, materials.

## Pilot 5: Continuous Formation – FADA CATEC – Level Advanced Actualization

Given the different results of the Pilot 5: FADA CATEC Continuous Formation, and that 100% of the people recommend this offer, this module will be reconducted.

The format will remain the same for FADA CATEC and they could reuse the support to do the training in their facilities for the following years.

	First day	Second day	Third day
8:30	AM	Calculation & Topology Optimization	QA
10:30			
10:30/11:00	Coffee		
11:00	AM	Calculation & Topology Optimization / DfAM	Lab. Experience
12:45			
12:45/13:00	Break		
13:00	DfAM	NDT	
14:30			

### Level acceptance

100% of the industrialists have recommended this module.

### Sustainability of the module

This continuous training doesn't require any logistics or budget constraints contrary to the transnational pilot 1. In fact, the module can be reused in the same condition and could be inserted in the FADA CATEC training offer.

### Certification

At the end of this training module, all the centers which are realizing this training have to deliver a training certificate (Training attestation).



## Profiles

Given the different concepts discussed during this module and the level advanced, we recommend this kind of profiles to assist the continuous module:

- Engineer / Technicians with a specialization in at least one of these areas: mechanic, industry, automatic, metal production, welding, mechatronics, robotics, metallurgy, materials, Non-Destructive Testing.
- Unemployed people looking for work with a previous experience on Additive Manufacturing
- PhD student with a specialization in at least one of these areas: mechanic, industry, automatic, metal production, welding, mechatronics, robotics, metallurgy, materials, Non-Destructive Testing.
- Post-doc with a specialization in at least one of these areas: mechanic, industry, automatic, metal production, welding, mechatronics, robotics, metallurgy, materials, Non-Destructive Testing.
- University or engineering school teacher with a specialization in at least one of these areas: mechanic, industry, automatic, metal production, welding, mechatronics, robotics, metallurgy, materials, Non-Destructive Testing.

## Pilot 6: Continuous Formation – LORTEK – Level Introductory Actualization

Given the different results of the Pilot 6: LORTEK Continuous Formation, and that 100% of the people recommend this offer, this module will be reconducted.

The format will remain the same for LORTEK and Don Bosco and they could reuse the support to do the training in their facilities for the following years.

Day 1 : LORTEK	
Time	Item
08:00 – 13:00	<ul style="list-style-type: none"> <li>- History, Additive Manufacturing. Low Cost 3D Machines</li> <li>- Parts of a 3D printer</li> <li>- Printing process, file formats</li> <li>- Software</li> <li>- Printing parts</li> <li>- Repositories</li> <li>- Change of filament</li> <li>- Part design</li> <li>- Printing with support</li> <li>- Optimization, internal channels, weight reduction</li> <li>- Cuts and joints. Repair parts</li> </ul>
14: 00 – 17:00	<ul style="list-style-type: none"> <li>- Introduction to the processes by electric arc with contribution of wire</li> <li>- Software used with the robotic cell</li> <li>- Practices with WAAM technology</li> </ul>

Day 2 : LORTEK	
Time	Item
08:00 – 12:00	<ul style="list-style-type: none"> <li>- MAM technologies</li> <li>- Materials and Powder for MAM</li> <li>- Post-processes and quality</li> <li>- Real applications</li> <li>- Visit to the facilities</li> </ul>
13: 00 – 17:00	<ul style="list-style-type: none"> <li>- Software used</li> <li>- Powder Characterization</li> </ul>

	<ul style="list-style-type: none"> <li>- Practices with LBM technology</li> <li>- Practices with LMD technology</li> <li>- Software</li> <li>- Course evaluation</li> </ul>
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## Level acceptance

100% of the industrialists have recommended this module.

## Sustainability of the module

This continuous training doesn't require any logistics or budget constraints contrary to the transnational pilot 1. In fact, the module can be reused in the same condition and could be inserted in the LORTEK training offer.

## Certification

At the end of this training module, all the centers which are realizing this training have to deliver a training certificate (Training attestation).

## Profiles

Given the different concepts discussed during this module and the level advanced, we recommend this kind of profiles to assist the continuous module:

- Engineer / Technicians with a sensibilization in at least one of these areas: mechanic, industry, automatic, metal production, welding, mechatronics, robotics, metallurgy, materials.
- Unemployed people looking for work
- PhD student with a sensibilization in at least one of these areas: mechanic, industry, automatic, metal production, welding, mechatronics, robotics, metallurgy, materials.
- Post-doc with a sensibilization in at least one of these areas: mechanic, industry, automatic, metal production, welding, mechatronics, robotics, metallurgy, materials.
- University or engineering school teacher with a specialization in at least one of these areas: mechanic, industry, automatic, metal production, welding, mechatronics, robotics, metallurgy, materials.

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