Call FoF-05-2016

AM-motion

A STRATEGIC APPROACH TO INCREASING EUROPE'S VALUE PROPOSITION FOR ADDITIVE MANUFACTURING TECHNOLOGIES AND CAPABILITIES

Grant Agreement Nº 723560

AMEF2018

PSOTER ABSTRACTS

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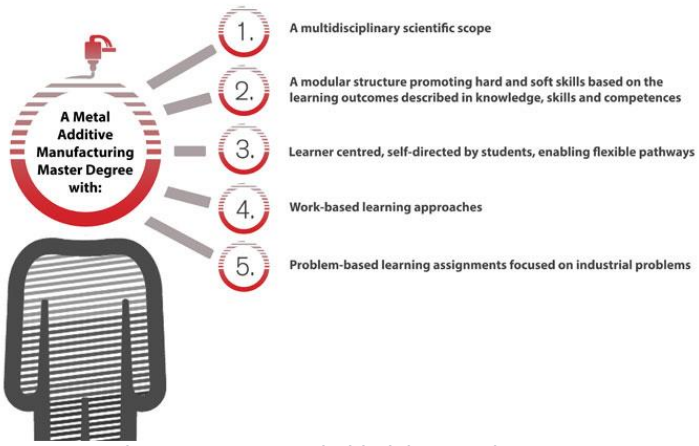
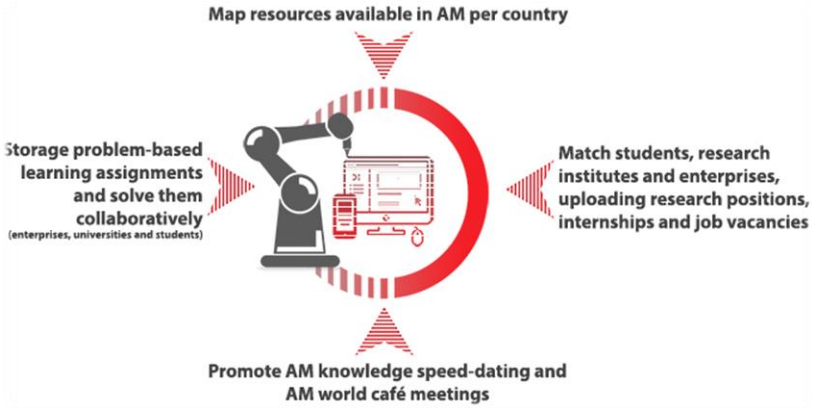
AM key projects summary

Posters from European projects

1. ADMIRE

POSTER TITLE	**ADMIRE**-Industry builds parts with additive manufacturing, together we build the workforce
PROJECT	*ADMIRE – Knowledge Alliance for aDditive Manufacturing between Industry and univeRsitiEs* *Reference: 575938-EPP-1-UK-EPPKA2-KA* *Website: http://admireproject.eu/*
AUTHORS & AFFILIATION	Elvira Raquel Silva, European Federation for Welding, Joining and Cutting (EWF) Eurico Assunção, European Federation for Welding, Joining and Cutting (EWF)
ABSTRACT	ADMIRE, funded under the Erasmus+ programme, intends to address the gap between enterprises, working with Additive Manufacturing supply chain, research centres and universities whilst qualifying the workforce in AM. Due to its novelty and fast growth, the AM field has a distinctive set of features: it is still quickly evolving and, as such, job positions are very hard to fill because of the scarce manpower with the required expertise. Similarly, the available educational programmes are unable to provide students with the skills needed for such high levels of performance (AM Engineers). Together, universities, companies and students are designing a Metal AM Master degree.  *Figure 1 - Features behind the Metal AM Msc* To enhance the flow of knowledge and innovation between the industry, universities and students a platform is going to be created for the following purposes (refer to figure 2).

	 *Figure 2 – Features of the ADMIRE platform* ADMIRE contributes to reaching the European Commission policy priority: a Smart, sustainable and inclusive economic growth.
Poster Contact	*Elvira Raquel Silva (partner) eraqsilva@ewf.be* *Filomeno Martina (project coordinator) f.martina@cranfield.ac.uk*

2. AMABLE

POSTER TITLE	**AMABLE**-Is your idea Additively Manufacturable?
PROJECT	AMable – SME Support for Additively ManufactrurABLE product ideas FoF-12-2017-Project ref. 768775 https://www.amable.eu/
AUTHORS & AFFILIATION	Ulrich Thombasen (Fraunhofer Institute for Laser Technology) André Cereja (European Federation for Welding, Joining and Cutting)
ASBTRACT	Support the uptake of AM AMable provides support to SMEs and mid-caps for their individual uptake of additive manufacturing. Across all technologies from plastics through polymers to metals, AMable offers services that target challenges for newcomers, enthusiasts and experts alike. Grouped along the value chain, four stages guide the idea to delivery. AMable Services Arena The AMable services arena offers a set of services to support the evolution of a product idea at all stages of the product creation process.

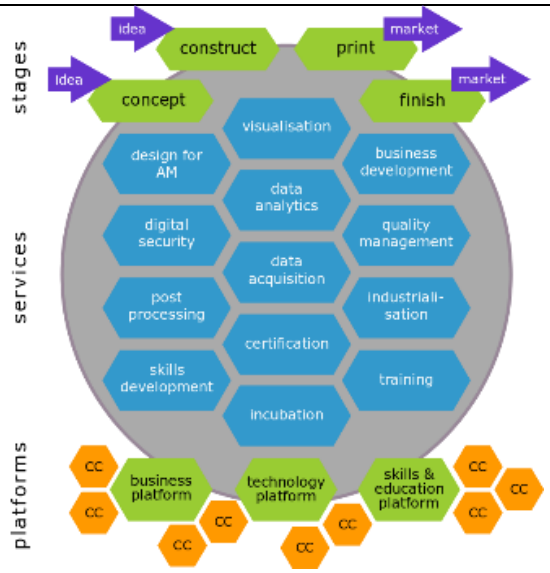


Figure 3 – AMable Services Arena

<u>Concept Stage</u>

The concept stage captures the product idea and assists in the development of suitable implementation scenarios. Visualisation through augmented and virtual reality (AR/VR) technologies allows for in depth discussion of features and functionalities.

<u>Construct Stage</u>

At the construct stage, experts give support to companies on simulating product properties such as fluid dynamics or load cases. Topology optimisation as a service stands at the heart of an interlinked holistic approach to ensure the achievement of all expected properties.

<u>Print Stage</u>

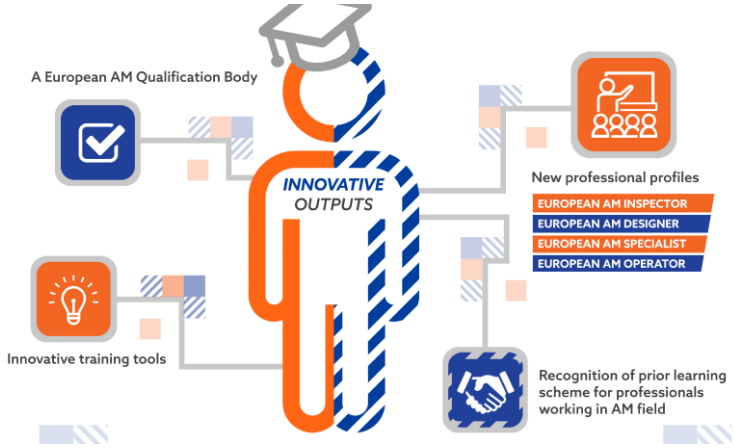
Once the company has a fully assessed 3D model, it can be printed wherever the company desires. The print stage supports data preparation and execution of critical prints. Data acquisition during production tracks progress and specifications.

<u>Finish Stage</u>

Finishing a part makes the company's part ready for use. If it needs milling or grinding, testing or computer tomography, the specifications created at the construct stage define the finish line.

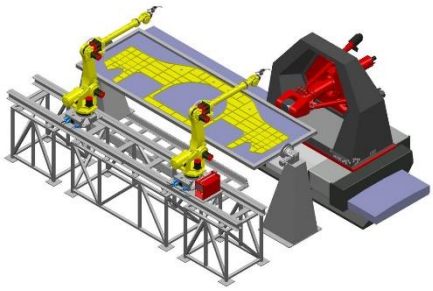
Poster Contact	*André Cereja, afcereja@ewf.be*

3. CLLAIM

POSTER TITLE	**CLLAIM**-The missing piece to overcome additive manufacturing (AM) skills' shortages
PROJECT	*CLLAIM – Creating KnowLedge and skilLs in AddItive Manufacturing* *Reference: 591838-EPP-1-2017-1-ES-EPPKA2-SSA* *Website: http://cllaimprojectam.eu*
AUTHORS & AFFILIATION	Elvira Raquel Silva, European Federation for Welding, Joining and Cutting (EWF) Eurico Assunção, European Federation for Welding, Joining and Cutting (EWF)
ABSTRACT	Europe is firmly committed to position itself at the leading edge of manufacturing innovation. Within the new technologies that are reshaping the industry, Additive Manufacturing (AM) stands out. A challenge that remains to be addressed is qualified professionals capable of taking advantage of this technology and bridge the gap between job offers and job seekers. Thus, CLLAIM intends to (Figure 1): - Create a European AM Qualification Body in AM; - Design the Operator, Designer, Specialist and Inspector professional profiles; - Deliver harmonised qualifications matching market requirements with innovative training tools; - Develop a recognition of prior learning scheme for professionals working in AM field.  *Figure 4 – CLLAIM's outputs* The training developed as part of the project will allow trainees to attain qualifications recognised by the industry across Europe.
Poster Contact	*Elvira Raquel Silva (partner)eraqsilva@ewf.be* *Ignacio Lopez (project coordinator) ilopez@cesol.es*

4. LASIMM

POSTER TITLE	**LASIMM**-All-in-one machine for Hybrid Manufacturing of large metal parts
PROJECT	*LASIMM – Large Additive Subtractive Integrated Modular Machine* *FoF-01-2016* *Project ref. 723600* *http://lasimm.eu/*
AUTHORS & AFFILIATION	André Cereja, Eurico Assunção (European Federation for Welding, Joining and Cutting) Cranfield University, Autodesk, Global Robots, LOXIN
ABSTRACT	LASIMM is developing a hybrid Additive & Subtractive machine based on integrating a standard articulated arm industrial robot for Additive Manufacturing (AM) with a parallel kinematic motion (PKM) robot for the Subtractive Manufacturing (SM) finishing step. The machine features a control software enabling full parallel manufacturing. AM has great potential for having a major impact on the production of components or parts in the future. The use of AM in the production of high strength, high integrity metals for application to large (several meters) engineering structures would have a significant impact potential. If this view is achieved cost effectively, it would have the potential to revolutionize major engineering sectors, such as energy (including renewables), construction and aerospace. From the several AM techniques, Wire Arc Additive Manufacturing (WAAM) is a technique with clear potential for such applications.  *Figure 1 – LASIMM's AM components for the deposition process. 20 kg landing gear rib built in titanium by WAAM.* On the other hand, WAAM is a near-net-shape process due to its high build rate and layer height. Consequently, a SM finish machining pass is required. Within LASIMM, PKM robots provide the accuracy and surface quality of CNC based machining systems whilst maintaining the flexibility and open architecture of robots. SM with PKM robots is already an industrial process used by industrial companies across the world.

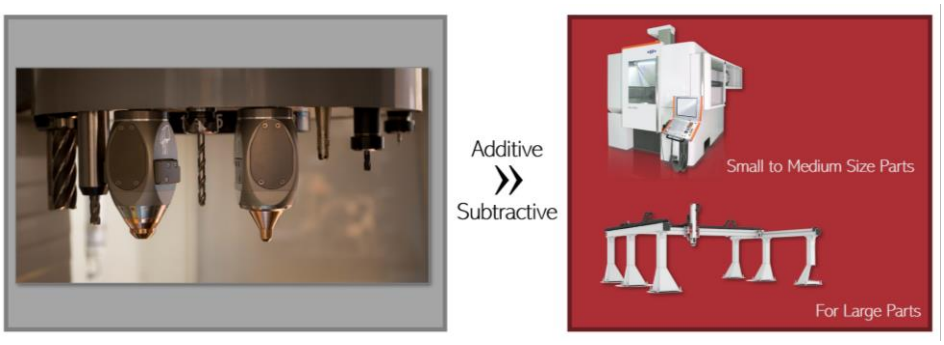
	 *Figure 2 – Parallel Kinematics Machine* LASIMM's design stage is complete, and the entire equipment is currently being assembled in Spain. Manufacture of the demonstrator components is scheduled to begin in the last trimester of 2018.  Figure 3 – *LASIMM architecture* For LASIMM's participation at AMEF 2018, the consortium will present a mock-up of the LASIMM cell plus relevant WAAM parts, both in the as-print condition and after machining.
Poster Contact	André Cereja, afcereja@ewf.be

5. ENCOMPASS

POSTER TITLE	**ENCOMPASS**
PROJECT	*ENCOMPASS - ENgineering COMPASS* *FoF-13-2016 - Photonics Laser-based production* *www.encompass-am.eu*
AUTHORS & AFFILIATION	Rita Bola, Eurico Assunção (European Federation for Welding, Joining and Cutting)
ABSTRACT	The ENCOMPASS project is creating a fully digital integrated design decision support (IDDS) system covering the whole manufacturing chain for the laser powder bed fusion (L-PBF) process, encompassing all individual processes within in. The ENCOMPASS concept takes a comprehensive view of the L-PBF process chain through synergising and optimising the key stages. ENCOMPASS is addressing the three key steps in the process chain: – Component design; – Build process; – Post-build process steps. The links between these stages are being addressed by the following five interrelations: 1. Between the design process and both the build and post-build processes in terms of manufacturing constraints / considerations to optimise overall component design 2. Between the design process and build process component-specific L-PBF scanning strategies and parameters to optimise processing and reduce downstream processing 3. Between the design process and the build and post-build processes in terms of adding targeted feature quality tracking to the continuous quality monitoring throughout the process chain 4. Between the build and post-build processes by using build specific processing strategies and adaptation based on actual quality monitoring data (for inspection and post-processing) 5. Between all stages and the data management system with the integrated design decision support (IDDS) system By considering the entire AM process chain, rather than the AM machine in isolation, ENCOMPASS is integrating process decision making tools and produce substantial increases in AM productivity, with clear reductions in change over times and re-design, along with increased 'right-first time', leading to overall reductions in production costs, materials wastage, and over-processing. The project implementation will enable significant energy savings, the creation of new jobs in Europe and enhance the uptake of AM by making it faster and cheaper.

Poster Contact	Project Coordinator: David Bracket, MTC Person expected to be at the poster during the event: Rita Bola, rgbola@ewf.be; Eurico Assunção EGAssuncao@ewf.be

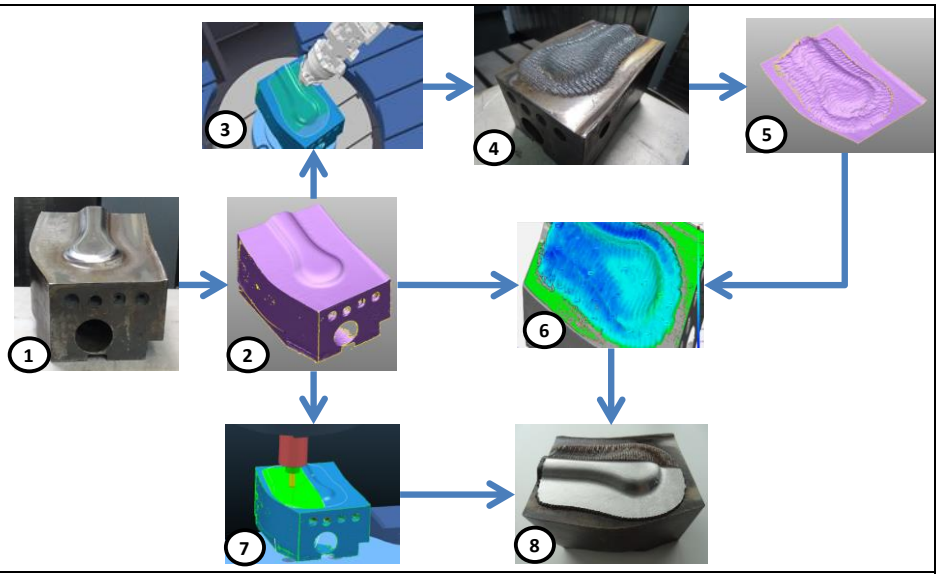
6. OPENHYBRID

POSTER TITLE	**OpenHybrid** – Developing a novel hybrid AM approach which will offer unrivalled flexibility, part quality and productivity
PROJECT	FoF-01-2016 - Novel hybrid approaches for additive and subtractive manufacturing machines www.openhybrid.eu
AUTHORS & AFFILIATION	Rita Bola, Eurico Assunção (European Federation for Welding, Joining and Cutting)
ABSTRACT	The OPENHYBRID project will overcome the technical and commercial barriers of current hybrid manufacturing systems to deliver a single manufacturing system capable of undertaking a wider range of processes in a seamless automated operation. The OPENHYBRID system will offer unrivalled flexibility in terms of materials, including the ability to switch between powder and wire feed-stock within a single part. Moreover, the process can be fitted to a diverse range of platform to produce parts from 2cm to 20m in length. The capability of the OPENHYBRID approach is being validated through the production of industrial demonstrators from the power generation, automotive and mining equipment sectors  A number of technologies are being developed creating a solid base for the future widespread adoption of Additive Manufacturing, and among them: – Smart Laser cladding heads, incorporating temperature sensors and material feed sensing; – Laser scanning head for heat treatment, polishing and texturing; – Laser ultrasonic non-destructive testing inspection for defect analysis; – Enhanced gas shielding, medium shielding through a trailing shield and high shielding through a flexible enclosure;

	– Mechanical stress relieving through the development of ultrasonic needle peening head; – Contamination control through the development of a cleaning head; – Enhanced inspection utilizing combined thermal and optical imaging. The project outcomes will increase productivity and reduce set-up times due to CAD/CAM developments and improved machining interface. Also, OPENHYBRID will have impact in health and safety benefits, as a reduced materials handling is expected and an upskilling of the workforce due to training on new hybrid AM systems.
Poster Contact	Project Coordinator: David Wimpenny , MTC Person expected to be at the poster during the event: Rita Bola, rgbola@ewf.be; Eurico Assunção EGAssuncao@ewf.be

7. PARADDISE

POSTER TITLE	**PARADDISE**-Production of metallic parts by means of hybrid manufacturing using structured light technology
PROJECT	PARADDISE *PARADDISE: A Productive, Affordable and Reliable solution for large scale manufacturing of metallic components by combining laser-based ADDItive and Subtractive processes with high efficiency* *Project Number 723440* www.paraddise.eu
AUTHORS & AFFILIATION	*Amaia Alberdi, Nerea Alberdi, Rakel Pacheco, Mikel Ortiz, Pedro Ramiro* *Tecnalia Research & Innovation*
ABSTRACT	With the development of the new concept of hybrid machine, which combines additive and subtractive manufacturing in the same machine, new opportunities for automation of applications such as the repairing of defective parts or the addition of coatings with specific properties are coming out. In these applications, the need for the use of measuring systems has been revealed, in order to know the actual geometry of the parts. Among the different measurement systems, the structured light technology presents many advantages for this process: it is capable of measuring parts of different sizes and with low texture in a single measurement, and additionaly, the lighting conditions barely affect to the measurement. In this poster, different applications of structured light technology for hybrid manufacturing are presented: i) Geometrical Inspection of additively manufactured parts; ii) Detection and location of defects; and iii) creation of digital models of parts. In addition, an example of the application of this technology is also described, *which consists in the manufacturing of the coating of a hot stamping die. For this, the ZVH 45/1600* Add+Process hybrid machine from Ibarmia manufacturer has been employed.

	
Poster Contact	*Amaia Alberdi (amaia.alberdi@tecnalia.com)*

8. SUPREME

POSTER TITLE	**SUPREME** - Sustainable and flexible powder metallurgy processes optimization by a holistic reduction of raw material resources and energy consumption
PROJECT	SUPREME *Sustainable and flexible powder metallurgy processes optimization by a holistic reduction of raw material resources and energy consumption H2020 -SPIRE) program (grant agreement no 768612)* https://www.supreme-project.com
AUTHORS & AFFILIATION	T.Baffie*, A.Witomski*, L.Aixala*, G.Gaillard* CEA-LITEN, Univ.Grenoble Alpes, F-38000 Grenoble, France, thierry.baffie@cea.fr
ABSTRACT	SUPREME aims at optimising powder metallurgy processes throughout the value chain. It focuses 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 mechanical alloying 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). CEA-LITEN is a major European research institute and a driving force behind the development of sustainable energies and Powder Metallurgy technologies. SUPREME addresses both Additive Manufacturing (AM) and Near-Net Shape (NNS) Powder Metallurgy processes, covering a wide particle size distribution.
Poster Contact	*Dr. Olivier Coube, EPMA,* oc@epma.com

9. KRAKEN

POSTER TITLE	**KRAKEN**-Hybrid automated machine integrating, subtractive and multi-material Additive Manufacturing, for the high-quality production of large functional parts.
PROJECT	*Kraken project* *www.krakenproject.eu*
AUTHORS & AFFILIATION	Berta Gonzalvo / José Antonio Dieste/ Iván Monzón / Alberto Laguía/ Javier de Vicente-AITIIP TECHNOLOGY CENTRE
ABSTRACT	**KRAKEN** is a FoF Project funded by the **Horizon 2020** research and innovation programme under grant agreement No 723759 that will develop a **disruptive hybrid manufacturing** concept to equip SME and large industries with affordable **All-in-one machine** for the customised design, production/reparation and quality control of **functional parts.** KRAKEN machine will be devoted to the production and reparation of functional parts of any size with dimensional tolerances under 0.3 millimetres and surface roughness under Ra 0,1 µm aiming to achieve, at least, 40% reduction in time and 30 % in cost and 25% increase in productivity when comparing to the current additive and subtractive processes. KRAKEN machine will be based on hybrid approach merging subtractive machining (working area 20x6x3 metres) together with high efficient metallic (10 kg/h deposition rate) and novel non-metallic (180kg/h deposition rate) additive technologies. In addition, KRAKEN will develop and demonstrate the efficiency and sustainability of this cost-effective hybrid manufacturing solution developing

	and constructing a functional machine concept that will use metal, resin, and combinations of both materials in industrially relevant environment for automotive and building industries.
Poster Contact	*Joseantonio.dieste@aitiip.com* *Berta.gonzalvo@aitiip.com*

10 4D HYBRID

POSTER TITLE	**4D-HYBRID**-Novel Hybrid Manufacturing Technologies for Repairing Operations
PROJECT	4D HYBRID *4D Hybrid - Novel ALL-IN-ONE machines, robots and systems for affordable, worldwide and lifetime Distributed 3D hybrid manufacturing and repair operations* *Website: http://4dhybrid.eu/*
AUTHORS & AFFILIATION	Anna Valente, SUPSI – ARM, anna.valente@supsi.ch Diego Gitardi, SUPSI – ARM, diego.gitardi@supsi.ch
ABSTRACT	In many industrial sectors such as aeronautics, power generation, oil & gas, complex metal parts embrace major challenges across their lifecycles from the green field resource intensive manufacturing in the shop-floor to the numerous maintenance and repairing activities. Requirements of such parts need several working operations that today are neither feasible nor affordable by AM techniques alone and require post-processing steps to ensure optimal tolerances and surface finish. On one hand, post processing requires additional equipment/suppliers, anyway guarantees a flexible saturation of the production capacity of additive and subtractive equipment. On the other hand, the need to combine AM and post processing in one-step is strong but with the drawback of increased complexity and cost of the equipment especially for large parts. A more synergistic

	combination of additive and subtractive processes could overcome individual shortcomings to achieve a technical result going beyond the simple succession of steps. 'Plug and produce' modular approach is a key factor to success for hybridization: minimizes the mechanical integration through specific mechatronic interface also suitable for new or existing manufacturing equipment, while maximizing the possibility of generating hybrid processes through deep re-engineering and openness of numeric control. In the 4D paradigm, virtually any combination among technologies could be possible: laser melting/heating, melt powder deposition, cold spraying and ablation. This approach will constitute a major innovation step compared to specifically designed machines for multiple processes by avoiding the risks associated to not fully exploiting the equipment capacity and capabilities.
Poster Contact	Diego Gitardi, SUPSI – ARM, diego.gitardi@supsi.ch

11 AMATHO

POSTER TITLE	**AMATHO** - A.dditive MA.nufacturing T.iltrotor HO.using
PROJECT	*AMATHO - A.dditive MA.nufacturing T.iltrotor HO.using* *Website: https://www.amatho.org/project/*
AUTHORS & AFFILIATION	Anna Valente, SUPSI – ARM, anna.valente@supsi.ch Andrea Marchetti, SUPSI – ARM, andrea.marchetti@supsi.ch
ABSTRACT	AMATHO (A.dditive MA.nufacturing T.iltrotor HO.using) is aimed to design, assess and manufacture a novel tiltrotor drive system housing exploiting the features of additive manufacturing techniques. Preliminarily, functional, structural and technological peculiarities of rotorcraft main gearbox housings are analysed and relevant requirements are issued. In the meantime, viable AM processes are reviewed, on the basis of specific suitability, technological potential and degree of maturity. In particular, powder feed direct energy deposition techniques (Direct Laser Deposition – DLD) and powder bed fusion techniques (Selective Laser Melting – SLM and Electron Beam Meelting – EBM) are considered. The powder precursors are investigated as well, in terms of chemical nature (magnesium, aluminium, titanium alloy, stainless steel), particles granulometry and morphology. Static, fatigue, fracture mechanics, damage tolerance, corrosion endurance, chemical compatibility, machinability, weldability and heat-treatability testing are worked out and final trade-off process accomplished for choosing optimal materials and processes.

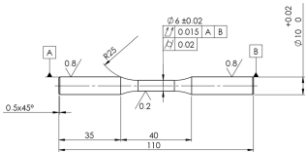
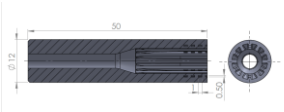
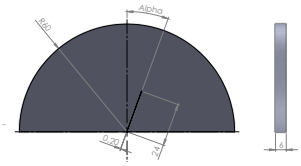
	Characterisation methodologies and NDI techniques are assessed as well. In addition to test activity on dedicated specimens, smaller, but fully representative, full-scale gearbox housing components (to be considered as proof of concept) are manufactured through the traded-off technologies and tested to check the compliance with general functional aspects of r/c drive system housing. In parallel, design rules and methodologies for detail design, optimisation and structural substantiation of AM components are defined and supporting numerical tools are set-up. Full-scale housing is manufactured and structural and functional tests are performed to support flight clearance on the NextGenCTR Demonstrator and procedures (engineering cost and industrial capability assessment) for the start-up of high-volume production are also investigated.
Poster Contact	Andrea Marchetti, SUPSI – ARM, Andrea.marchetti@supsi.ch

12 BIONIC AIRCRAFT

POSTER TITLE	**BIONIC AIRCRAFT**-Resource efficient 3D-printing: new high strength aluminium alloys and bionic design
PROJECT	**Bionic Aircraft** *Increasing resource efficiency of aviation through implementation of ALM technology and bionic design in all stages of an aircraft life cycle* http://www.bionic-aircraft.eu
AUTHORS & AFFILIATION	P. Imgrund; M. Gralow; T. Wischeropp; D. Jutkuhn; F. Teng; H. Blunk; C. Emmelmann Fraunhofer Research Institution for Additive Manufacturing Technologies (IAPT), Hamburg, Germany
ABSTRACT	With the possibilities to produce highly complex and bionic optimized lightweight structures, the laser beam melting (LBM) process promises a high weight saving and assembly time shortening potential. However, the current design and manufacturing process is time-consuming and expensive, which limits its applicability in the aerospace industry. In order to overcome these barriers, a number of bionic principles were tested with regard to implementation in topology-optimized components. As a result, an automated bionic design process is developed. To further increase the lightweight construction potential of additive production, new types of aluminium alloys are developed on the material side and innovative beam shaping concepts are tested on the process side.
Poster Contact	*Dr.-Ing. Philipp Imgrund-philipp.imgrund@iapt.fraunhofer.de*

13 A_MADAM

POSTER TITLE	**A_MADAM -** AM design rules for optimal dynamic behaviour
PROJECT	***A_MADAM: Advanced Design Rules for Optimal Dynamic Properties of Additive Manufacturing Products*** Reference: 734455 — A_MADAM — H2020-MSCA-RISE-2016/H2020-MSCA-RISE-2016 Coordinator: Faculty of Mechanical and Civil Engineering, University of Kragujevac (RS) Consortium: University of Bologna (IT); Studio Pedrini (IT); Plamingo (BA); Topomatika (HR) 01-01-2017 to 31-12-2020 http://www.a-madam.eu
AUTHORS & AFFILIATION	Snežana Ćirić-Kostić, Zlatan Šoškić, Faculty of Mechanical and Civil Engineering, University of Kragujevac /Serbia/ Giangiacomo Minak, Dario Croccolo, Giorgio Olmi, Department of Industrial Engineering, University of Bologna /Italy/
ABSTRACT	**Project aim / summary:** AM belongs to those key enabling technologies where Europe has the leading research role. The AM technologies put considerably fewer limits on shape of the manufactured objects than conventional technologies and offer un-paralleled freedom to industrial and mechanical designers. Since the AM technologies are insensitive to production scale, they put in focus knowledge and creativity of designers instead of low prices of mass production, paving the way to development of new business models. The AM technologies, therefore, represent a technology platform that may best serve Europe in its intent to develop knowledge-based economy, driven by innovation.  However, the industrial deployment of AM technologies is hindered by a gap that exists between the excellent research and its exploitation in industry. The research knowledge about the AM technologies is published in scientific journals and in conference proceedings, in a form suitable for researchers. On the other hand, industrial and mechanical designers use sets of design rules, which represent condensed and comprehensive form of the research findings that are easy to follow. **The lack of sets of design rules for AM technologies is one of important reasons why engineers often prefer conventional technologies**

	to AM.
	
	A_MADAM project uses the research capacities and partnerships developed in previous EU funded projects to carry out systematic studies of dynamic mechanical properties (fatigue, fracture mechanics and impact resistance) of products manufactured by AM with the goal to establish the proper rule sets for design of products.
	
	Project Objectives
	
	• Define design rules for optimal dynamic properties of products manufactured by SLS technology
	  • Metal (steel) – fatigue
	  • Plastics (Polyamide)– fracture mechanics
	• Publish the rules in the form of open access digital repository of optimal design rules for products manufactured by SLS, which will include the already known optimal design rules for static mechanical properties, but also the established optimal rules for dynamic mechanical properties
	
	Research program
	
	• Fatigue behaviour
	  • Main direction: standard tests + standard samples
	  – 45 experiments on 654 samples
	  – Almost three years
	
	 
	
	  • Auxiliary direction: influence of product shape
	  – 10 experiments on 93 samples
	  – Around two years of work
	
	 
	
	• Fracture mechanics
	  • Influence of the material and crack orientation
	  – 16 experiments on 96 samples
	  – Almost two years of work
	
	 

Poster Contact	Snežana Ćirić-Kostić, cirickostic.s@mfkv.kg.ac.rs Zlatan Šoškić, soskic.z@mfkv.kg.ac.rs Project Manager: S. Ćirić-Kostić, Scientific Manager: G. Minak, amadam@mfkv.rs

14- IBUS

POSTER TITLE	Exploring the Possibilities of Additive Manufacturing in Safe Customised Toys & Games applications
PROJECT	**iBUS** – An integrated business model for customer driven custom product supply chain (CA-646167)

AUTHORS & AFFILIATION	iBUS Consortium
ABSTRACT	**Introduction**: iBUS platform allows to transform the design information coming from the customer into a form that allows the supplier, included within the iBUS supply chain, to manufacture the customised design. Designs can be achieved multichannel; bought by the consumer (professional or not), adapted from a manufacturer or be a consumer's own design. Therefore, iBUS platform (Dooventure) is suitable for makers, buyers, professional designers, manufacturers or any dabbler aiming to create its own customised product. **Objective:** Minor, parametric and free-form types of customisations are being analysed. A set of comprehensive case studies that shows the different manufacturing techniques to use in each of the increasing complex worked examples have been developed. Only those addressing to additive manufacturing techniques are displayed in this study. To meet Toys safety EN-71 requirements, materials have been previously validated. **Results: Action Figure:**  Figure 5 3D design of the action figures and pieces obtained by Polyjet **Level of Customisation**: Parametric. Potential to change the dimensions (length, width…) or colour of the different parts. Minimum thickness of the parts parametrised in the design phase within the iBUS design virtual environment. **Methodology and materials used**: The following technologies and materials, which were previously validated were used: Object polyjet; VERO family resins Laser sintering; polyamide FDM; PLA MCOR; paper MFJ; PA **Safety according to EN-71**: Material cleanliness, edges, points and metallic wires, warnings and instruction of use. Children under 3: Small parts, torque test, tension test, drop test, impact test to check if, in case of breakage, accessible hazardous sharp edges, sharp points or small parts are produced. Some design factors can be parametrised in the design tool. Physical tests to be carried out in the Lab. In case of assembly by the children, small parts are produced and would not suitable for children under 3 years old. **Safety Results**: Only suitable for children over 3.

	Slot cars (WRC[1])  Figure 6 Laser Sintered, FDM & MFJ PA manufactured slot cars **Level of Customisation**: Free-form. Potential to change the external shape of the body car (not the chassis to allow running through the tracks). External volume dimensions limited (double track and bridges along the circuit). Minimum thickness. **Methodology and materials used**: The following technologies and materials, which were previously validated were used: Object polyjet; ABS like resins, VERO family resins Laser sintering; polyamide 12 FDM; PLA MCOR; paper material (post-treatment) MFJ; polyamide 12 **Safety according to EN-71**: Material cleanliness, edges, points and metallic wires, moving parts against each other, drop test, impact test, accessibility of a part or component, sharpness of edges, sharpness of points. Children under 3: warning and instructions for use. **Safety Results**: All the cars met the standards except Objet polyjet cars (for children under three) as they generated small parts and sharp edges or points when applying the impact and drop tests.
Poster Contact	*Paco Varela – Email: proyectos@aiju.info*

Posters from 3DP Pilot Vanguard Initiative

1. Healthcare demo case

POSTER TITLE	3DP Pilot Vanguard Initiative – **Healthcare demo case**

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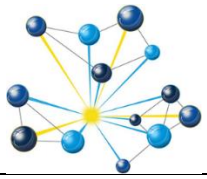
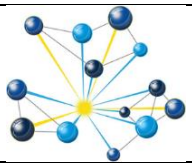
PROJECT	 https://s3vanguardinitiative.eu/cooperations/high-performance-production-through-3d-printing
AUTHORS & AFFILIATION	Lead partners: Alberto Leardini - Istituto Ortopedico Rizzoli (Emilia Romagna) Participating regions: Saxony, Wallonia, Nordrhein-Westfalen, East Netherlands and Flanders, Emilia Romagna Interested companies: CRP (IT), Materialise (BE), Antleron (BE)
ABSTRACT	<u>Vision: scope and objectives</u> The case aims at developing cross regional demonstration activities in the fields of 3D printed external orthosis and internal implants/prostheses. In the long term, the main objective seeks to demonstrate the feasibility, the value, the sustainability and the efficacy, as well as safety, of the 3DP technology once applied to medical problems. As mentioned below, the first step of the demo case is to develop a certification guide. Indeed, the new regulation of medical devices at EU level does not include concrete information on certification procedures, particularly for products from additive manufacturing. This leads to high uncertainty among companies willing to introduce new 3DP-based medical products for the market <u>Implementation: concept and state of play</u> As a first step, this demo case aims to develop a guide aimed at certification bodies that would identify useful certification procedures. Gathering of cross regional information and expertise is essential for the elaboration of such a 'certification guide'. As a starting point, the guide would focus on the following applications: -Orthotics: foot and ankle orthosis, lower hand and arm; -Internal implants and reconstruction: total ankle replacement, general implants, and bones reconstruction Currently 6 regions are actively involved in this demo case. In order to structure the work and activities to be undertaken in the coming months, several work packages have already been defined and elaborated. First action related to WP1 (collection evidences) were undertaken.
Poster Contact	*Alberto Leardini (DPhil – Istituto Ortopedico Rizzoli, Bologna) – leardini@ior.it*

2. 3DP hybrid components demo case

POSTER TITLE	3DP Pilot Vanguard Initiative – **3D-Printed Hybrid Components**
PROJECT	 https://s3vanguardinitiative.eu/cooperations/high-performance-production-through-3d-printing
AUTHORS & AFFILIATION	Lead partners: Luca Tomanesi - Universita di Bologna, UNIBO (Emilia Romagna) Partners: -Participating/co-leading regions: Aragon [ES], Norte [PT], Baden Wurttenberg [DE], Saxony [DE], Lombardy [IT], Rhone-Alpes [FR] and Region Orebro Lan [SW]. -Other organisations: CIRI MAM University of Bologna [IT], TUC Chemnitz [DE], German Aerospace Center (DLR) [DE], Institute of Vehicle Concepts [DE], Politecnico di Milano [IT], Centre Technique de la Plasturgie [FR], Alfred Nobel Science Park [SW] and more than 7 companies
ABSTRACT	Vision: scope and objectives This demo case aims at demonstrating the added value of 3DP metals-CFRP (Carbon Fibres Reinforced thermoplastics) combinations for different automotive and industrial applications. In particular, the demo case focuses on combining components made from different materials and technologies (in particular combining CFRP and metals) but not on printing together combinations of different materials (e.g. metal and CFRP). The demo case therefore relies on available and already well know technologies and focuses relatively more on 'functional design-related activities' (than on 'technology-related' activities). The 3DPrinting technologies enable new ways to create metal inserts, by instance metal cores within fibre reinforced polymer. Those inserts are enhanced through weight reduction and new topological designs. Nevertheless, mechanical properties (stiffness, solidity…) are preserved, or even improved. The demo case aims at deploying industrial uses of such inserts. In particular, the demo case aims to cover the entire value chain of European automotive, and particularly in the segments located at TIER-1 and TIER-2 levels (SMEs or midcaps). In order to achieve this objective, the demo case will connect existing and complementary demonstrations facilities in the participating regions through the creation and management of a common platform. Implementation: design and targeted actions The targeted offered services are: product/process design, process demonstration and setup, products/process testing through the creation and management of a platform. A possible outline of a common platform is suggested in the following figure:

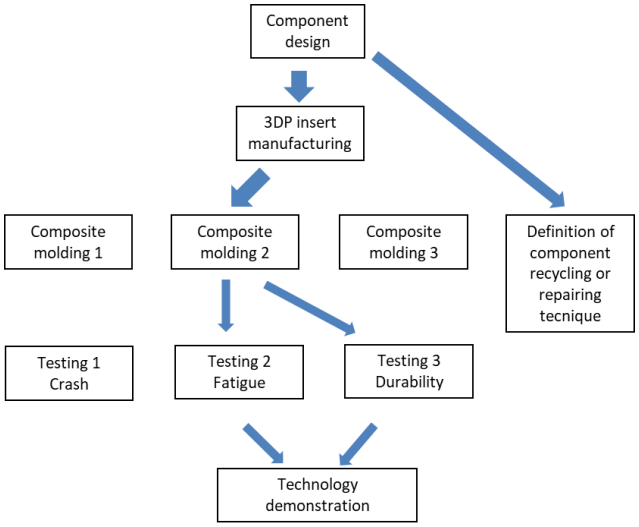


Figure 7: Possible outline of a common platform

Several manufacturing and testing options are offered through the platform. The Pilot Sequence is initially defined by the specific technology, while the testing needs would be pulled by the final use.

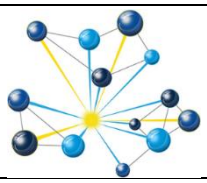
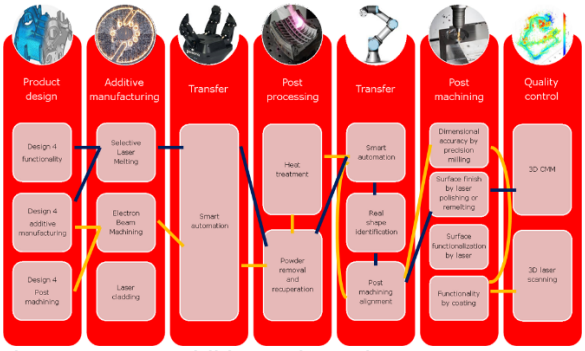
Industrial companies are key actors for the Pilot Composite, as production facilities are capital intensive. A Pilot team is formed for each application. The final customer makes the component design, supported by the concept Centres and DFM of each Pilot Partner.

The business model relies on the following principle: income is generated through paid project-based trial set-ups and production runs for participating companies. Specific consortium agreements account for IPR issues. Financing is revolving and could be yielded through different sources:

- A daily fee for access to the pilot plants,
- A percentage of revenue paid by the user,
- A yearly fee from technology partners,
- A co-funding 'in kind' by most of the SME's and other partners e.g. through HR supply.

Poster Contact	*Luca Tomesani (UNIBO), luca.tomesani@unibo.it*

3. Additive-Subtractive platform demo case

POSTER TITLE	3DP Pilot Vanguard Initiative – **Additive Subtractive Platform**
PROJECT	 https://s3vanguardinitiative.eu/cooperations/high-performance-production-through-3d-printing
AUTHORS & AFFILIATION	Lead partners: Coen De Graaf - Brainport (South Netherlands), Bianca Maria Colosimo - Lombardy [IT] Partners: -Participating regions: Baden-Württemberg [DE], Emilia-Romagna [IT], Flanders [BE], Trentino [IT], Saxony [DE], Wallonia [BE], East Netherlands [NE], Lower Austria [AT], Brainport - South Netherlands [NL], Lombardy [IT] -Organisations: Brainport Development [NE], TU Chemnitz (MERGE) [DE], DLR [DE], CIRI MAM University of Bologna [IT], Flame3D [BE], Politecnico di Milano [IT]
ABSTRACT	Vision: scope and objectives The demo case aims at integrating additive & subtractive technology production flows to enable a quick, professional analysis of several production process set-ups by the participating companies. In order to do so, the objective is to develop a digitally connected network of pilot lines / production hubs able to test and produce in a cost effective way, a piece or a small product series. The demo case will target production with an extremely high precision, a high quality of finish and a significant added value, by combining additive and subtractive technologies for a wide range of specific applications. Around 20 'uses cases' (i.e. specific requests by companies requiring services from the platform) have been identified and cover all of the aforementioned value chains. Implementation: concept and targeted actions The demo case aims to set up a platform of (digitally) networked production hubs to test the production of existing parts via Additive manufacturing (focussing on high-end metal parts). The figure below illustrates the types of integrated services provided by the platform. More specifically, the following preliminary allocation of services among regions has been elaborated:  *Figure 8: 3DP additive-subtractive case - scope*

	1) Material selection and characterization (South Netherlands, Wallonia); 2) Design for AM – topological optimization (South Netherlands, Wallonia); 3) Laser and EBM powder-bed processes (all regions); 4) Directed Energy Deposition (Lombardy); 5) Hybrid systems combining directed energy deposition + subtractive (South Netherlands), process optimization and simulation (Lombardy, Wallonia); 6) Heath treatment (South Netherlands); 7) Quality monitoring and control in-situ and offline (Lombardy); 8) Machining (all); 9) Standards (Wallonia, Lombardy); 10) Training (all). While an elaborated business model still has to be further specified, the general functioning of the platform will be as follows: A decentralised model will connect demonstration facilities, whose facilities will be upgraded when key assets are missing in the network (see Annex with list of missing assets). Requests from companies will be submitted to a centrally managed 'one-stop shop' connecting all participating facility centres; Relevant (materials, capabilities, proximity, etc.) facility centres will be invited to submitted offers to the request. The best offer will be selected by the company. Revenues for the management of the platform will be generated through the different possible funding sources to be investigated further in the coming weeks: 1) Access fees from companies, 2) yearly fees from facility centres, etc.
Poster Contact	*Coen De Graaf (South NL), cdgraaf@brabant.nl and Bianca Maria Colosimo (Polimi), biancamaria.colosimo@polimi.it*

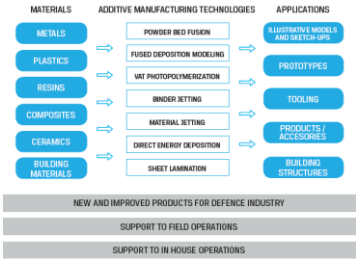
4. 3DP automotive components platform demo case

POSTER TITLE	**European Reference Pilot Centre for Large Volume-size Additive Manufacturing for metal and non-metal materials**
PROJECT	*Vanguard Initiative (Demo Case: 3D-Printed automotive components (mono-material) for large (>2500 mm), medium and small complex parts)* *https://s3vanguardinitiative.eu/cooperations/high-performance-production-through-3d-printing* VANGUARD INITIATIVE NEW GROWTH THROUGH SMART SPECIALISATION
AUTHORS & AFFILIATION	Berta Gonzalvo / José Antonio Dieste/ Iván Monzón / Alberto Laguía/ Javier de Vicente, AITIIP TECHNOLOGY CENTRE

ABSTRACT	The main objective of the '3D-Printed automotive components (mono-material) for large, medium and small complex parts' demo case, is the application of additive manufacturing technologies in the **broad industrial sector**, such as automotive, aeronautics, shipbuilding, railway and construction. The demo-case targets more specifically the further **development and integration of advanced WAAM metal Additive Manufacturing technologies, and resin-based 3D printing, with innovative Mobile Robot solutions and Artificial Intelligence**. It is expected to contribute to the complete deployment, acceptance and adoption of these advanced metal and resin AM technologies through measurable and vast improvements in the quality, sustainability and productivity of metalworking industries in Europe. Vanguard Initiative by means of the Pilot Facility implementation for this Demos case will enhance the collaboration of several European interested regions, to accelerate the development and industrial use of large size 3D printing in large, medium and especially small companies.
Poster Contact	*Joseantonio.dieste@aitiip.com* *Berta.gonzalvo@aitiip.com*

Other projects

1.- AM-factory

POSTER TITLE	Exploring new sectors by deploying an AM-factory
PROJECT	EDA-AM project - *EDA Additive Manufacturing Feasibility Study & Technology Demonstration* Reference: EDA-16.ESI.OP.144 Website: https://eda.europa.eu/what-we-do/activities/activities-search/additive-manufacturing-3d-printing-feasibility-study-technology-demonstration
AUTHORS & AFFILIATION	Almudena González Álvarez, Fundación Prodintec David Santos González, Fundación Prodintec Paula Queipo Rodriguez, Fundación Prodintec Patricia López Vicente, European Defence Agency (EDA)
ABSTRACT	AM have a significant potential for to enhance defence capabilities. Among them, the most likely are mobility, sustainability, ensuring platform availability, effect and protection through e.g. on-site and on-demand field repair & maintenance, reduced logistic burden of deployments and improved sustainability in warfighting and peacekeeping missions. Substantial economic benefits are also expected.  To identify and explore areas where additive manufacturing will have a wider impact, the European Defence Agency (EDA) commissioned Prodintec (www.prodintec.es) and MBDA FR (www.mbda-systems.com) to conduct this project. The project targeted the entire spectrum of European defence and AM stakeholders, at all levels of defence and AM supply chains. **Objectives**: • Raise awareness in the defence community and of promoting a better understanding of the potential held by these technologies, thereby stimulating their implementation in defence specific areas. • Create synergies between the R&T community and the operational staff, helping the R&T community to understand the requirements from the operational side. • Demonstrate the deployability of these technologies in a simulated defence specific scenario.  **Workstrands**:

	• State of the art and strategic study, • Technology demonstration, including the deployment of an AM-factory. • Conference and exhibition on AM. Thanks to the project, not only the R&T community is informed, but also other potential beneficiaries of the technology, linked to the EDA capabilities mentioned above. This creates a synergy between the R&T community and the operational staff, helping to understand the requirements from the operational side.  **Conclusions**: • While there are different available AM technologies, current technical capacities and cases of application are wide and varied, showing a promising future for their implementation in the Defence. • Non-technical factors (IPR, training, standardization and certification, health and safety, etc.) represent solid limitations for AM implementation, stronger in fact than technical ones. • Although it is remarkable how some organizations taking part on Defence activities currently have earned a significant experience on AM, overall Defence sector experience still needs to increase in order to achieve a broader perspective over the impact of AM on defence capabilities.
Poster Contact	Almudena González Álvarez, aga@prodintec.com

2.- LILIAM

POSTER TITLE	**LILIAM** – Lifelong Learning in Additive Manufacturing
PROJECT	*This project is supported by the KIC Raw Materials and aims to provide a training scheme for European specialists in Additive Manufacturing*
AUTHORS & AFFILIATION	Bianca Maria Colosimo (Politecnico di Milano) Jacky Lecomte (SIRRIS

ABSTRACT	The additive manufacturing techniques, like 3Dprintin or other techniques able to manufacture products with complex shape thanks to a “layer by layer” construction, are innovative technologies that open ne perspectives for the design of products. They are applied to different types of materials (polymers, metals and ceramics) and may be used in almost all sectors of the industry. Those techniques are able to reduce the amount of raw material used to manufacture a product, and that at least 2 ways: first, the material is placed only where it is needed for functional purposes, and second, there is no removal of material, like it is the case with the traditional techniques using machining, drilling and cutting. However, those techniques are not sufficiently known by the engineers and technicians, and need specialised people to be used at their best: their success is linked to several factors, like the optimisation of the design of the parts (topological optimisation), but also the perfect control of the parameters of the processes: in those techniques, the material is built together with the product, and the mechanical characteristics of the material are strongly linked to the process parameters. The present project aims to give an European frame to dedicated training programs in order to specialise different categories of workers (operators, designers, and engineers) towards the control of additive manufacturing techniques.
Poster Contact	*Bianca Maria Colosimo Biancamaria.colosimo@polimi.it* *Jacky Lecomte Jacky.lecomte@sirris.be*

3.- HYDRAULIC SYSTEMS

POSTER TITLE	**Additive Manufacturing to develop metal components for hydraulic systems**
PROJECT	This project is supported by POR FESR 2014-2020, Innodrovers S3 https://www.aidro.it/3d-metal-printing.html
AUTHORS & AFFILIATION	Valeria Tirelli (Aidro Hydraulics & 3D Printing) Maurizio Vedani (Politecnico di Milano)

ABSTRACT	The project aims to investigatee the microstructure and mechanical properties of hydraulic components produced by Selective Laser Melting (SLM) by Aidro Hydraulics & 3D Printing and tested in different heat treatment conditions, in collaboration with the Mechanical Department of Politecnico di Milano. There is a huge potential for applications of Additive Manufacturing for hydraulics and the research want to prove that this technology is reliable and generates unique advantages. One of the study cases is an hydraulic manifold normally used in a portable hydraulic power unit. The traditional hydraulic manifold has been redesigned for Additive Manufacturing and 3D printed in AlSi10Mg0,3 alloy to became a compact, lightweight manifold with the same mechanical properties as the machined manifold. The result is a hydraulic manifold that weighs about one-fourth that of its conventional counterpart machined from a solid block of metal. The 3D-printed manifold matches up dimensionally to a previous design.  *Figure 1. Traditional manifold 5 kg vs the 3D printed manifold 1,3 kg* The analyses made on hydraulic components produced by SLM compared their properties and verify the absence of defects.
Poster Contact	Valeria Tirelli valeria.tirelli@aidro.it