D6.4 AMable Experiment Success Stories (interim)

Project Information

Acronym	AMable
Funding	European Commission, H2020, Innovation Action (IA)
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Coordinator	Fraunhofer ILT, Aachen, Germany
Contact	projectoffice@amable.eu
Web site	www.amable.eu

Work Package	WP500, WP600
Confidentiality	PU

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0.1	28/01/20		Draft	All
0.2	30/01/20	Add logos and info missing	Draft	All
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1.0	03.04.2020	Layout		All,EC

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Distribution:	<list of partners>/all/EC

Contents

1 Abstract

Success stories from AMable started to evolve from the conduction of what we called the “initialisation experiment”. It was the first test of our approach to support SMEs in the uptake of AM through the provision of services. This deliverable gives details about the achievements from the first wave of experiments.

2 Introduction

AMable is a platform for SMEs that are interested in the uptake of additive manufacturing for their product ideas. AMable is creating an eco-system to provide impartial access to the best European AM knowledge to support this adoption. This knowledge will be offered as advanced and tailored services to assist SMEs in the adoption of AM and include technological, business and training services. As a core component of this, AMable conducts so called “application experiments” to support European SME’s and mid-caps to develop their idea of an additively manufactured functional product.

To build a truly pan European initiative, there are several renowned research institutes and best-of-breed consulting companies involved in the AMable project. Partners come from Germany, the UK, the Netherlands, Belgium, Spain, Greece, Finland, Italy, Poland, Denmark and Cyprus, among other countries. These partners provide the technological backbone for guidance and support to transfer ideas into production in a profitable way. This process is supported by the service offerings in the “AMable Service Arena”.

The AMable Service Arena was created to cover the whole value chain through three platforms: business, technology and skills. So, a SME or mid-cap can start at different stages of the production process: from the idea to the market.

The experiment needs to have an impact on European business and employment thus achieving an economic benefit. It needs to address at least one societal challenge: Environment, Energy, Mobility, Health and Well-being, Security.

The types of experiments are Feasibility Study (FS) and Best Practice (BP):

- ✓ FS: short-term experiments focused to analyse and demonstrate the feasibility of developing new additively manufactured products.
- ✓ BP: application experiments towards specific product performance and robust manufacturability which are conceived for testing, benchmarking, validation and improvement of new AM products, services and standards.

Experiments	3rd Party involved in experiment		Proposal length / pages	TRL	Number of services used per experiment	Duration / months	Cost* / Euro
	Supplier	User					
Feasibility Study Experiments (FS)	X		4	3-5	1-3	3-6	5k-25k
Best Practice Experiments (BP)	X	X	10	4-8	2-X	4-12	10k-60k

Figure 1 Table from the Guide for Applicants for experiment types

The SMEs have agreed on sharing and assess their experiences including their challenges or gaps (technical or not), milestones, business impact, benefits (ideally from the supplier side and from the user side but it could include benefit for the EU or the society as well: new jobs, impact on the global market in favor for the EU, reduction of emissions, Security level improvement, etc.). And it should be all described for a non-technical audience. The performance will be measured by the KPIs at the end of the whole project.

All services are provided by the AMable Consortium with was created thinking in complementarity and offering the broadest potential range for AM services. Actually, the list of services were collected in a matrix that will be improved along the AMable project.

"Tutors" or "Mentors" have a key role guiding SMEs through service arena and find a service provider, helping out with reporting and documentation fulfilling procedures, supporting experiment activities during the experiment and acting as coordinator of the experiment, interacting with SMEs. Business plan should be reviewed and approved by Tutor. Tutor could be also a service provider.

This document reports the results of the experiments from a success factor angle, focus on the more relevant experiment success stories of AMable project carries out during the two first Open Calls for experiments: OC1 and OC2.

Table 1. Service Matrix- how to find a service provider

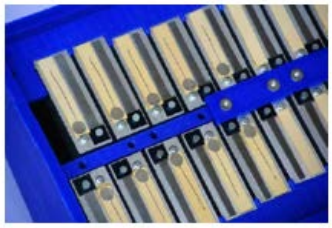
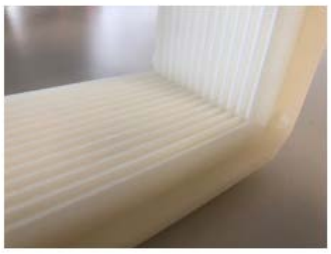
PARTNER	SERVICES													
	Maturity Assessment for AM	Implementation Roadmap Design	Access to Finance	AM Decision Support/AM Wizard	Design for AM	Visualization/ Immersive design	Modelling, Simulation and HPC	Data Analytics	Data Acquisition	Robotics	Industrialization	Quality Assurance and Certification	Post-Processing	Lifecycle Management Framework
AIMEN	X					X		X		X		X		
DTI	X				X			X					LEAD	
EWF	X										X	X		
FhG ILT	LEAD				X			X			LEAD			
FRC					X		LEAD							
IDS					X									
INSPIRE					X	X			LEAD		X			
KB	X	LEAD	X											LEAD
LMS				X	X	LEAD	X		X				X	
LORTEK	X				X	X		LEAD		X	X	X		
MTC	X				LEAD	X					X	X		
POLITO	X				X	X	X				X			
SIRRIS					X						X			
SUPSI								X			X			
TNO	X			LEAD		X		X			X	X	X	
TWI	X							X	X	LEAD		LEAD	X	
VTT	X				X		X			X	X			
WRCAMT		X							X				X	
ZABALA	X		LEAD											
Total	12	2	2	2	11	7	4	7	4	4	10	6	5	1

For further information, please visit:

https://www.amable.eu/
http://cordis.europa.eu/project/rcn/211557_en.html

3 AMable Experiment success stories

General information	
Experiment acronym:	T601 AMAC
Acronym description:	Producing accordion parts through additive manufacturing techniques
Duration (months):	4M
Type (FS/BP):	FS - Feasibility study
Lead participant company:	Pigini Nederland B. V.
Company contact:	info@pigini.nl
Industry sector:	Repair & sale of musical instruments
Country:	Nederland
Services used:	S305 S306 S314
AMable experiment Tutor:	Inspire (CH)
Tutor contact:	kleijnen@inspire.ethz.ch
Specific information	
PIGINI *Company Logo*	**Idea & Company's background**
	The idea is to replace conventional accordion parts with 3D printed parts to reduce labour costs during manufacture and repair: enhancing accessibility of the instrument, especially for children. Pigini Nederland have been the exclusive importer of PIGINI accordions since 2001. Professional musicians, teachers and musicians ranging from beginners to advanced know how to find their way to our studio for years. Service, maintenance, modifications, finding the best solution.
	Impact (by sectors)
	Health: Playing music is a means of expressing oneself and helps in people's wellbeing. Thus, the product will have a positive effect on the quality of life and health of the population. **Consumer Goods: T**he accordion is very suitable for using AM by being flexible and having the ability to produce personalised instruments, but affordable. It enhances the appreciation of musical instruments and the product stimulates creativity and happiness.
inspire *Tutor Logo*	**Challenge(s)**
	Mechanical and sound quality: The most important requirements. There is too much slack on each button, due to the physical properties of the print. A new mechanism for the moving parts needs to be constructed. Making the instrument sound more in line with the shifting possibilities of a conventional instrument is the second big challenge.

	Bellow Design: design a functional bellow to be incorporated in the product is a big challenge (low TRL). Design will be on the edge of what's possible with AM. it needs to be durable and multi-material, as it requires both rigid and flexible parts but to be strong in the right direction on all four sides.
	Objectives
	1.- Creating a fully functional instrument for children, with a focus on the right-hand side of the instrument. Ideally, this instrument is constructed without the use of (conventional) wooden parts. **2.-** Establish a cost reduction compared to a conventional instrument of similar size. The result must be a full-fledged, durable and well-sounding product that can compete with the current instruments on the market. **3.-** Evaluate suitable production technologies, such as extrusion or powder-based in AM.
 *Photo 1*	**Benefits - how did AMable help?**
	Up till this point, AM techniques have been used as a starting point in the design process. Now it is the time for further experimentation and technical optimisation. In the production stage, AM techniques is a game changer. We improved the design and build out an adept company that makes high-quality products in an ethical manner. Creating a full-fledged and affordable alternative to conventional accordions. We further command the techniques of AM in order to create an improved design and thereby showcase the added value of AM to the instruments market.
 *Photo 2*	**Contribution to European Union (EU)**
	-Increase in local production (instruments) -Boost in AM market. A showcase is as an inspiration for others, as well as the actual economic boost on AM-related equipment. -Mental wellbeing and quality of life will increase through playing music by increasing instrument access for EU citizens -Material reduction through additive technologies
sirris driving industry by technology inspire *Service provider Logos*	

General information	
Experiment acronym:	T602 BEACTIVE
Acronym description:	Development of Personalized orthopaedic assistive devices with anti-microbial properties and super-hydrophobic surfaces by exploiting the Additive Mamufacturing (AM) principles combined with advanced composite materials.
Duration (months):	12M
Type (FS/BP):	BP - Best practise
Lead participant company:	BioG3D
Company contact information:	dbras@biog3d.gr
Industry sector:	Material Science
Country:	Greece
Services used:	S306 S308
AMable experiment Tutor:	MTC
Tutor contact information:	Andrew.Triantaphyllou@the-mtc.org
Specific information	
Company Logo	**Idea & Company's background**
	BioG3D is dedicated to the development of customized products through AM techniques. It is engaged with all stages of research and development of novel composite materials and filaments for AM as well as their functionality assessment, towards a holistic approach for the fabrication of products with defined external shape and internal micro-architecture. It will be developed innovative feedstock materials for FFF based process for the fabrication of medical devices that can be re-processed and recycled after the complete remedy of patients. By tailoring filaments composition with anti-bacterial and anti-microbial nanoparticles (NPs), bioactive AM products will be realized. Hybridization of FFF machine with cold atmospheric plasma also permit to obtain super-hydrophobic properties in the 3D printed devices in one-step process.
	Impact (by sectors)
	Health: BeActive will pave the way for the fabrication of new generation personalized assistive devices, by combining 3D printing technologies with innovative nanocomposite thermoplastic materials and surface nano-functionalization. Since it presents high digitalization and automation, the proposed process possesses the required flexibility to accommodate the

	demand for mass customization. This innovative approach has the potential to revolutionize the use of casts or splints, due to the development of devices designed to prevent bacterial infections and with improved water tolerance. Additionally, the proposed lightweight designs that perfectly fit the anatomical features of each patient will provide ultimate support, thus facilitating effective treatment without affecting daily tasks, even for the most demanding patient, such as small children. **Consumer and goods:** The strategic objective is to achieve its goal with a cost-effective, user- and environmentally-friendly device covering the extended consumer needs. Although today some 3D printed assistive devices with tailored structure have been produced, the development of devices with anti-microbial and super-hydrophobic properties is a relatively complex process. BeActive will introduce in the EU and global market widely available, inexpensive, high-performance splints or casts, thus facilitating personalized treatment and wound dressing without affecting everyday life and without the problems associated with the cumbersome and heavy traditional devices. This innovative approach will also demonstrate a leverage effect on reducing healthcare costs and improving quality of life. BeActive's ambition is therefore no less than a significant contribution to a more sustainable world.
mtc Manufacturing Technology Centre *Tutor Logo*	**Challenge(s)**
	Environment: zero-waste process. Furthermore, medical devices will be recycled after the complete remedy of each patient and will be re-used for the development of new devices with commercial value. **Health and well-being:** Fractures or broken bones, either caused by trauma or bone diseases, are among the most common orthopaedic problems, thus these is an increased demand for personalized assistive devices that will allow patients to return to their everyday life with a reduced impact on their abilities to perform everyday activities.
	Objectives
	The ultimate goal is to establish manufacturing processes and provide high-value design services and product materialization to many different fields of industry. It is also envisaged to expand activities and incorporate further AM technologies. Main objectives: 1: Development of medical devices with high degree of customisation 2: Avoid risk of infection & Allow easier re-dressing of wounds 3: Tackle limitation of patients' exposure to water

	4: Lightweight & More attractive Devices
 *Photo 1*	**Benefits - how did AMable help?** The technologies proposed in BeActive allows the precise control and repeatability of the AM processes, increase cost-effectiveness and robustness of the process and resulting products, and demonstrate direct benefit to the involved industries in the form of reduced costs.
 *Photo 2*	**Contribution to European Union (EU)** -New business opportunities regarding nanotechnology, advanced composite filament production and AM systems -Enhance European world leadership in 3D printing of medical applications
mtc Manufacturing Technology Centre FREDERICK RESEARCH CENTER *Service provider Logos*	

General information	
Experiment acronym:	T603 CLIMATE
Acronym description:	Development of a Lithography-based Metal Manufacturing (LMM) to build mold-inserts with integrated topology optimized conformal cooling channels.
Duration (months):	6M
Type (FS/BP):	FS - Feasibility study
Lead participant company:	ARGO
Company contact information:	Eleonora.doglio@argosrl.eu
Industry sector:	Innovation management and services for SMEs
Country:	Italy
Services used:	S314
AMable experiment Tutor:	Politecnico di Torino
Tutor contact information:	mariangela.lombardi@polito.it
Specific information	
Company Logo	**Idea & Company's background**
	The main idea is to develop an integrated solution including both design and manufacturing of high added-value mold inserts with internal Conformal Cooling (CC) channels. CC in molding is related to channels that follow the shape of the cavity and core, reach hot spots, and promote temperature uniformity in the molten materials being molded. ARGO develop innovative simulation models using open source CAE software. ARGO possess CAD skills and software to design or modify geometry and perform pre-processing and meshing.
	Impact (by sectors)
	Aerospace: Enabling technology for the production of more complex and optimized (i.e weight reduction) components with higher fatigue life **Automotive:** idem. **Consumer Goods:** idem. **Industrial Equipment and Tooling:** Production of highly optimized inserts to increase the molding technology productivity.
Tutor Logo	**Challenge(s)**
	Design tools for conformal cooling are fast developing however there is a real lack in the manufacturing processes capability for complex hollow metal inserts. Actual AM produces too rough surfaces affected by severe thermal fatigue damage. LMM technology can provide better surface roughness and

thus strongly reduce the thermal fatigue intensity, promoting thus the manufacturing of long lasting high quality CC mold inserts capable to withstand the cycle loads. A new optimized and CAE based design route is required to speed up design process of such high technology inserts.
Basically, any shape can be printed with the LMM printer, however, a successful debinding and sintering step requires certain guidelines.
-To find the best optimization rule to maximize the surface heat removal.
-With the LMM printing process a green part is manufactured which needs a dedicated debinding and sintering step which are critical properties to achieve the experiment goal. And Lithoz to develop a dedicated M2 steel post-processing strategy.

Objectives

1.- Find a suitable case study for CLIMATE approach
2.- Evaluate first manufacturing criteria/constraints to be implemented in the optimization model.

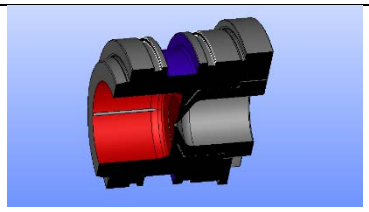


Photo 1

Benefits - how did AMable help?

To evaluate the technical capabilities in terms of LMM AM technology (i.e. minimum thickness, final roughness, dimensional tolerance) for M2+binder material. Post-processing step defined and validated with the help of Politecnico di Torino (tutor). Lithoz is involved in the development of a sustainable LMM process. Furthermore, **ARGO** setup and further develop its TO-CFD algorithms forward to the LMM AM process basing on the technical capabilities.

Photo 2

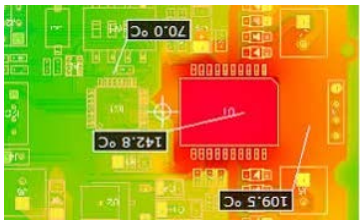
Contribution to European Union (EU)

-To plan a business expansion in the molding sector, both polymer and metal injection (nowadays leaded by Asia, production companies outsourced due to low manpower cost). CLIMATE makes the IM more convenient exploiting high added value technology and qualified manpower, reducing the influence of low-quality manpower cost.
-CLIMATE can thus bring back European economy to higher competitivity both in mold making and IM parts production.

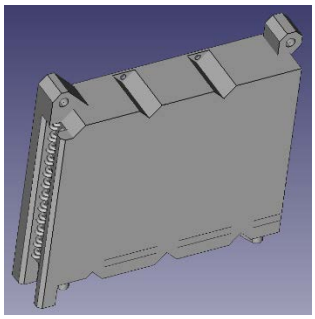
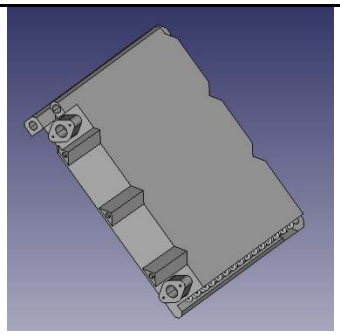
POLITECNICO DI TORINO

Service provider Logos

General information	
Experiment acronym:	T604 ENCLOSENS
Acronym description:	Design, simulation, analysis and manufacturing of functional enclosures using AM technology for outdoor sensors and accessories for Smart Cities addressing lot-size one market challenges
Duration (months):	8M
Type (FS/BP):	BP - Best practise
Lead participant company:	HOP Ubiquitous S.L.
Company contact information:	jara@hopu.eu
Industry sector:	Consulting services to enable IoT-based solution
Country:	Spain
Services used:	S303 S305 S306 S308 S312
AMable experiment Tutor:	Sirris
Tutor contact information:	benjamin.denayer@sirris.be
Specific information	
undo prototipos hop ubiquitous *Company Logo*	**Idea & Company's background** EncloSensors aims to design, simulate, validate and manufacture enclosures to house outdoor sensors for Smart Cities that reach a trade-off between accuracy of data values and protection for outdoor hazards. HOP Ubiquitous is specialized in IoT connectivity, IoT management and provisioning of consulting services to enable IoT-based solutions. Undo Prototypes (third party) is focused on design of prototypes of functional products for other companies, developing all phases of the process, from the study of the requirements, CAD design, simulation, prototyping and final manufacturing.
	Impact (by sectors) **Health & Electronics.** This project is especially aimed at encapsulates for sensors. To measure different parameters that have a direct impact on people's well-being and health. **Industry.** HOP Ubiquitous sensors have an impact on industry, as cities often seek to monitor as emission hotspots of industries close to the city.
sirris driving industry by technology *Tutor Logo*	**Challenge(s)** -Design and implementation of any type of sensor requires high precision and sensitivity. During the design of the enclosure, all physical variables that affect each sensor must be taken into account, to create an optimal design that ensures proper operation while protecting the sensor.

	-Capacity and manufacturing costs.
	Objectives
	1. Obtain functional 3D enclosure designs for each sensor in a cost-effective / scalable way, to also satisfy lot-size-one production requirements. **2.** Preliminary design validation: check all pieces fit into each other. Prototypes will be assembled together with real sensors to test sensor behaviour. **3.** Prototypes of designs verified using different AM technologies and materials and taking into account needs/requirements from different environments. **4.** Verification of prototypes under real operating conditions (at least different 3 locations). **5.** Manufacture of validated prototypes in small quantities to attend lot-sizeone market feasibility & product cost-effectiveness. To get the encapsulate.
 *Photo 1*	**Benefits - how did AMable help?**
	To develop custom enclosure for each sensor that the company develops and integrates, so that they meet functional requirements of each sensor, provide robustness and protect the sensors against adverse weather conditions and have a pleasant aesthetic that increases interest in our product. Technical support from AMABLE project specialists: -Decision support for AM uptake. -Design for AM. -Modelling, simulation and HPC. -Industrialization of AM. -Post-processing.
Paste here a HD Experiment image – *Photo 2*	**Contribution to European Union (EU)**
	-It will necessary professionals from different categories and skills to develop different tasks. -Investment in new raw material, machines, tools, getting the support from third parties, etc. And that means people working with news salaries which should be spent in their economics. -Achieve a leader position of European countries at technology level, getting an innovative solution. -Environmental monitoring solution to enhance and raise awareness about air pollution
sirris driving industry by technology; mtc Manufacturing Technology Centre; DANISH TECHNOLOGICAL INSTITUTE *Service provider Logos*	

General information	
Experiment acronym:	T605 IHEMAM
Acronym description:	Innovative Heat Exchanger by Metal Additive Manufacturing
Duration (months):	10M
Type (FS/BP):	BP - Best practise
Lead participant company:	RAMEM SA
Company contact information:	slopez@ramem.com
Industry sector:	Engineering and Manufacturing
Country:	Spain
Services used:	S306 S308 S314
AMable experiment Tutor:	LORTEK
Tutor contact information:	jcpereira@lortek.es
Specific information	
RAMEM Your Engineering and Manufacturing Partner *Company Logo*	**Idea & Company's background**
	EPSILON is a French thermal & fluidic engineering company with strong expertise in thermal, EPSILON develops specific products such as test benches or scientific equipment. In this i-HEMAM EPSILON will have the role of USER. **i-HEMAM** product idea is an innovative Heat Exchanger (HE) that can function in severe environments as helicopter engine one with new functionality; then it must respect aeronautics standards. It has been developed in the context of a "micro hybridization" of a gas turbine to ensure the thermal management. It has several functions: • Cooling a complex high-power electronic device • Transfer heat flux between two fluids and maintain their temperatures within the allowed ranges.
	Impact (by sectors)
	Health: Healthier breathable air **Aerospace**: More electric Aircrafts, cleaner and more efficient **Automotive**: Future applications regarding HE in automotive **Electronics**: HE of complex electronic devices is one of the goals **Energy**: Future applications for HE of Energy turbines
	Challenge(s)
	-Redesign for AM avoiding the leakage problems. -Redesign for AM solving the manufacturability issues.

IK4 LORTEK Research Alliance *Tutor Logo*	-Assessment of different manufacturing strategies and thermal distortion simulation during the AM process to anticipate eventual problems. -Redesign for weight reduction, removing the additional material that needed to be included to allow manufacturability using AM. Several orientation strategies may be an option to reduce or eliminate the additional material.
	Objectives - **1:** Redesign the geometry to improve the mechanical characteristics of the HE and to allow the manufacturing using AM - **2:** Redesign the HE to reduce weight - **3:** To deliver a functional HE to the user manufactured using AM and post-processing to be evaluated by the user.
 *Photo 1*	**Benefits - how did AMable help?** -To gain knowledge in how to improve the design of the HE to fulfill the specifications, including mechanical performance, lightweight and minimize defects on new designs for AM -To evaluate the Thermal distortion of the HE when manufacturing using AM. -DTI Assess the postprocessing strategies and the knowledge in how to reduce weight and improve surface quality in HE additively manufactured, if finally needed
 *Photo 2*	**Contribution to European Union (EU)** -New product sold by a European SME Competitiveness of the EU: AM HE redesigned and first steps for qualification taken -Competitiveness of the EU: HE Modelling expertise
mtc Manufacturing Technology Centre FREDERICK RESEARCH CENTER DANISH TECHNOLOGICAL INSTITUTE *Service provider Logos*	

General information	
Experiment acronym:	T606 SASSHPPE
Acronym description:	Shock Absorbing Structures for Sport Helmet Personal Protective Equipment
Duration (months):	10M
Type (FS/BP):	FS - Feasibility study
Lead participant company:	Topofab
Company contact information:	bernat@topofab.com
Industry sector:	Digital Fabrication
Country:	Spain
Services used:	305: AM Decision, 308: Modeling
AMable experiment Tutor:	TNO
Tutor contact information:	Aart_willem.benschop@tno.nl

Specific information	
TOPOFAB  *Company Logo*	**Idea & Company's background**
	Design and test of shock-absorbing structures produced by AM to be applied to helmets used as PPE in sports as climbing, biking, skating, etc. Topofab has experience with multiple AM technologies and plans to integrate new technologies as they become available for our customers. Our ambition is to provide design and consultancy services that cover the available and future AM technologies. The overall business objective is to help clients to innovate their business models and product offerings via AM technologies. Our services roadmap follows the AM software and hardware releases and innovations.
	Impact (by sectors)
	Health: Design of safer PPE **Consumer Goods**: A new kind of Personal Protective Equipment products could emerge from this project, creating a whole new market for better performing helmets, for the workforce, for transportation and for leisure and sports. **Industrial Equipment and Tooling**: Personal Protective Equipment must pass safety regulations, and is a mandatory equipment in most factories, industrial plants and construction sites.
TNO innovation for life *Tutor Logo*	**Challenge(s)**
	The technical challenge of this project is choosing and adapting the lattice to the chosen product. To our knowledge lattice structures have not been employed in Personal Protection Equipment. Being a lattice structure, the main challenge regarding AM

technology might be support-material removal and removal of enclosed raw material. To solve this challenge, a technology that doesn't require support structures might be chosen, and the lattice design might be developed using open-cell geometries.
Being a Personal Protection Equipment (PPE) product, the main challenge might be the mechanical properties of AM material and its stability over time.

Objectives

As helmets are heavy and inconvenient to wear, people often avoiding wearing them. Even when wearing a helmet and a person is hit, there is still a risk of injury because shock absorption limits. So, there is a real need for lighter, more convenient to wear helmets, with improved shock absorption. In the experimentation team: productosclimax.com (user partner) is currently selling sporting personal protection equipment which are used in outdoor sport scenarios. Current market price of sporting activities helmet PPE (depending on usage, demand price perception, and country safety regulations) ranges from 50 to 300 Euros. If the experiment is positive it is expected the producer to increase its product line, its reputation and to reach new market segments.

Photo 1

Benefits - how did AMable help?

With AMable financial & technical support Topofab managed to design and produce a lattice structure that meet the requirements for shock absorbing.
Selection of materials was done with the help of the decision support service of TNO and methodology to come to the right structure design was done with the help of lattice structure experts at MTC.

Photo 2

Contribution to European Union (EU)

-High skill job creations (5 operators of highly sophisticated AM machinery)
-Design of safer Personal Protective Equipment and so decrease injuries
-A new kind of Personal Protective Equipment products could emerge from this project, creating a whole new market for better performing helmets, for the workforce, transportation, leisure & sports.

Service provider Logos

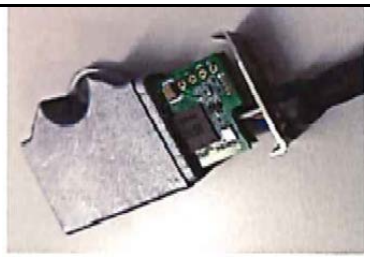
General information	
Experiment acronym:	T607 WAAMTOP
Acronym description:	Wire Are Additive Manufactured Titanium Optimized Parts
Duration (months):	12M
Type (FS/BP):	BP - Best practise
Lead participant company:	Ramlab BV
Company contact information:	Vincent@ramlab.com
Industry sector:	Metal industry sector
Country:	The Netherlands
Services used:	S306 S315
AMable experiment Tutor:	TWI
Tutor contact information:	emily.davison@twi.co.uk

Specific information	
RAMLAB *Company Logo*	**Idea & Company's background**
	WAAMTOP enables and optimises the deposition of metal on large industrial components. Based on the wire arc technology, titanium is deposited on parts like propellers of marine ships. Robots are brought together with innovative processes to achieve material build up rates that are economically viable and to produce final material properties. The overall solution ensures full functionality of the part. RAMLAB is a service provider of Wire Are Additive Manufactured (WAAM) parts and has the Vision to make large metal parts on demand, when they're needed, where they're needed. RAMLAB is an initiative of three founding partners: Port of Rotterdam, InnovationQuarter and RDM Makerspace. RAMLAB is building up a portfolio of WAAM parts made for different industries with different materials. Titanium is one of those materials that RAMLAB wants to add to it's portfolio.
	Impact (by sectors)
	Aerospace. Titanium is a common material in this sector. Fokker has shown interest if RAM LAB will add Titanium to it's portfolio. As Hittech case, the buy-to-fly ratio would be reduced. **Automotive.** Automotive companies would benefit from economy manufacture of liqht weight parts **Industrial:** hittech is an industrial equipment and tooling supplier. **Equipment**: Also the tooling sector will benefit from economy and Tooling manufacture of particularly large size amd liqht weiqht parts.

	Challenge(s)
	RAMLAB has experience in the WAAM process for producing near net metal parts. This technology is particularly of interest for difficult to machine materials such as Titanium, with which RAMLAB does not have experience. The key technical challenge is to demonstrate the feasibility of producing TI-parts at RAMLAB, which meet with the required quality and manufacturing cost targets. Also of importance is being able to develop new toolpath strategies that are suitable for manufacturing complex geometries using Ti.
Tutor Logo	**Objectives**
	-Create less waste (90% material use) -Manufacture parts on demand (no stock needed) -Unlock local production (creating jobs and minimizing transportation) -Reduce lead time which saves need for additional machines this saves needed floor space -Also the use of data capture (as it currently already done) for further process optimization and quality control is part of the exploration study.
	Benefits - how did AMable help?
 *Photo 1*	To reduce of waste during the production of titanium parts thanks to the uptake of AM: material, energy, cutting tools and valuable machining hours. The further use of already captured data is another important element of the experiment where RAMLAB suppose it can expand its expertise.
	Contribution to European Union (EU)
	-An improved buy-to-fly ratio means there is less waste and reduces the environmental impact of producing such components (90% material use). -Creation of local jobs which increases competitiveness of workforce and reduces transportation emissions (Unlock local production) -Manufacture parts on demand (no stock needed) -Reduce lead time which saves need for additional machines this saves needed floor space
Service provider Logos	

General information	
Experiment acronym:	T608 VISEAM
Acronym description:	Additive Manufacturing of casing for Vibration Sensor
Duration (months):	5M
Type (FS/BP):	BP - Best practise
Lead participant company:	Future Materials AS
Company contact information:	ahn@futurematerials.no
Industry sector:	Service provider with materials technologz (testing, AM, etc.)
Country:	Norway
Services used:	S306 S3012 S314
AMable experiment Tutor:	DTI
Tutor contact information:	oja@teknologisk.dk

Specific information	
FUTURE MATERIALS NORWEGIAN CATAPULT CENTRE *Company Logo*	**Idea & Company's background**
	Foresights vibration edge sensor casings are expensive to manufacturing using traditional CNC machining technology. It is expected that AM can reduce the production cost by 50%. Future Materials is a national development and testing center for materials of the future. The Centre aims to bridge the gap between the initial idea phase and pilot scale production in a way that makes it easier to materialize.
	Impact (by sectors)
	Aerospace: Foresight is a cross innovation of technology between aerospace and Marine industry. **Automotive:** Sensor too high-end for the consumer goods industry **Consumer goods:** Sensor too high-end for the consumer goods industry **Energy:** Foresight is applied today on offshore wind farms **Industrial equipment:** Foresight is applied today on offshore wind farms **Construction:** Foresight is applied today on offshore cranes
	Challenge(s)
	-Design and construction (AM restrictions, degrees of freedom) -Finishing and OA (final processing, customer requirements)

	-Skills gaps (training, expert consultation, outsorcing).
DANISH TECHNOLOGICAL INSTITUTE *Tutor Logo*	**Objectives** -Redesign of the casing for efficient 3D-printing -Simulation of the frequency response of the new casing -Manufacture and post-processing optimization -Sensor assembly -Testing
 *Photo 1*	**Benefits - how did AMable help?** Sensor casing will be redesign for AM designing and testing and carrying out simulations previously in order to get the optimize topology and design. After processing of the parts sensor casing and complete vibration sensor assembly will have to go though a series of tests and NDT. The selected services will complement the teams´existing competence and expertise.
 *Photo 2*	**Contribution to European Union (EU)** -Lower environmental impact due to reduce maintenance needs. -Increased safety and up time and reduced cost of operation for in shipping and aerospace.
Still too early to define the most suitable *Service providers*	

General information	
Experiment acronym:	T609 NAMAC
Acronym description:	New Additive MAnufacturable Components for electronic-hydraulic tools
Duration (months):	10M
Type (FS/BP):	BP - Best practise
Lead participant company:	ALKAR S. COOP.LTDA.
Company contact information:	inagar@alkarcoop.com
Industry sector:	Electric and Industrial Tools
Country:	Spain
Services used:	S305 S306 S314
AMable experiment Tutor:	LORTEK
Tutor contact information:	jcpereira@lortek.es
Specific information	
Company Logo	**Idea & Company's background**
	ALKAR has identified AM technologies potential applied in the high-pressure hydraulic tools market by studying, adapting and developing new additive components to the company`s hydraulic tools; this is, to a pipeline of more than 40 models hydraulic portable devices. The product Idea cover New AM Components for hydraulic tools to be incorporated in the latest generation of innovative self-managed electronic-hydraulic systems. Alkar hydraulics is a dynamic, innovative company that changed from a business model of traditional tool manufacturing to a business model of self designing and manufacturing novel tools for different sectors. Alkar designs, develops, manufactures and commercializes portable hydraulic tools for electric utilities, railways, e-mobility, eolics and the industrial sector.
	Impact (by sectors)
	Aerospace: New portable Crimping Tools for EU Aircrafts Manufacturers **Automotive**: New portable Crimping Tools for EU Railway Manufacturers and related companies **Energy**: New portable Crimping Tools for EU Eolic and e-mobility manufacturers, civil work and installations. **Industrial Equipment and Tooling**: Enabling technology for the production of more complex and optimized (i.e weight reduction) components and machinery. With the crimping tool developed,

	benefits of improved ergonomic, extended-life and durability, will increase the EU competitiveness **Construction**: Production of new generation of high-performance portable tools
IK4 LORTEK Research Alliance *Tutor Logo*	**Challenge(s)** To reduce weight and improve performance with extended life in key components, like for example, crimping head and fork through new disruptive AM designs to be manufactured by metal AM using laser-based powder bed fusion process (L-PBFP). As a result of weight reduction and the ergonomics of the tools will be improved. **Objectives** To reduce the material usage for the product by replacing substractively manufactured parts by additively manufactured ones. - AM tool head Design. - Prototype metal heads Printing and final post processing. - Internal Testing. - In service “end user” testing. - Final conclusions and detailed business analysis.
 *Photo 1*	**Benefits - how did AMable help?** -To identify which AM technologies, materials availability and cost could help to screen and select potential technologies for the product idea. -Primary service. Get knowledge on DfAM in house. Creation of new designs for the main two components of the tools. -To identify which Post-processing route or technologies could help and test it.
 *Photo 2*	**Contribution to European Union (EU)** -It can reduce the energy required for production Portable and lightweight tools will help to reduce the transportation costs and the excessive handling costs. -The proposed idea will improve the ergonomics of portable tool operators. Furthermore, low weight of the tool will increase the security during and after the operations.
LMS Laboratory for Manufacturing Systems & Automation VTT DANISH TECHNOLOGICAL INSTITUTE *Service provider Logos*	

General information	
Experiment acronym:	T610 FABTHEP
Acronym description:	3D Printed PEEK Interlayer as a toughening mechanism for CFRP Composites (FabricThermoPrint)
Duration (months):	12M
Type (FS/BP):	BP - Best practise
Lead participant company:	AMDM – Advanced Materials Design & Manufacturing Limited (AmaDema)
Company contact information:	Themistokli Petridi 8, 1st Floor, 1037 Nicosia, vassilis@amdmcomposites.com, +357 22262280, +357 96411830
Industry sector:	Plastics, Composites, Design and Manufacturing
Country:	Cyprus
Services used:	T305, T306, T308
AMable experiment Tutor:	FRC
Tutor contact information:	l.papadakis@frederick.ac.cy

Specific information	
Company Logo	**Idea & Company's background**
	The project idea is to create a process that uses Additive Manufacturing to apply very thin layers of thermoplastic material on technical fabrics and more specifically on carbon fabrics. This process will be using a high temperature, high strength thermoplastic to 3D print patterns onto the fabric surface at the micron level. The ultimate goal is the creation of a fine interlayer reinforcement which will dramatically increase the fracture toughness of the final composite. Through this innovative 3D printing process, the resulted technical fabrics will offer an increased strength and mechanical performance to multilayer composite structures.
	Impact (by sectors)
	FabricThermoPrint has currently 3 market impacts: -A self-standing textile product as raw material. Customer: Composite manufacturer -A reinforcement of composite structures / components products. Customer: OEMs, End Users -Technology licensing. Customer: Fabric and Composite Manufacturer
Tutor Logo	**Challenge(s)**
	1: Reach a micron level thickness to be printed on technical fabric from AM technology. **2:** Modification of current AM machine to be able to print a high temperature thermoplastic on carbon fabrics

Objectives

Fibre reinforced polymer composites (FRPs) are extensively used to mitigate issues due to their higher specific strength. In the level of material structure, material performance improvement for polymer composite multilayer structures is largely dependent on the interlayer strength and on the overall material through thickness properties. AmaDema sees additive manufacturing technology as a unique process that can assist its novel technology of enhancing technical fabrics to scale-up and adjust to state-of-the-art machines of technical fabrics manufacturing.

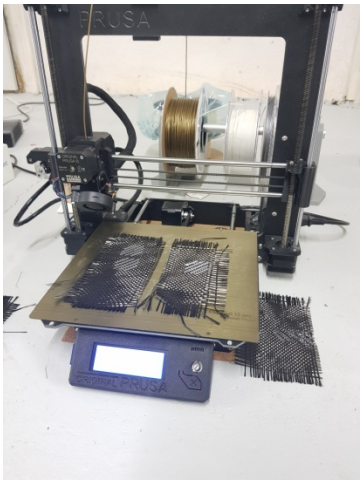


Photo 1

Benefits - how did AMable help?

ID 305 - AM decision support / AM Wizard

Through this service there has been expert advice on AM/FDM processes and material availability.

ID 306 - Design for AM

The design of the component for this application, although it is simple enough, it has to be precise, accurate and most importantly 3D printable.

ID 308 - Modeling, Simulation and HPC

Modeling and simulation for the FDM's machine hot end and cooling. High Temperatures need to be maintained at the hot end but cooling is also important for the rest of the assembly (cold end). Using CAD and advance heat flow simulations the optimal design for cooling will be developed.

Photo 12

Contribution to European Union (EU)

FibricThermoPrint is in-line with EU2020 Strategies:
- The "scientific excellence" by producing advanced research results toward commercialization,
- The "industrial leadership" by potentially attracting private investments and creating new jobs
-The "societal challenges" by addressing critical environmental issues through applications in transportation sector. It is also compatible with the Smart Specialization Areas (S3Cy) of Cyprus National strategy for energy and environment.

mtc Manufacturing Technology Centre

FREDERICK RESEARCH CENTER

Service provider Logos

General information	
Experiment acronym:	T611 PROSAD3D
Acronym description:	PROSthesis Adapters by 3D printing
Duration (months):	6M
Type (FS/BP):	FS - Feasibility study
Lead participant company:	Space Structures GmbH
Company contact information:	Luca Pompa, pompa@spacestructures.de
Industry sector:	Aerospace
Country:	Germany
Services used:	S313 S314
AMable experiment Tutor:	VTT
Tutor contact information:	Antti Vaajoki, antti.vaajoki@vtt.fi

Specific information	
Company Logo	**Idea & Company's background**
	Prostheses are the key to mobility for the disabled. Lightweight and custom design shall be provided. The technological challenge is to manufacture a lightweight prostheses adapter that can resist the high dynamic load environment with a tailored geometry for the user at low cost and time. Mathematical topology optimization software can quickly derive an optimised design fulfilling previous requirements, but conventional manufacturing technology cannot manufacture it. AM is the only solution that can achieve the complex geometry and customization freedom at competitive price and time. Space Structures GmbH is willing to expand its knowledge in AM in order to provide industries with high quality and reliability 3D printed products.
	Impact (by sectors)
	Health: The product enhances the overall wellbeing of the user. With a product value of 200 Euro per piece, the product related market size amounts to 77.5 million Euro. Geographical focus is on the Americas, EMEA and Asia-Pacific regions. Targeted market share after three years is around 25% i.e. ca 100 000 pieces or 20 million Euro per year. The company can enter a cooperation with a subset of end users by means of the paralympic sport club in Berlin (PSC Berlin e.V.). Athletes belonging to the club will provide professional testing feedback on the product demonstrator and will advertise it during competitions (in Berlin and in all Europe). The

	president of PSC Berlin e.V. (Dr. Ralf Otto) has already expressed his interest in the product and testing collaboration. The goal is to make the product accepted within competitive sport levels to have a high acceptance within amateur fitness and rehabilitation end users as well.
Tutor Logo	**Challenge(s)**
	The main objective of the project is to manufacture an ultralightweight prothesis adapter which could weight about 50% less than the nominal one. Meanwhile, it has to withstand the high dynamic load environment from agonistic use and consider a reduction in cost and time for future manufacturing. Mathematical topology optimization software is implemented to quickly derive an optimized design fulfilling mass, stiffness, strength and interfaces requirements. Due to the complex geometry, conventional subtracting manufacturing technology cannot be exploited. Additive Manufacturing is the only solution that can properly manufacture the component. Two different high-performance materials and processes, already certified for space applications, can be exploited: carbon filled PEEK by means of Fused Deposition Modelling (FDM) and $AlSi_{10}Mg$ through Selective Laser Melting (SLM). Regarding the first case, the tensile test will be performed on specimens in order to better understand the printed material properties achievable with in-house technology and how to control the model orientation in order to reduce the delamination issue of this semi-crystalline thermoplastic. An important technical objective is to understand the correct procedure to assure the requested quality for this 3D printed medical component.
	Objectives
	A reduction in wastage of materials of about 35% for every manufactured part could be achieved. Besides, reduction in energy consumption could be attained exploiting multi-parts production of AM (it could be estimated a saving up to 25%).
	Benefits - how did AMable help?

Photo 1

The company motivation is to bring forward this product idea with space technology know-how and, if successful, to spin it off with a partner in the medical devices domain.
The service provision of the planned AMable services is about to start and thus, so far the help has been giving initial comments for approach and the component that the SME is designing on their own.
The plan is to utilize AMable services:

- **313 Quality Assurance and Certification** (How assuring required conformities and which certificates need to be accommodated)
- **314 Post-processing** (Final finishing of the manufactured AM part).

Photo 2

Contribution to European Union (EU)

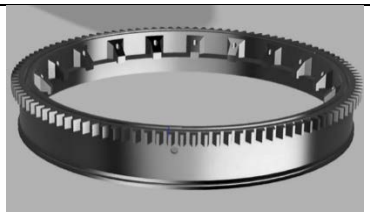
-Reduce wastage of materials with respect to traditional subtracting processes (about 35%).
-Reduce energy consumption (up to a maximum of 25%).
- The knowledge in topology optimization could be transferred to aerospace structure to improve commercial transport.
- Enhance the overall wellbeing, in particular of the disabled.
- End-to-end security of digital design and manufacturing supply chain.
New spinoffs will be created in EU providing new jobs.

TNO innovation for life TWI

Service provider Logos

General information	
Experiment acronym:	T612 MUPMED
Acronym description:	Best Practise Experiment on highly efficient, 3D printed industrial dryer system.
Duration (months):	12M
Type (FS/BP):	BP - Best practise
Lead participant company:	Chardon engineering BV
Company contact information:	merlijn@chardon-engineering.com
Industry sector:	Engineering product development
Country:	The Netherlands
Services used:	S306 S308 S312
AMable experiment Tutor:	SIRRIS
Tutor contact information:	benjamin.denayer@sirris.be

Specific information	
chardon engineering *Company Logo*	**Idea & Company's background** A novel multi-purpose industrial dryer has been designed. This dryer has three characteristics, a low-CAPEX design, a high thermal 'multi-effect-drying' efficiency and the ability to power the dryer using residual heat. Key multifunctional parts in the design are envisioned to be 3D printed (FDM) since their complex geometry is difficult to machine otherwise. Components will be used 24/7 in hot (80-90°C) and humid environments while subject to mechanical and abrasive loads. Such conditions are challenging for typical FDM materials and long-term material/component performance is hard to predict.
	Impact (by sectors) **Energy**: Waste streams that could be dried afficiently with the Chardon-dryer can be used as -bio- fuel for energy production. Also, in many existing dryer applications the Chardon-dryer could save a lor of energy **Industrial Equipment and Tooling**: Chardon-dryer can replace existing industrial equipment. Also, the concept of combining 3D printed smart parts with standard bulk products resulting in affordable, efficient and lightweight machinery, could be applied on other industrial equipment.
sirris driving industry by technology *Tutor Logo*	**Challenge(s)** -Find suitable engineering filaments (85°C, 95%RH) that fit within business case budget -Determine if parts printed from selected filaments can last for at least three years.

	-Demonstrate technical and economic feasibility of concept -Show that parts can be produced in production setting.
	Objectives
	Goal of this experiment is to identify suitable materials and test them thoroughly, whilst studying the potential of 3D printing the parts on an industrial scale. - Identify suitable FDM materials. - Test materials in dedicated endurance test set-ups and prototypes. - Optimize design and printing procedure for selected filaments aiming at cost effective part production on industrial scale.
 *Photo 1*	**Benefits - how did AMable help?**
	-Knowledge on suitable engineering filaments and how to design parts for best print results. -Simulations on expected lifetime. -Expertise on implementing AM on industrial scale to judge technical and economic potential.
	Contribution to European Union (EU)
	-Find suitable engineering filaments (85°C, 95%RH) that fit within business case budget -Determine if parts printed from selected filaments can last for at least three years. -Demonstrate technical and economic feasibility of concept -Show that parts can be produced in production setting.
Still too early to define the most suitable *Service providers*	

General information	
Experiment acronym:	T613 TADSOLE
Acronym description:	The Adjustable Sole
Duration (months):	5M
Type (FS/BP):	FS - Feasibility study
Lead participant company:	GMKS
Company contact information:	Gerwin.mondria@mondria-kinematic.nl
Industry sector:	Industrial design
Country:	The Netherlands
Services used:	S309 S310
AMable experiment Tutor:	MTC
Tutor contact information:	Andrew.Triantaphyllou@the-mtc.org

Specific information	
Company Logo	**Idea & Company's background**
	GMSK is a company focus on industrial design. In a world where innovation plays a major role but innovations hardly ever blow the users' minds, GMKS prepares a major breakthrough. A groundbreaking technology, integrated in midsoles of sports shoes that can really transform sport. We intend to not merely change design, feel, comfort or material. GKMS is creating a product that changes the way a shoe fits, feels, behaves, protects, supports and lasts. Not just when you put the shoe on your foot, but especially during your sporting practice! Flex-fix technology is designed with the user in mind. Furthermore, in preparation for this feasibility study, a study was carried out into the current international state of the art. The study was carried out by the Netherlands Patent Office and is therefore known to the Netherlands Office for Entrepreneurship. After an extensive research the concepts as proposed in the application were found to be completely new, inventive and industrially applicable on the international market by the handling officer. The specific innovation has been patented by GMKS as the flex-fix technology. The principle describes a midsole that can be adjusted (+ fixation of + flexibilization) to optimize performance, comfort and reduce the risk of injury.
	Impact (by sectors)
	Health: The shoe with the flex-fix mechanism will reduce injuries and drive down health-care costs. **Consumer Goods**: This smart shoe opens up the sportswear market by identifying a user's need to

	relax muscles to prevent pain or to give more support to prevent injury.
Manufacturing Technology Centre *Tutor Logo*	**Challenge(s)** - A multi-layered system of elastic flexible insole polymers on a rigid plate with integrated crumple plates. - Pressure points in the flexible polymers provide information on the pressure exerted by the athlete on the sole and the flex-fix mechanism (in combination with a mechanically or digitally adjustable sole), - The flex-fix mechanisms inside the crumple zones execute the flexible or fixing movement based on the exerted pressure.
	Objectives To add value, the objectives of GMKS with the flex-fix mechanism are: 1. to prevent injuries; 2. to promote sporting performance and; 3. to make both recreational and top-level sports as well as outdoor activities accessible to the people.
 *Photo 1*	**Benefits - how did AMable help?** This feasibility study (FS) is part of a project to produce and market a midsole that can be completely customized to the user's needs through the use of Additive Manufacturing (AM). The characteristics of AM allow for a completely customized build-up of a midsole and thus offers the best chances to reduce risk of injury in combination with the flex-fix mechanism. We intend to use AM in the prototyping and production if we can find a solution for the dataprocessing. Completing the experiment in a successful way means handling a vast amount of data. We need a data analysis tool to collect and process the data into information.
Paste here a HD Experiment image – *Photo 2*	**Contribution to European Union (EU)** -Looking for renewable materials and will install a recycle plan for our customers -Flex-fix mechanism increase personal mobility -Flex-fix mechanism is all about comfort and reducing the risk of injuries.
Still too early to define the most suitable *Service providers*	

General information	
Experiment acronym:	T614 NIMAS
Acronym description:	A device for Non-Invasive Monitoring of Aquaculture Systems that comprises of an additively manufactured submersible underwater camera housing
Duration (months):	9M
Type (FS/BP):	BP - Best practise
Lead participant company:	Orion AM
Company contact information:	adam@orion-am.com
Industry sector:	Mechanical Engineering
Country:	Germany
Services used:	S310 S312
AMable experiment Tutor:	INSPIRE
Tutor contact information:	kleijnen@inspire.ethz.ch
Specific information	
Company Logo	**Idea & Company's background**
	The goal is to develop a novel device for non-invasive monitoring of aquaculture systems. This system based on physicochemical sensors and image sensors which have a direct output connection to a smartphone. The device is to be submerged under water and depends on advanced optical components, such as stereographic cameras, to monitor fish colonies. By enabling the fish farmers the ability to visually monitor their fish colonies, they can use the acquired information such as water quality, growth rate, feed, waste, biological factors and anthropogenic influences in order to improve animal welfare and optimize production. Orion AM is focused on scientific research and development of AM technologies for solving the complex problems of today and building innovative solutions of tomorrow.
	Impact (by sectors)
	Electronics: This product idea can be further applied to housing of electronic components in other demanding environments. **Energy**: This product idea can be applied to produce customized submersible camera housings for the offshore energy sector (oil and gas, wind energy) for the inspection and maintenance of underwater equipment. **Industrial Equipment and Tooling:** this product can be further applied to sea life monitoring or

	pollution monitoring in the sea. And be adapted for submersible housings into other demanding environments or liquids.
inspire *Tutor Logo*	**Challenge(s)** The user is interested in finding a cost-effective method to produce the submersible underwater camera housings by means of additive manufacturing to be able to advance rapidly from concept to finished product. AM reduces lead-time and costs, on demand, quickly and effectively. The user is aware that fused filament fabrication is economically feasible, however, the current state of the art process produces porous, inhomogeneous structures unsuitable for their application. The challenge is to overcome this porosity and additively manufacture a cost-efficient, hermetically sealed device for non-invasive monitoring of aquaculture systems. **Objectives** To ensure that AM produced parts can achieve a hermetically sealed enclosure capable of withstanding hydrostatic pressure up to 10m depth. The state of the art has shown that FFF produced parts, although cost effective, are not airtight and need to be treated with in a post process in order to be hermetically sealed by either melting the surface or the addition of sealants. Furthermore, post-processing not only increases production time and costs, but also affects the final dimensions of the part by either addition or removal of material.
 *Photo 1*	**Benefits - how did AMable help?** Orion plans on commercializing their technology by offering AM services in addition to the sale of their proprietary AM equipment. Orion's ambition is to produce AM parts for demanding environments such as for underwater or space applications as well as for implantation. These application environments not only require parts with good mechanical strength but also homogeneous structures with low porosity. AMable has helped Orion's roadmap which involves applying our technology to new case studies in our first year of operation while we finalize development and prepare for commercialization of the AM equipment.
	Contribution to European Union (EU)

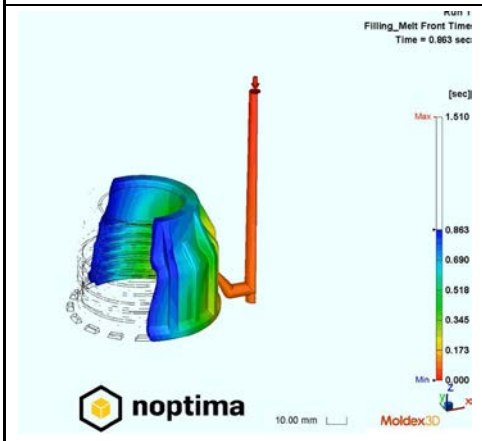
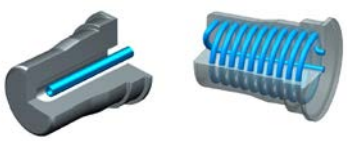
 *Photo 2*	-It will allow fish farmers to more effectively monitor and analyze their fish colonies and their health in order to alter their food, temperature or other environmental factors in order to have the most cost effective output. -Other applications for the NIMAS device can be applied to the energy sector for maintenance of underwater equipment and infrastructure. -Aquaculture industry is bound to play an important role in the human nutrition supply in the future. NIMAS device will aid in raising food stocks to feed growing, undernourished societies. -Addressing the problem of food security has a direct benefit to the security of the European Union as a whole.
Still too early to define the most suitable *Service providers*	

General information	
Experiment acronym:	T615 STIRPSH
Acronym description:	Safety Test And Industrialization Requirements For Personalized Sport Helmets
Duration (months):	8M
Type (FS/BP):	BP - Best practise
Lead participant company:	Topofab
Company contact information:	bernat@topofab.com
Industry sector:	Digital Fabrication
Country:	Spain
Services used:	S312 S313 S314
AMable experiment Tutor:	TNO
Tutor contact information:	aart_willem.benschop@tno.nl

Specific information	
 *Company Logo*	**Idea & Company's background**
	Personalized sport helmets with impact-absorbing lattice structures manufactured with AM (ie.climbing, snowboarding, cycling). Due to geometric constraints and material properties, the desired outcome can only be achieved with the use of AM technologies. AM technology makes personalization possible with the production of unique digital models from individual head measurements. TOPOFAB have experience designing and testing AM lattice structures and they can build upon previous work to execute his product idea.
	Impact (by sectors)
	Health: Design of safer Personal Protective Equipment. **Consumer Goods:** A new kind of Personal Protective Equipment products could emerge from this project, creating a whole new market for better performing helmets, for the workforce, for transportation and for leisure and sports. **Industrial Equipment and Tooling:** Personal Protective Equipment must pass safety regulations, and is a mandatory equipment in most factories, industrial plants and construction sites.
TNO innovation for life *Tutor Logo*	**Challenge(s)**
	Design and test a sport helmet produced in AM that performs equal or better than the current solution. There is a need for lighter protection sport helmets, more convenient to wear and with improved shock

	absorption. Lattice structures manufactured with AM have shock absorbing properties. Furthermore, AM produced lattice structures can be personalized to make helmets more convenient to wear and improve shock absorption compared to standard-size helmets. To achieve personalization it is needed to identify the personalization parameters and to identify the equipment requirements to gather personalized data. A crucial challenge for commercialization of such personalized products is to perform tests according to Europe Safety Regulations.
	Objectives
	1) we aim to discover, understand and report how sport helmets with AM perform according to EU safety regulations for helmets. 2) we aim to identify the manufacturing infrastructure needed for industrial production of such AM produced personalized sport helmets.
 *Photo 1*	**Benefits - how did AMable help?**
	The solution can be used in helmets produced by the User Partner. In the future, other shock absorbing products could benefit from the project results. Our ambition is to provide design and consultancy services that cover the available and future AM technologies. And our overall business objective is to help clients to innovate their business models and product offerings via AM technologies. Our services roadmap follows the AM software and hardware releases and innovations.
	Contribution to European Union (EU)
	-Improved Health and Well-being of EU workforce by having access to a safer product. In 2015 there were over 4000 fatal workplace injuries at EU. Safer and more convenient PPE helmets will stimulate to be used and help to reduce such number. -The product will be developed with attention for sustainability issues. Using AM enables that parts will be manufactured on demand, eliminating the need for large stocks, and reducing waste.
Still too early to define the most suitable *Service providers*	

General information	
Experiment acronym:	T616 NOPTIMA
Acronym description:	**N**umerical **OPTI**mization **M**anufacturing processes by **A**dditive technologies
Duration (months):	12M
Type (FS/BP):	BP - Best practise
Lead participant company:	SIMLEAD LTD
Company contact information:	6, VELESTINOU STR., 2038 NICOSIA, CYPRUS, s.avraam@simlead.eu, +35770087172
Industry sector:	MECHANICAL ENGINEERING AND MANUFACTURING
Country:	Cyprus
Services used:	T308, T314
AMable experiment Tutor:	FRC
Tutor contact information:	l.papadakis@frederick.ac.cy
Specific information	
simlead Elysee *Company Logo*	**Idea & Company's background**
	According to end user's requirements (Elysee Irrigation), mould design and process of its polypropylene pressure fitting cap needs to be optimized in order to improve its quality, axisymmetric shape and mechanical properties. The application of additive manufacturing in injection moulds can push design into greater functionality, by providing faster cooling time and increased production through conformal cooling channels. This faster cooling rate achieved through the channels also significantly reduces component warpage from uneven cooling and prolong service life through less thermal stresses.
	Impact (by sectors)
	Plastics piping and fittings market is a mature high volume market; hence, a straightforward access of the innovative NOPTIMA to the market is expected. The market already acknowledges the technical and operational characteristics of AM. A profitable market for the final product of NOPTIMA project will be accomplished by providing customers enhanced quality and properties of the existing conventional product and be superior in terms of economic and environment costs. It is envisaged that the final product resulting from NOPTIMA project, will enter the market with project completion.
FREDERICK RESEARCH CENTER	**Challenge(s)**

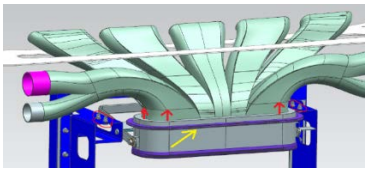
Tutor Logo	1: Computational optimization of final product's lifetime, quality, axisymmetric shape and mechanical properties. 2: 3d Printed Insert Metal Mould and Post Processing Operations for Optimum Performance and Quality 3: Production of Water Supply Fittings Via AM Insert Mould and Implementing a Quality Assurance Campaign for their Evaluation. The objectives of TC3 are: • Mounting the AM inserts into existing injection moulds (cooling systems, diagnostic checks) • Trial production of final products in order to reach optimum conditions of the machine • Quality assurance of the end-products through 3D scanning solutions and mechanical testing
	Objectives The proposed work is a unique opportunity for Simlead to explore and establish new applications regarding metal printing. AM technologies offer advanced features and capabilities in contrast with the conventional processing technologies (e.g. milling) such as; topography optimization, tailored designs, product quality that are of critical importance in almost all consumer products.
 *Photo 1*	**Benefits - how did AMable help?** For the exploitation of above challenges, the service (ID 308) named Modelling, Simulation and HPC has been facilitated. Through this service the understanding of the underlying physics that control the macroscopic behaviour of printed products has been achieved. Frederick Research Center has taken over the mentoring role in this regard. In addition, the service (ID 314) named Postprocessing, has been selected for the consistency of 3d printed component with the desirability of end user; mechanical properties, surface smoothness and post-processing treatment.
 *Photo 2*	**Contribution to European Union (EU)** -It is in the intention of the consortium that AM services and technologies will be utilized for advancing research at European levels and for enhancing the competitive edge of national and European industries. -Optimized design of conformal cooling channels will yield to drastically elimination of climate environmental pollution, water recourses and waste material.

	-Conformal cooling and heat distribution will further enhance the energy savings by minimizing the injection mould cycle, in combination with the minimisation of power consumption of heat pump.

Service provider Logos

General information	
Experiment acronym:	T617 LARGE3DRAIL
Acronym description:	Construction of Large and Complex 3D Geometry for Rail vehicles build with certified materials
Duration (months):	5M
Type (FS/BP):	FS - Feasibility study
Lead participant company:	OPTIMUS3D
Company contact information:	aruiz@optimus3.es
Industry sector:	Engineering and 3D AM parts production
Country:	Spain
Services used:	S305 S314
AMable experiment Tutor:	AIMEN
Tutor contact information:	Camilo.prieto@aimen.es

Specific information	
Company Logo	**Idea & Company's background**
	The product idea is to manufacture by AM air ducts for the new TALGO power train generation, FULCRUM. We aim to produce low quantities of complex geometry without non recurrent costs, fulfilling rail business regulations, and reducing the weight than actual solution. It will be used in new power train actually in designing process. OPTIMUS3D is a qualified engineers team with design skills. It is based on additive manufacturing capabilities and latest equipment to provide optimum solutions for the client needs.
	Impact (by sectors)
	Aerospace: Large parts with ESD materials, JIGS and not flying parts **Automotive:** Big parts without NRC (non-recurrent costs) **Consumer Goods:** Parts built with certified raw materials. **Energy:** Produce parts from 0,5-2m with certified polymers, for complex geometries with NRC **Industrial Equipment and Tooling:** Produce parts from 0,5-2m with certified polymers, for complex geometries with NRC **Construction:** Produce parts from 0,5-2m with certified polymers, for complex geometries with NRC
	Challenge(s)
	Complex geometries, with especial raw materials printed at room temperature will be a trial and error process. We have develop machinery, geometry,

	samples but we need to check real part. We have found a real customer, but we need to convince that the whole process is real, robust and replicable. this involve development costs.
Tutor Logo	**Objectives** We aim to produce low quantities of complex geometry without non recurrent costs, fulfilling rail business regulations, and reducing the weight than actual solution. It will be used in new power train actually in designing process. In order to reduce material the air ducts adopts “complex” geometry to optimize courses.
 *Photo 1*	**Benefits - how did AMable help?** We are working as consultants in TALGO (Spanish manufacturer of trains) and this feasibility would probe the maturity of this technology. We have certified material, geometry was redesigned for 3Dprinting, new machines, but it will be checked that all different stages together work.
 *Photo 2*	**Contribution to European Union (EU)** -Reduce the total amount of required raw materials. Lighted weight in the structure, reduce energy needs in all operation time. -Increase the efficiency of public transport. -Increase of ergonomics task in assembly, parts more light than actual ones.
Service provider Logos	

4 Focus: SASSHPPE Featherlight Head Protection

A special success story is the SASSHPPE experiment with the company Topofab. The team of engineers, designers and developers has experience in manufacturing, digital business, health & mobility. Topofab from Spain has engineering design capabilities in AM and challenges personal protective equipment.

OBJECTIVE

In AMable, the goal is the realisation of personalized sport helmets with optimum impact-absorbing lattice structures for activities such as climbing or cycling.

CHALLENGE

Due to geometric constraints and material properties, the desired outcome can only be achieved with manufacturing by AM technologies. In this regard, the selection of the right material for 3D printing is key. Also, for shock absorption, freedom in geometry brings advantages to the core functionality. Finally, the improved impact shock absorption is maximised through a tailored design which fits shape and size of the helmet to the individual user.

BENEFITS

This case was submitted to OC1 resulting in a feasibility study called SASSHPPE. With a result of increased TRL from the study, they were selected for a best-practice experiment. In this experiment STIRPSH, they aim to validate that the solution can be produced and certified. Their benefit from AMable:

- Challenge: During SASSHPPE and with AMable financial & technical support they managed to design and produce a lattice structure that meet the requirements for shock absorbing. Thanks to decision support service of TNO, Topofab selected the more suitable materials. Experts at MTC help them with methodology to come to the right structural design.
  Benefit: tested samples of shock absorbing structures and designed a sports helmet with the most effective structure.
- Challenge: During STIRPSH the previous solution is “feasible”, so, it can be used in helmets produced by the User Partner to validate the product. The supplier partner has experience launching online based services for AM manufacturing, so it can assist the User part into deployment and ramp-up scenario. The overall business objective is to help clients to innovate their business models and product offerings via AM technologies. Our services roadmap follows the AM software and hardware releases and innovations.
  Benefit (anticipated): to discover, understand and report how sport helmets with AM perform according to EU safety regulations for helmets. And, also, to identify the manufacturing infrastructure needed for industrial production of such AM produced personalized sport helmets.

SKILLS GAP

Expert consultation for industrialization planning with regards to machine specifications and configuration, quality assurance plans, certification.

FUTURE

In the future, other shock absorbing products could benefit from the results.