

University of Applied Sciences and Arts of Southern Switzerland

SUPSI

BOREALIS

Enlightening Next Generation of Material

PRIMA Paolo Calefati Prima Industrie SpA

FoF.2014-2 Manufacturing processes for complex structures and geometries with efficient use of material



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Today "most complex" still means "most expensive" and "most inefficient"

Multi material Titanium, Aluminium, Nickel, Inconel

Functionally graded materials density and composition

Medium-big parts up to 4500x2500x1000 mm

One-of-a-kind

Multiple Technologies deposition, subtraction, joining, heat treatments

Conscious manufacturing costs zero defects, energy efficient, buyto-fly



Traditional





Additive Manufacturing Design by Tech

Category	KPI	SoA Benchmark						
On the matter of product quality								
Superficial product quality	Superficial roughness	1-10 micron						
Structural performance	Ratio of a specific property (density, fatigue, tensile, etc.) / the same property with SoA technology	95% and 100% in the highest productive configuration						
Out of control parts	% of faulty manufactured parts	60% of scrap						
Time to build	Time to build the standard 125 mm cube	24h at 0.3 detail capability and 9 micron Ra finish						
Buy to fly	Ratio bought material / product weight	Process economically convenient for BTF>10						
On the matter of material efficiency								
Material usage	Ratio product weight / material used	From 5% in powder bed to 70% in material jetting						
Powder usage efficiency (regenerated powders)	Ratio melted powders / input powders	Maximum 70% - state of the art AM processes						
Overall energy consumption in AM	Energy consumption per kg deposited	144 MJ/kg referring to the average						
Overall energy consumption in Ablation	Energy consumption per kg subtracted	+machining						
Deposition rate	Rate amount of material deposited for unit of time	5 Kg/hour is the today most productive direct energy deposition equipment						





Machine architecture







Laser source

Maximum deposition rate of **2000 cm3/h** (given a laser spot of 4 mm) and a maximum ablation rate of **100 mm2/s**

Direct energy deposition

High beam quality fibre laser, CW up to 3 kW of optical power

Ablation

Short laser pulses, of pico/femto-second duration of average power in the 50-100 W range, with MHz repetition rates, resulting in MW peak power

Three step heating process





Closed Loop Monitoring





Extended CNC





	WP 1 PROJECT MANAGEMENT						
	WP 2 PRODUCT-TECHS REQUIREMENTS		Product activities				
	WP 8 ADAPTIVE AUTOMATION & NC	WP 3 PROCESS DESIGN & PLANNING	Techs activities				
	WP 7 INTEROPERABLE CAX CHAIN	WP 4 DESIGN OF LASER SOURCE AND 3D SCANNER	Control activities				
	WP 6 RECONFIGURABLE VISION SYSTEM	WP 5 DESIGN OF MACHINE ARCHITECTURE & EFFICIENT MECHATRONICS	CAx activities Optimization Machine activities				
WP 9 MONITORING & OPTIMIZATION		ΤΙΜΙΖΑΤΙΟΝ	Sensing activities				

WP 10 DEMONSTRATION MEDTECH-AEROSPACE-AUTOMOTIVE



Prima Industrie	IT	LE – AM machine integrator	
Supsi-ISTePS	СН	RTD – designer of machine, robots	
Polito	IT	RTD – design of new materials for AM	
TNO	NE	RTD – product design	
ILT	DE	RTD – laser based AM processes	
University of Patras	GR	RTD – energy assessment of the AM and ablation processes	
IRIS	IT	SME – qualification of laser processing performance	
PE	IT	LE – provider of mechatronics and NC platform	
FRAMOS	DE	SME – expert vision systems hardware	
IRIDA Labs	GR	SME – expert vision systems software platforms	
Synesis	IT	SME – providers of automation solutions	
GLOBOTICS	СН	SME – provider of robotic structures	
OPI Photonics	hotonics IT SME – provider of laser source modules		
Diad Group	ES	SME – end user in the automotive sector	
GE - AVIO	ITA	LE – end user in the aerospace sector	
Sintea	СН	SME – end user in the medtech sector	

Family of products





Category	Borealis target	SoA Benchmark							
On the matter of product quality									
Superficial product quality	Under micron		1-10 micron [69]						
Structural performance	100%		Most of SoA AM technology have this parameter in between 95% and 100% in the highest productive configuration						
Out of control parts	Zero		60% of scrap						
Time to build	12h at 0.05 detail capability and 1 μm Ra finish		24h at 0.3 detail capability and 9 µm Ra finish						
Buy to fly	Process economically convenient for BTF>3		Process economically convenient for BTF>10						
On the matter of material efficiency									
Material usage	95%		From 5% in powder bed to 70% in material jetting						
Powder usage efficiency (regenerated powders)	90% (resulting from 80% overall efficiency and 50% inline recycl wasted powder)	ing of	Maximum 70% - state of the art AM processes						
Overall energy consumption in AM	80 MJ/kg		144 MJ/kg referring to the average specific consumption for casting +machining						
Overall energy consumption in Ablation	60 MJ/kg								
Deposition rate 15 Kg/hour			5 Kg/hour is the today most productive direct energy deposition equipment						

Plan to market







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Borealis demonstrates a novel machine that will produce,

at unprecedented throughput (up to 2000 cm3/h) and efficiency (40% energy and 75% material saving),

in true net shape (no final machining needed), with closed loop controlled and certified quality (zero faulty parts delivered), large (up to 4.5 m) and complex (in geometry, functionality, composition) products.

> Thank you paolo.calefati@primapower.com anna.valente@supsi.ch

