Finmeccanica nelle tecnologie di Additive Manufacturing

Foligno, 24 Marzo 2016

Mauro Varasi

FINMECCANICA

Contenuti

- Finmeccanica in breve
- Cosa intendiamo per Additive Manufacturing
- Settori di potenziale applicazione
- Limitazioni e sfide
- Percepita evoluzione

Contenuti

- Finmeccanica in breve
- Cosa intendiamo per Additive Manufacturing
- Settori di potenziale applicazione
- Limitazioni e sfide
- Percepita evoluzione

FINMECCANICA

2015 - Focus on Aerospace, Defence and Security

Finmeccanica is Italy's main industrial Group, leader in the high technology sector, and ranks among the main Aerospace, Defence and Security groups worldwide.

HELICOPTERS

- AgustaWestland

DEFENCE AND SECURITY ELECTRONICS

- Selex ES
- DRS Technologies

AERONAUTICS

- Alenia Aermacchi
- ATR
- SuperJet International

DEFENCE SYSTEMS

- OTO Melara
- WASS
- MBDA

SPACE

- Telespazio
- Thales Alenia Space

TRANSPORTATION

- AnsaldoBreda
- Ansaldo STS

owned company joint venture

RESULTS 2014 in €mln.	
Revenues	12,549
New Orders	12,602
Order Backlog	29,063
R&D	1,495

As of 31 December 2014

FINMECCANICA

2016 - the new Finmeccanica …. the “one company”

a more focused, cohesive and dynamic industrial group that creates value for shareholders, customers and other stakeholders.

The group strategic evolution leverages on:

MARKETS

Strengthening our international presence and business model

PRODUCTS AND TECHNOLOGIES

Increasing the quality of the offer and optimising technological investments

BUSINESS

Improving industrial processes and rationalising the assets portfolio

"ONE COMPANY"

FINMECCANICA

SECTORS

- FINMECCANICA HELICOPTERS SECTOR — Helicopters
- FINMECCANICA AERONAUTICS SECTOR — Aeronautics
- FINMECCANICA ELECTRONICS, DEFENCE AND SECURITY SYSTEMS SECTOR — Electronics, Defence and Security Systems
- FINMECCANICA SPACE SECTOR — Space

DIVISIONS


Elicopters


Aircraft


Aerostructures


Airborne & Space Systems


Land & Naval Defence Electronics


Security & Information Systems


Defence Systems

ATR

SuperJet International

DRS Technologies

MBDA

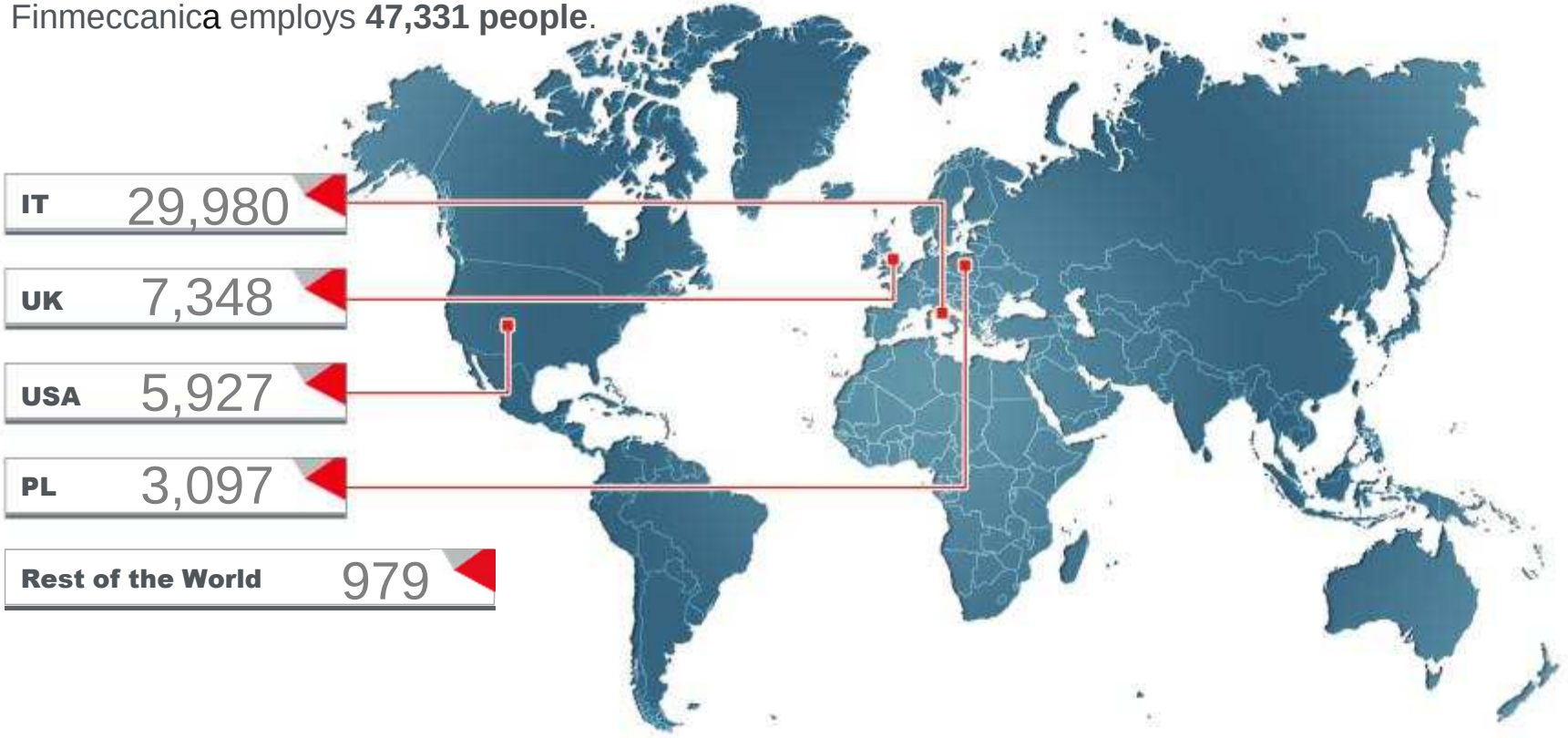
Telespazio

Thales Alenia Space

■ **owned company** ■ ***joint venture***

Global Presence

We have a strong industrial presence in four markets: Italy, UK, USA and Poland. We operate globally in more than 20 countries and our product and systems are operative in nearly 150 nations.
Finmeccanica employs **47,331 people**.



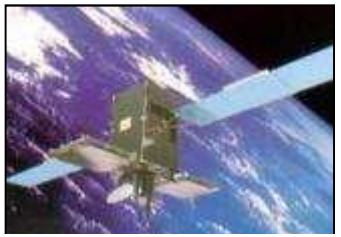
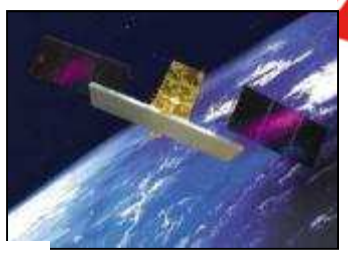
The figure refers to employees as of 30.11.2015, after the deconsolidation of the Transportation sector.

Does not include JVs workforce data

FINMECCANICA

FOR A DUAL USE PRODUCT PORTFOLIO …..

Satellites for hearth observation and telecommunications

Helicopters SAR and Heli Ambulance


Composites for aerostructures


UGV fo surveillance and civil protection


from C4ISTAR ……. to Homeland Protection


8

FINMECCANICA

BASED ON A WIDE TECHNOLOGY PORTFOLIO .....

SOFTWARE

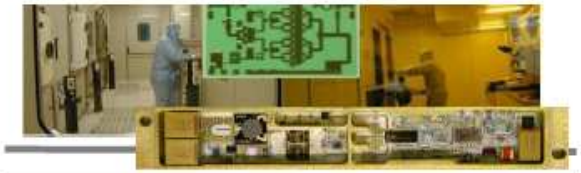
Firmware, Middleware, Application Layer

MATERIALI

Metal, Ceramic, Composite, Coating

ELETTRONICA

Microelectronics, RF/IF, Power Electronics, Digital HW



OPTRONICA

Passive, Active

MECCANICA

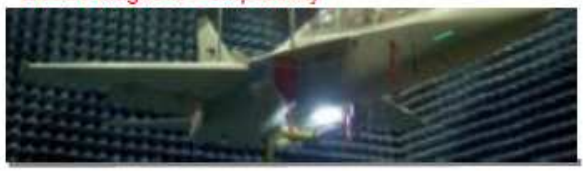
Precision Mechanics, Thermal Management, Electromechanics

MODELLING & SIMULATION

Training, Integrated test Bed, Virtual Environments and Tools

SYSTEM DESIGN

Aerodynamics, Structural Design,, Architectures , Electro Magnetic Compatibility



SISTEMI AUTONOMI

Artificial Intelligence, Cognitive Sensing, Autonomous Decision SW

COMUNICAZIONI CYBER SECURITY

ICT Networks e Cyber Security

Finmeccanica invests ≈ 11% of the revenues in R&D (≈ 1.5 B€ in 2014)

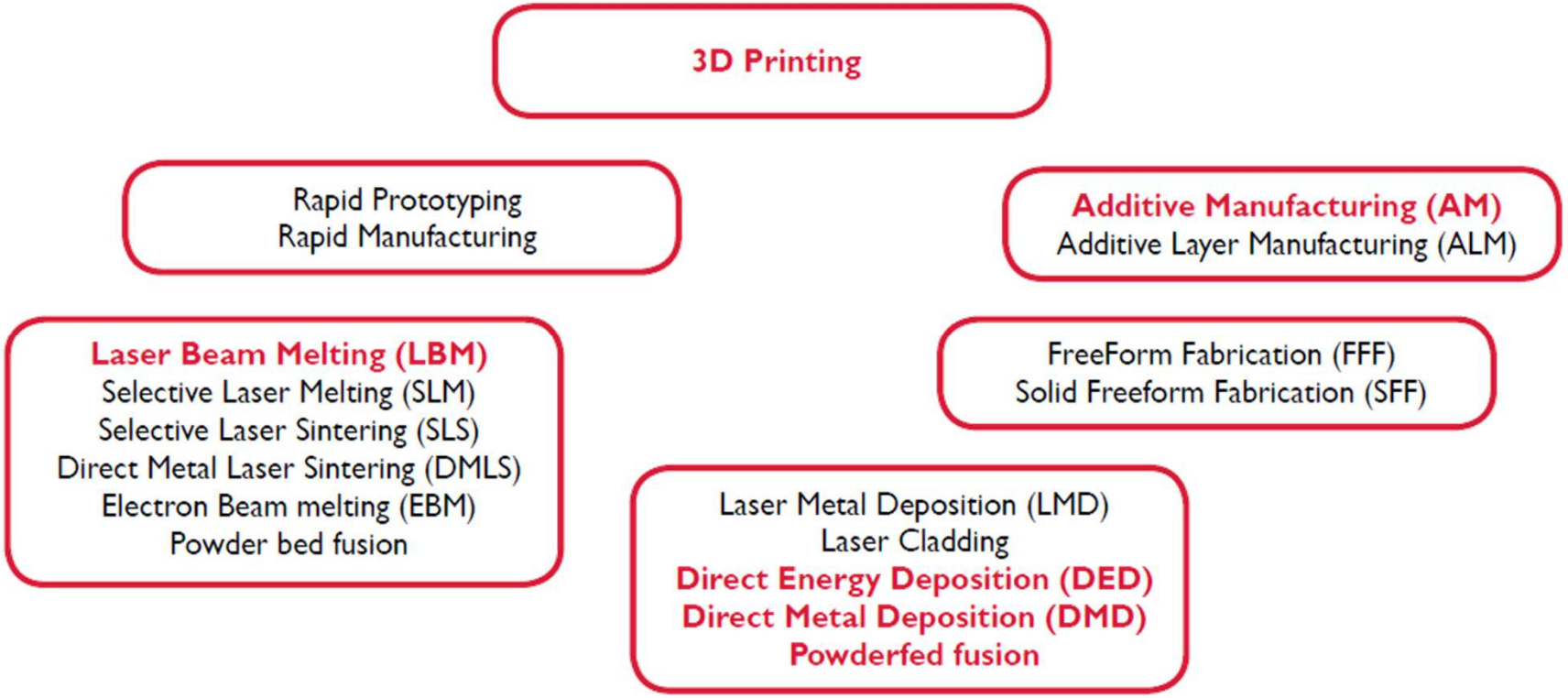
FINMECCANICA

Contenuti

- Finmeccanica in breve
- Cosa intendiamo per Additive Manufacturing
- Settori di potenziale applicazione
- Limitazioni e sfide
- Percepita evoluzione

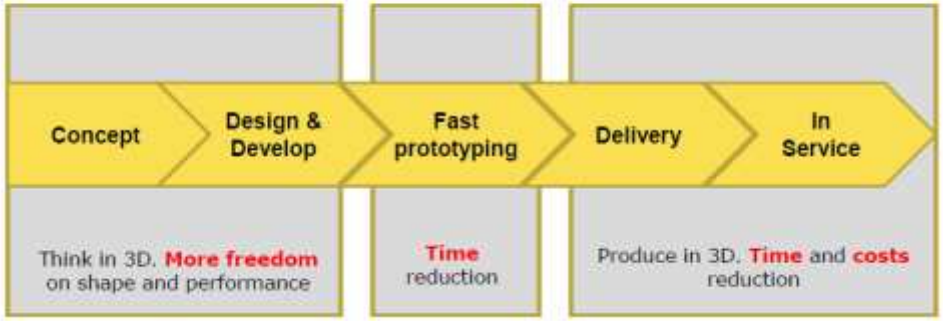
Cosa intendiamo per AM

- La tecnologia definita Additive Manufacturing è definito dallo ASTM standard F2792-10, *the « process of joining materials to make objects from 3D model data, usually layer upon layer, as opposed to subtractive manufacturing methodologies, such as traditional machining."*
- Nella realtà vi sono diversi processi che fanno riferimento al AM, spesso indicato commercialmente com 3D printing



Necessità di gestire l'intero processo

Additive Layer Manufacturing technology
BENEFITS ON PRODUCT LIFECYCLE



Progetto Componente

Conversione Modello CAD

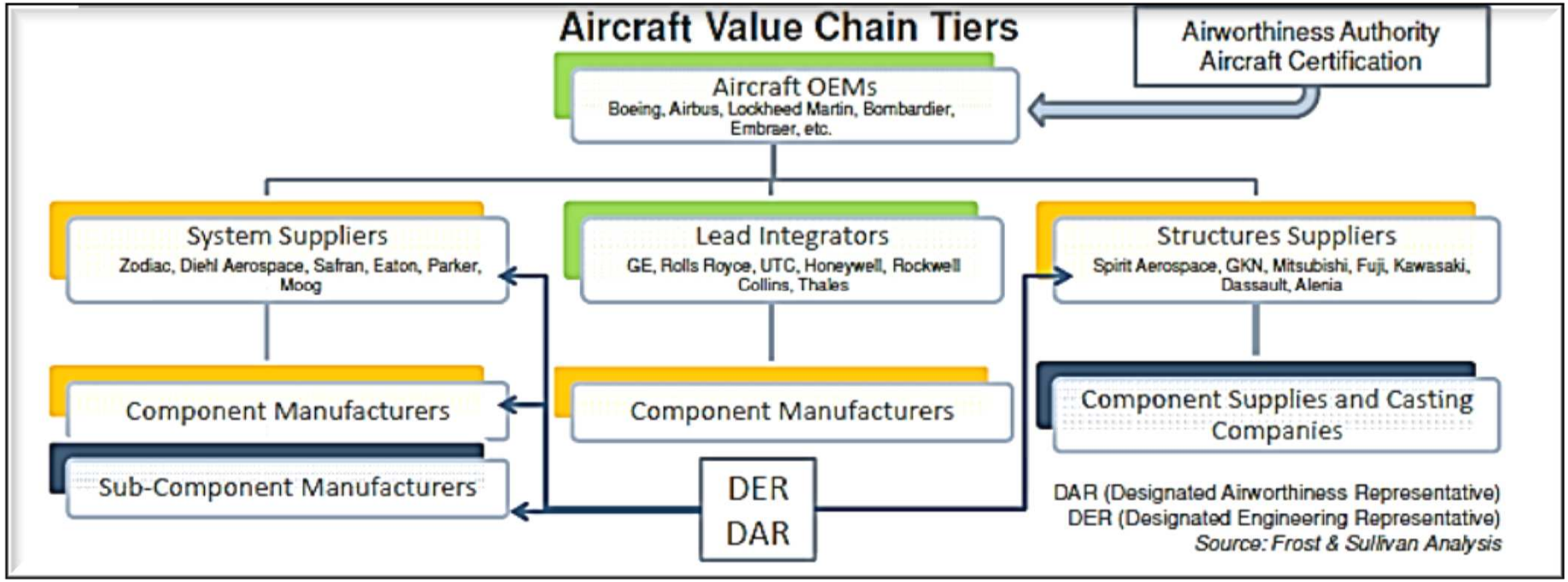
Produzione

Polveri

Finitura del componente

Qualifica e Certificazione

Coinvolgimento della Supply Chain



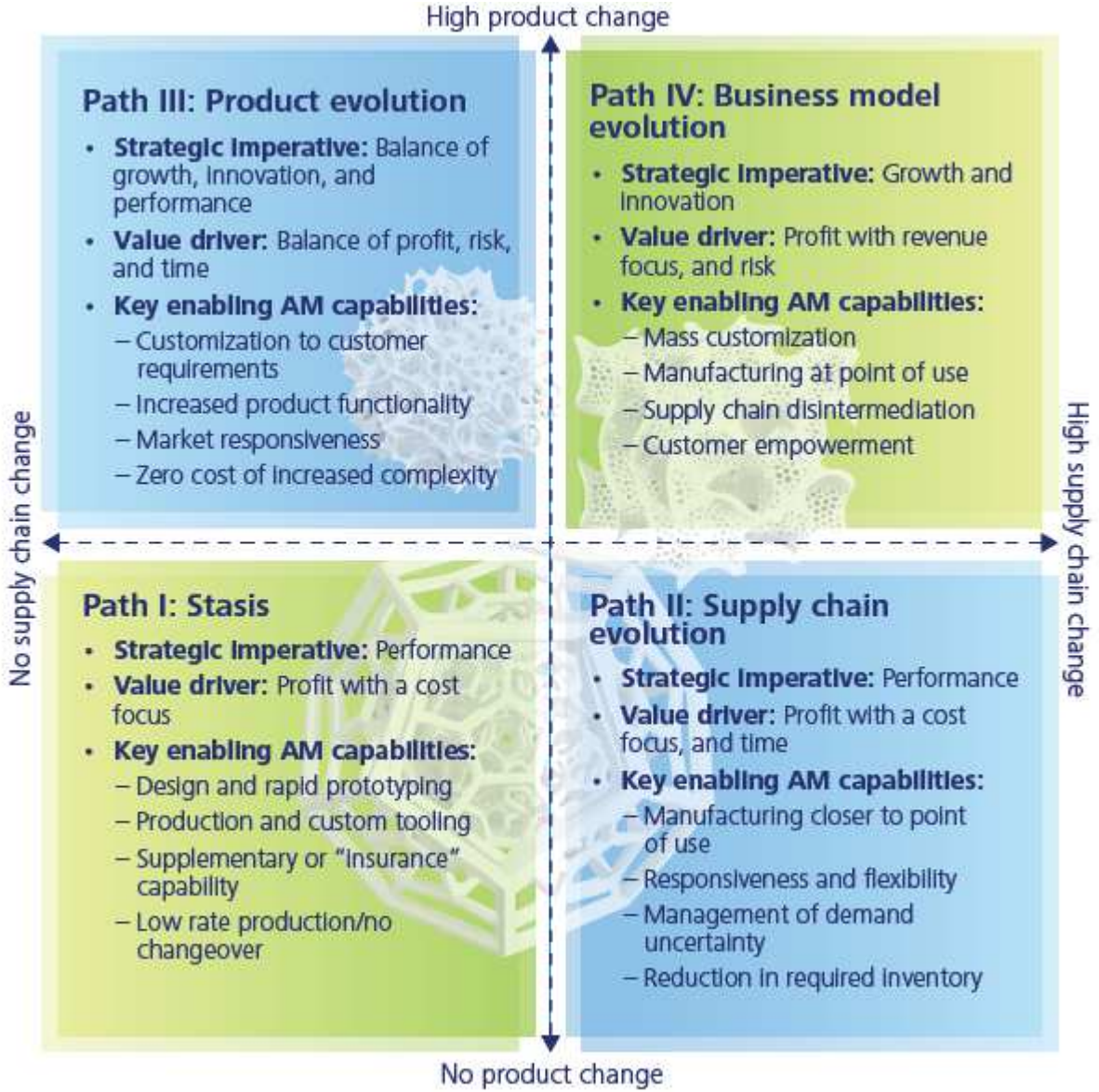
Decisori

Followers

Fornitori critici

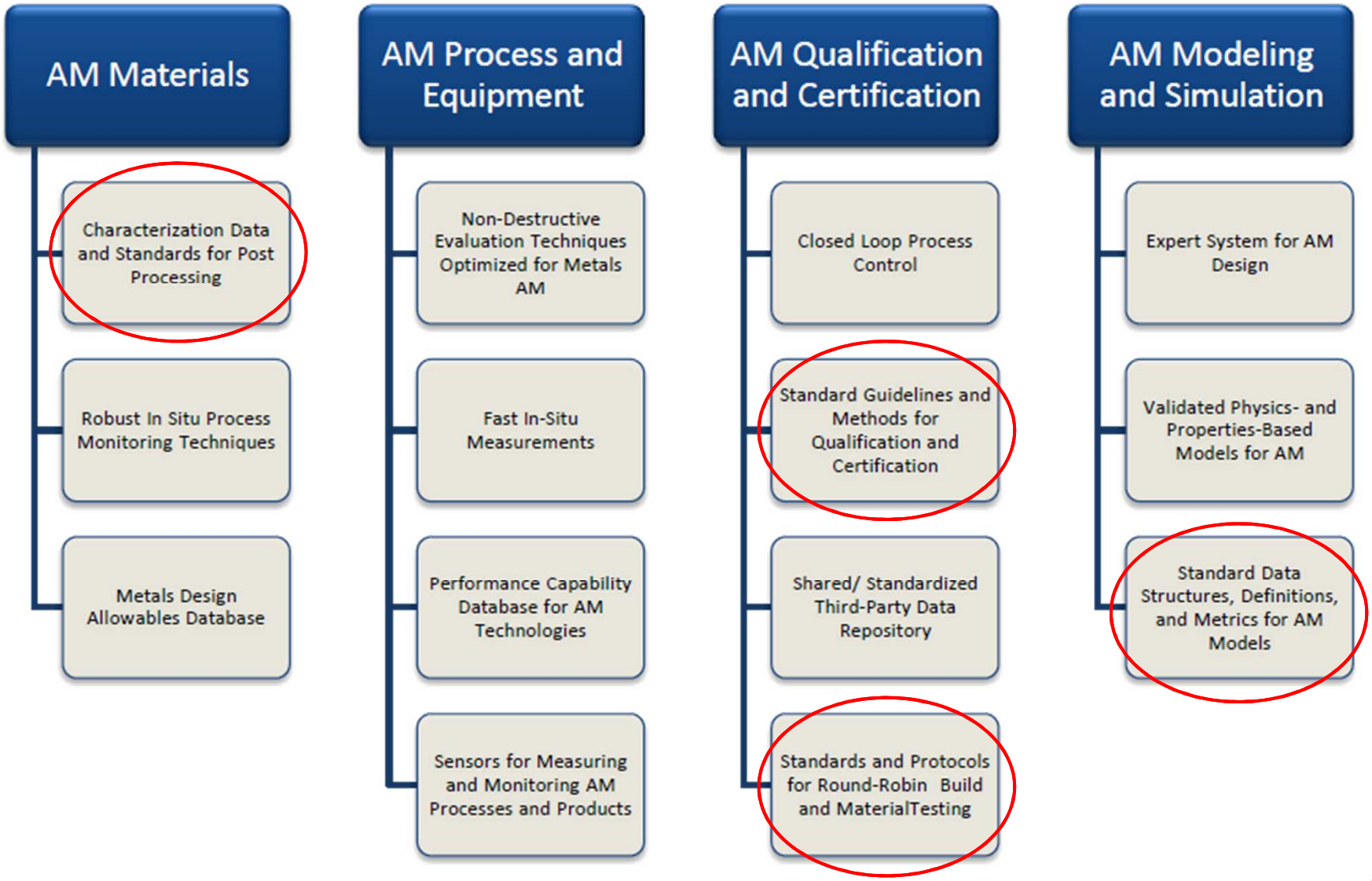
Fonte: Frost & Sullivan 2014

Percepite fasi di evoluzione della tecnologia AM



Fonte: Deloitte review 2014

Sfide tecnologiche



Fonte: NIST 2013

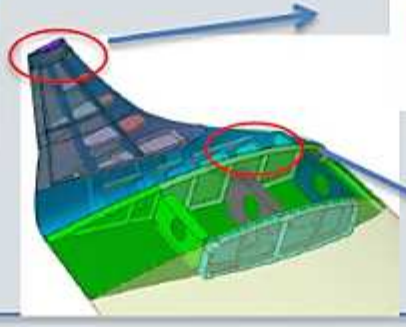
Contenuti

- Finmeccanica in breve
- Cosa intendiamo per Additive Manufacturing
- Settori di potenziale applicazione
- Limitazioni e sfide
- Percepita evoluzione

Esperienze della Divisione Velivoli di FNM

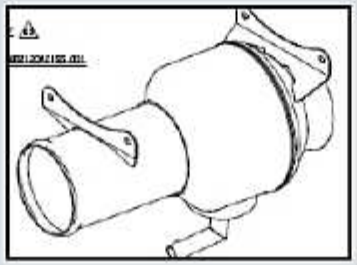
C27J

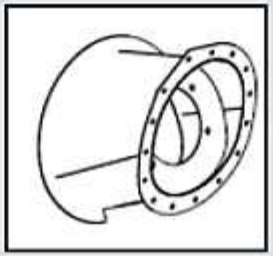
Components	Material	Dimensions	Allowable
Winglet Tip	AlSi10Mg	320x150x50	Static
Winglet Fairing	AlSi10Mg	300x220x205	Static



M346

Components	Material	Dimensions	Allowable
Drain Valve	AlSi10Mg	234x120x176	Static
ATS Component	Ti6Al4V	250x200x220	Static

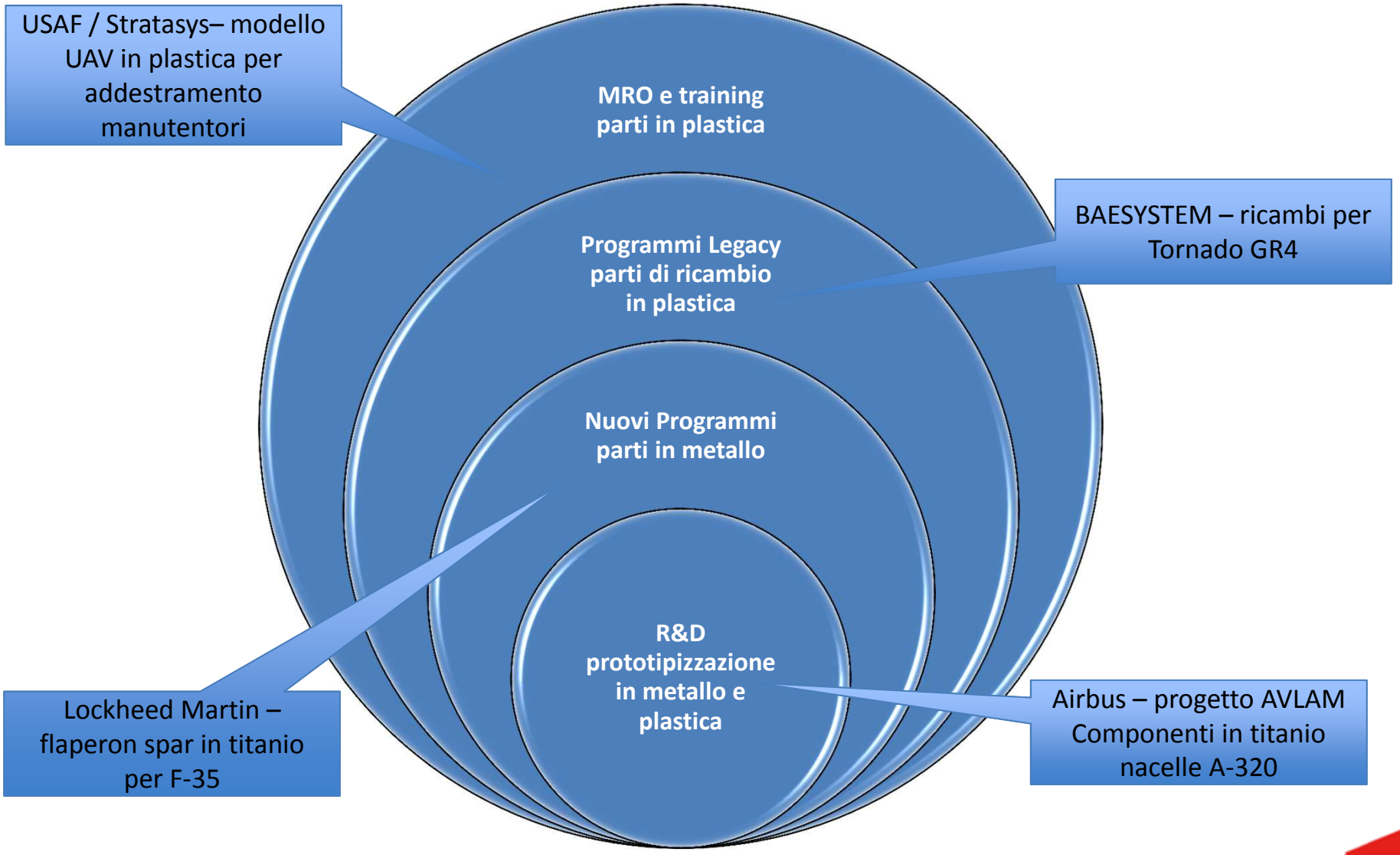




ATR

Components	Material	Dimensions	Allowable
Hand Wheel	AlSi10Mg	330x160x40	Static & Fatigue

Applicazioni della tecnologia tra i Competitors

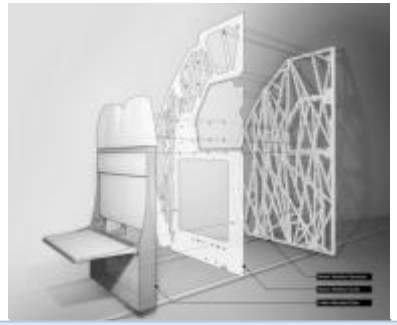


Settore Aeronautico

Applicazioni della tecnologia tra i Competitors

GKN ha realizzato un centro in UK dove collabora con Airbus utilizzando sistemi EBM Arcam

19 componenti del LEAP **Jet Engine (GE)** saranno prodotte con tecnologia AM



100 componenti del A350 XWB **(AIRBUS)** saranno prodotte dalla Stratasys con il materiale ULTEMTM 9085

Rolls-Royce Trent-XWB engine Front Bearing Housing

Boeing utilizza componenti plastici sul B787

Settore Aeronautico

Brevetti specifici su AM

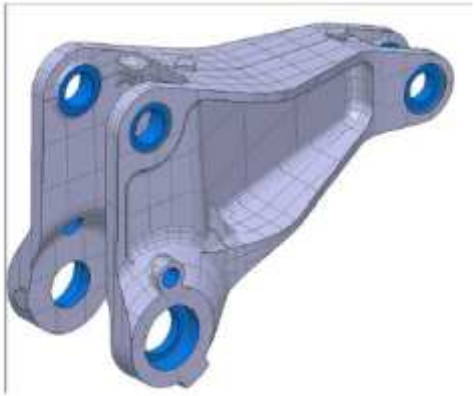
Aerospace Rank	Firm	Number of Patents	Cross-industry Rank
1	Boeing	19	11
2	BAE Systems	12	23
3	General Electric	11	26
4	United Technologies	10	30
5	Honeywell Aerospace	9	35
6	Snecma (Safran)	9	35
7	Airbus Operation GmbH	6	54
8	EADS N.V.	6	54
9	Lockheed Martin	2	152
10	Raytheon	2	152

Source: 3D Printing, Technology Insight Report, An analysis of patenting activity around 3D-Printing from 1990-Current (02/2014), Gridlogics Technologies

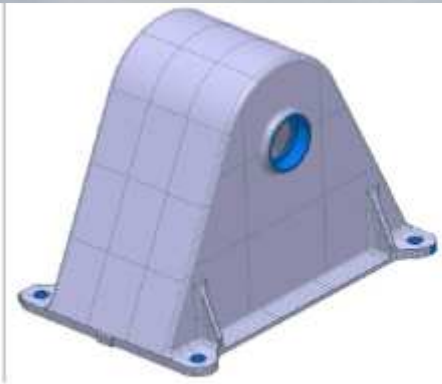
- L'analisi dei brevetti fa emergere che vi sia un numero crescente di brevetti presentati da aziende aeronautiche, sebbene la maggior parte dei brevetti siano stati presentati da aziende specializzate nel settore AM

Settore Elicotteri

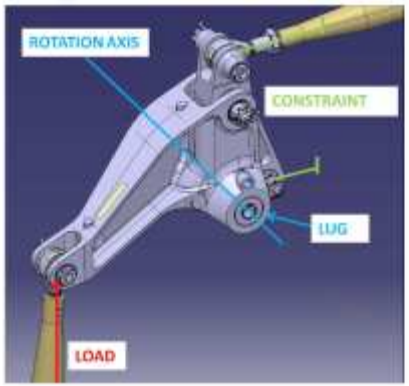
The driving force is to consider additive manufacturing technologies for the production of fixed flight controls bellcrank assemblies, i.e. supports and levers, which at the moment are realized with traditional manufacturing technologies, like machining or castings. At this purpose two components, a support and a lever, have been selected as interesting for this investigation.



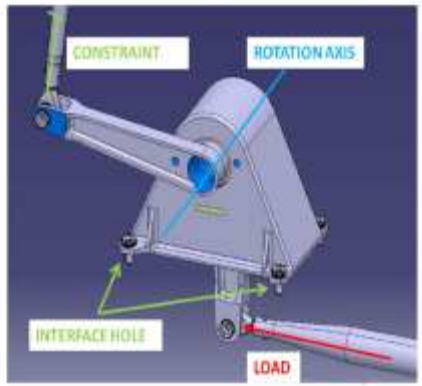
Lever P/N 8G6712A04551



Support P/N 8G6713A02351

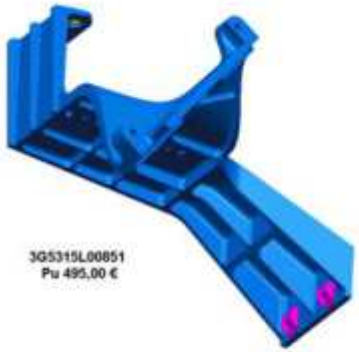


Lever Boundary Conditions



Support Boundary Conditions

Examples of flame retardat thermoplastic supports for cable assembly on AW139 (Material: ULTEM 9035, tensile strength 71 Mpa)

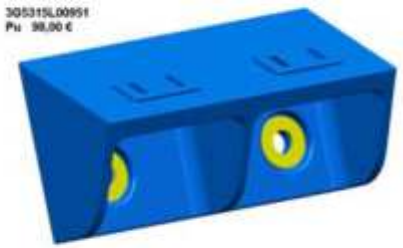


158.0 X 203.0 X 153.0 mm

Weight = 0.175 Kg

157.0 X 133.0 X 150.0 mm

Weight = 0.127 kg



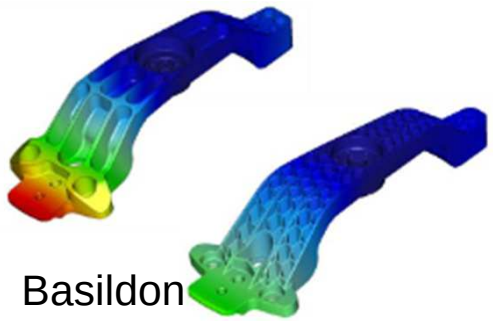
29.0 X 29.0 X 65.0 mm

Weight = 0.023 Kg

Mechanical Case Studies

Finmeccanica is now investigating ALM, to assess how such a technology might benefit the design and production of critical mechanical parts of its own electronic systems

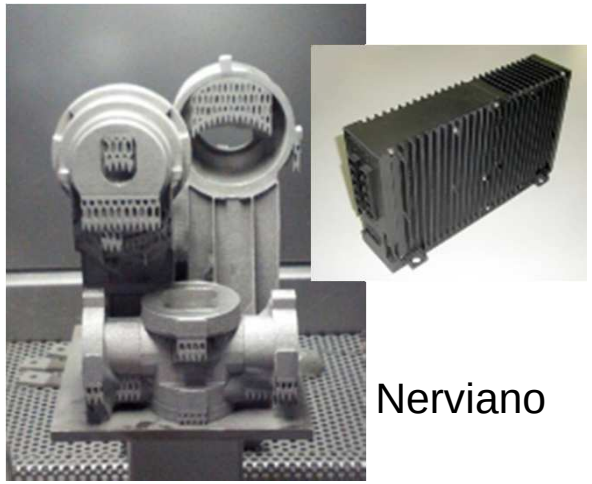
Luton



Basildon

Edinburgh

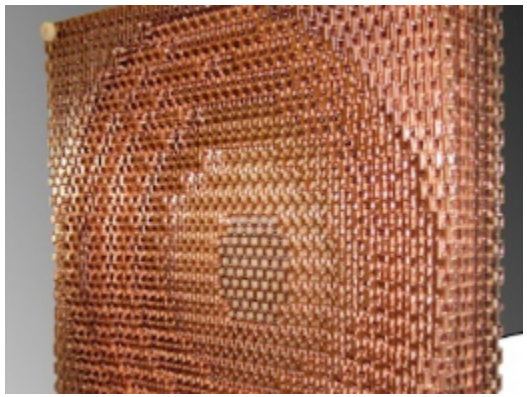
Caselle and Pomezia



Nerviano

Florence

Electromagnetic Metamaterials



materiali sintetizzati attraverso la aggregazione di celle elementari uguali tra loro progettate ad hoc, in grado di offrire caratteristiche elettromagnetiche non raggiungibili con materiali "naturali"

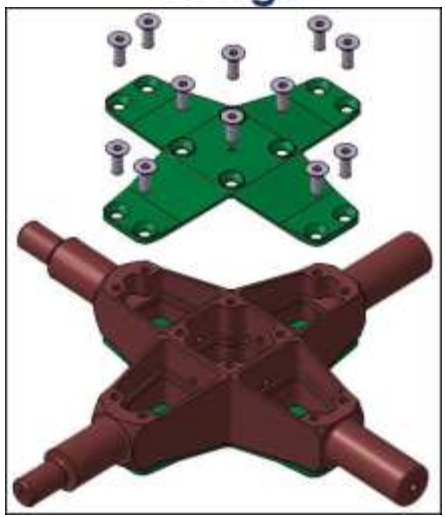
A wide range of challenges for radar and communication systems can today be faced with the use of Metamaterials:

- In multifunctional radar and EW applications MTMs give the best compromise between very large desired bandwidth and reduction of weight and dimensions.
- In realizing conformal antennas –for specific shapes of platforms, or MIMO configurations- or low cost electronic scanning arrays
- In the reduction of coupling among different antennas -or mutual coupling among different elements of the same array- and radiation in unwanted direction (back-lobe).
- For WAIM (Wide Angle Impedance Matching) antenna covers that keep stable the active impedance of the radiating element on varying the scan angle;
- Suitable to fulfil polarizers, in order to modify antenna polarization, or to realize surfaces with different polarization characteristics depending on frequency, particularly useful in multiband systems.
- MTM surfaces can be used as lenses, in order to give a desired shape to the antenna beam, and to compensate frequency dispersion effects.
- …….

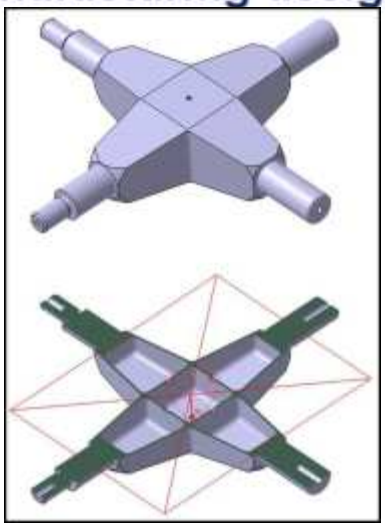
Spacecraft antenna support

A structural spacecraft parts manufactured & assembled by several pieces has been re-design in a unique components obtaining mass & cost saving thank to additive layer manufacturing technology.

Standard design



Additive layer manufacturing design



Materiale: TiAl6v4
Tecnologia: EB-AM)
Risparmio di massa: 30% c.a su 200 gr c.a

Il mass saving per un sistema spaziale comporta un risparmio sia per i costi di lancio in orbita, stimabile nel range 50-100 Keuro/kg, sia per la riduzione dei costi della struttura sul ciclo di vita dello spacecraft.

The COLUMBUS Toolbox

ULTEM 9085 is the only material utilized for the manufacturing of all the parts (apart from hinges) of the TOOLBOX, including:

- **tool retentions:**
  - Tool retention concept have been designed and developed in 5 different typologies for restraining different tool size/typology (wrenches, bits). Each selected tool restraint concept has been qualified with 3000 insertion / extraction cycles
- **labels** have been (inserted) engraved, not protruding

Sistemi Difesa - Missili

Facility operating from Oct 2014

Plant specification:

- Conform to ATEX directives (anti-explosion)
- Fire resistant REI 120 (UNI 9723)
- Antistatic floor
- Pneumatic plant specifically filtered
- Argon gas plant
- Autonomous cooling system
- Electric continuity (UPS)
- Control room with 3D SW workstation and polymer 3D printers for rapid prototyping

MBDA's Experience ALM Infrastructure

2 printers installed in Fusaro Mechanical workshop:

- Installation completed on November 14
- Mod/Type: EOSINT-M280, P/N 1212-0602
- S/N: SI-1841 setup for Steel
- S/N: SI-1842 setup for Aluminium

Printing room

Control room

Sistemi Difesa - Missili

Gas in processing chamber			Argon and/or Nitrogen
Laser power		W	200 - 400
Processing volume		mm (x,y,z)	250x250x320
Throughput/productivity		cm3/h	2-20
Scanning velocity		m/s	7
Layer thickness		micron	20-60
Precision		mm	+/-0.05
Roughness		micron	4-6
Number of available materials		Num.	12
Aluminium availability		Available	Yes
Typical energy consumption		KW/h	**3,2**
Oxygen control in processing chamber		Available	Yes
Laser power control		Available	Yes
Certified materials from supplier	Stainless Steel		17-4 PHI
	CoCr superAlloy		CoCrASTMF75
	Titanium		TI6AI4V
	Nickel alloys		Inconel 625,718
	Aluminium		AlSilOMg

Contenuti

- Finmeccanica in breve
- Cosa intendiamo per Additive Manufacturing
- Settori di potenziale applicazione
- Limitazioni e sfide
- Percepita evoluzione

Limitazioni attuali

- **Dimensioni delle parti**: ad oggi vi sono limitazioni nelle dimensioni degli oggetti realizzabili, in futuro sarà necessario fare gli appropriati trade-off tra dimensioni e costi/complessità delle macchine
- **Produzioni di serie**: ad oggi l'entità della produzione è limitata dalle caratteristiche della macchine utilizzate.
- **Progettazione delle parti**: criteri di progettazione specifici sono necessari per ottenere I potenziali benefici della tecnologia
- **Scelta dei materiali**: non tutti i materiali sono utilizzabili e la qualità delle polveri è un fattore da considerare con grande attenzione
- **Proprietà dei prodotti ottenuti**: anisotropia e porosità residua

Contenuti

- Finmeccanica in breve
- Cosa intendiamo per Additive Manufacturing
- Settori di potenziale applicazione
- Limitazioni e sfide
- Percepita evoluzione

Percepita evoluzione

- L'adozione delle tecnologie AM sarà graduale in un settore fortemente vincolato da regolamenti certificativi
- Su prodotti già in servizio l'utilizzo di tale tecnologia sarà limitato alla produzione di parti non critiche (interiors o componenti non safety critical)
- Nel progettare nuovi prodotti nel medio-lungo termine l'adozione di tale tecnologia sarà progressivamente estesa anche a componenti critici per i quali potrebbe essere conveniente adottare tale tecnologia, probabilmente combinata a tecnologie di finitura tradizionali
- Non si prevede che tale tecnologia sostituirà in modo massiccio la produzione di componenti ma potrebbe influenzare in modo significativo sia la supply chain sia le logiche di gestione del business MRO