Composites challenges for a further development in aerospace sector

ICAS Biennial Workshop - September 5, 2011

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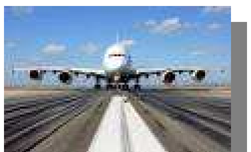
EADS programmes are setting global standards

TODAY

Ariane



A380

Eurofighter

EC135

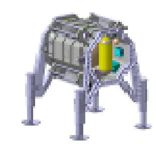
A320

TOMORROW

A350XWB

Talarion UAV

HOMER



AEW

X³

Outline

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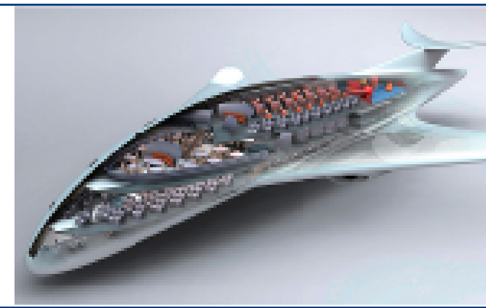
Evolution of composites over the last 40 years at EADS

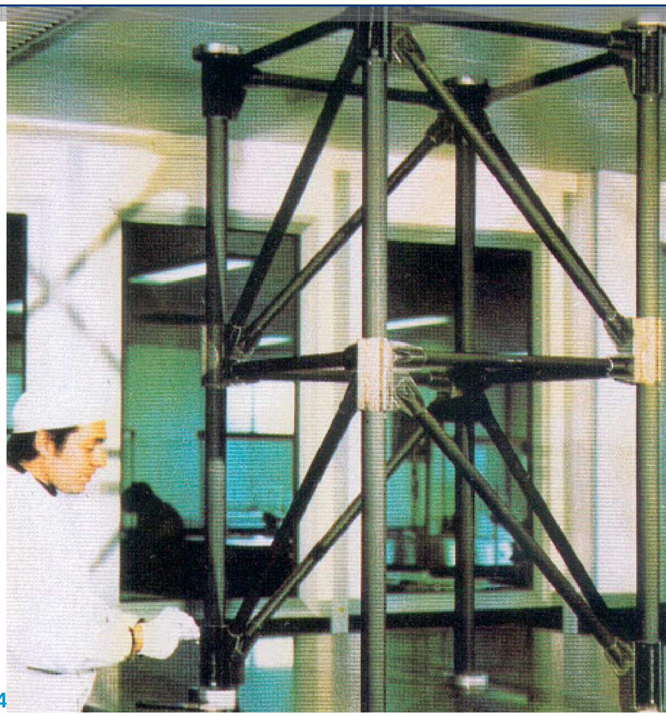


Remaining challenges for a further step

Typical space structure: Some years ago

Drivers

- Weight
- Stiffness
- Dimensionally stable (Thermal stability)
- Thermal "management"



Satellite main structure

Satellite lattice structure

Typical space structure: Communication & observation satellites

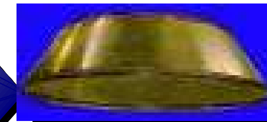
Same drivers +

- Versatile platform & technologies for short development lead time of communications satellites
- Very competitive market
- Larger size

Astra-3B

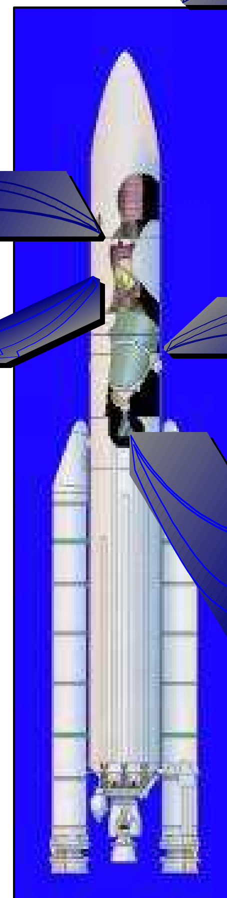
TerraSAR-X

Civil launchers Applications



3936 adapter
L: 1m ϕ : 3.9m W: 250Kg


Payload adapters
L: 1 m ϕ: 2.6m W: 100 Kg



Equipment bay
L: 1.5 m ϕ : 5.4 m W: 400Kg

Inter-stage structure
L: 3m ϕ: 5.4 m W: 600Kg

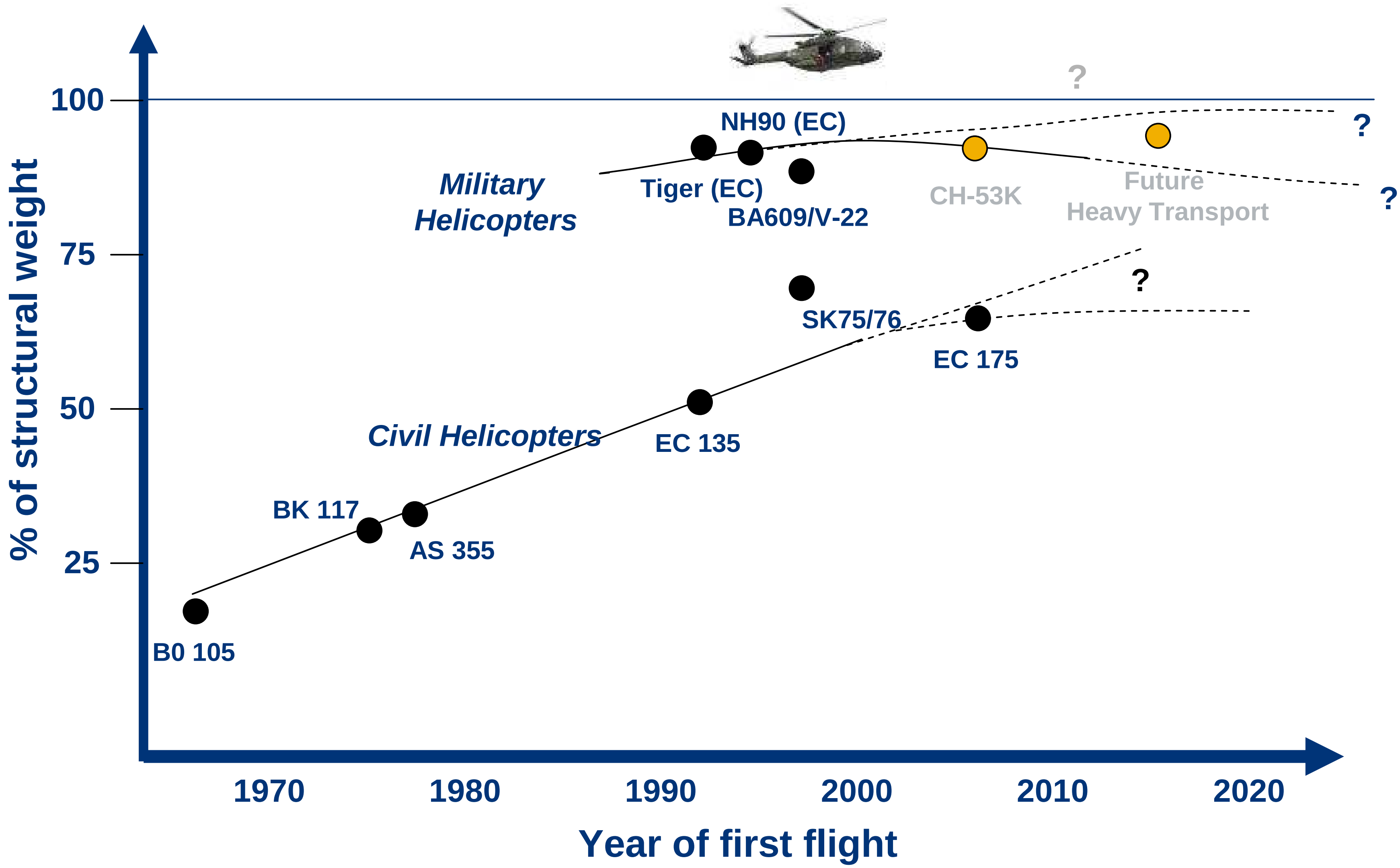
Launcher upper stage in composite

Up to 6 m dia. & 600 Kg

Increasing size !

ARIANE 5 ECA

Helicopter trends for composite usage



Helicopter structures & blades evolution

- **Trade off between metallic and composites on civil H/C depends on non technical issue**
- **Looking for processes & materials allowing**
  - **Automation**
  - **Integration of parts**
  - **Integration of functions**

  with high quality standards
- **High concerns with environmental issues**
- **Market expect disruptive technologies for blades**

EC 175

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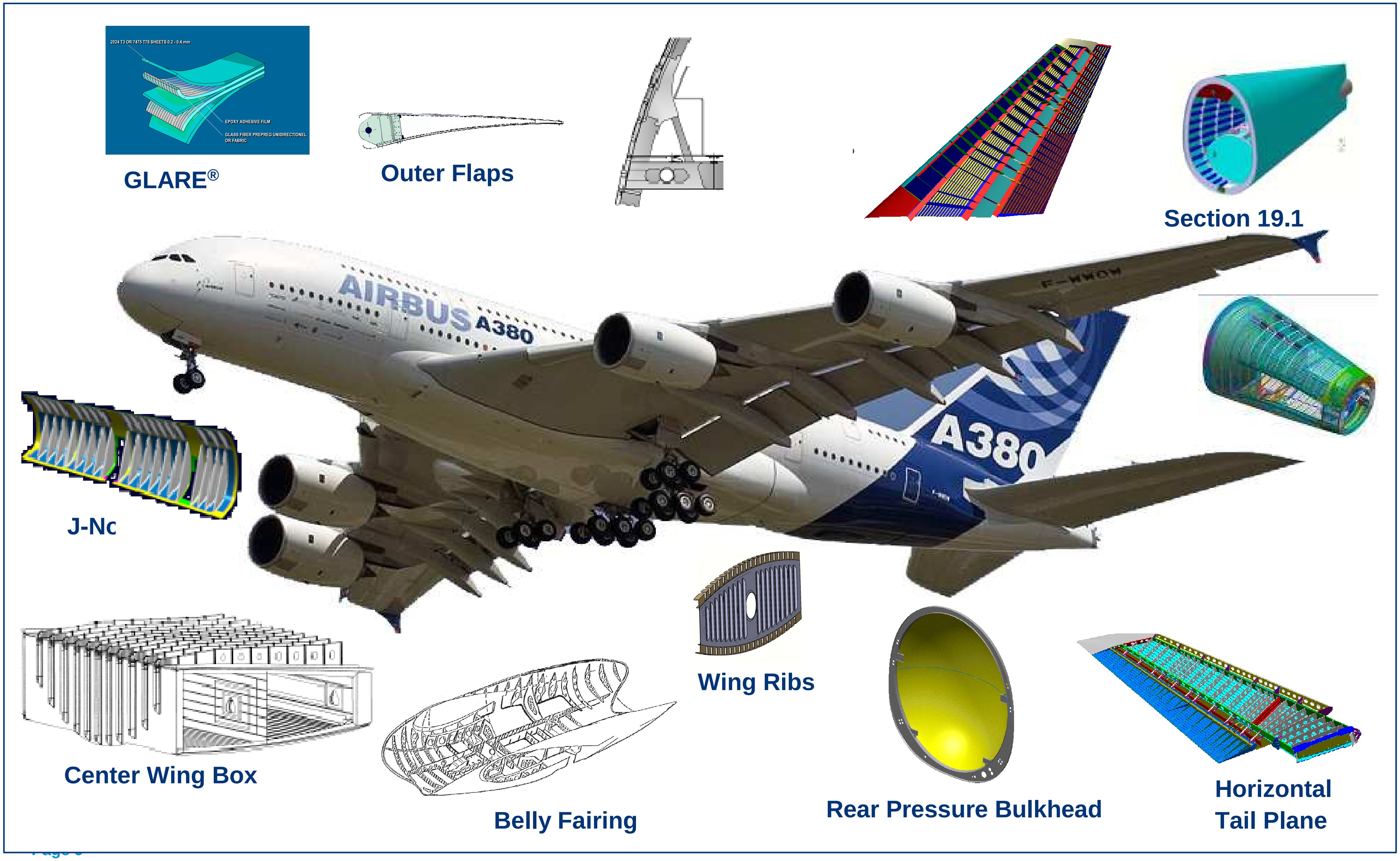
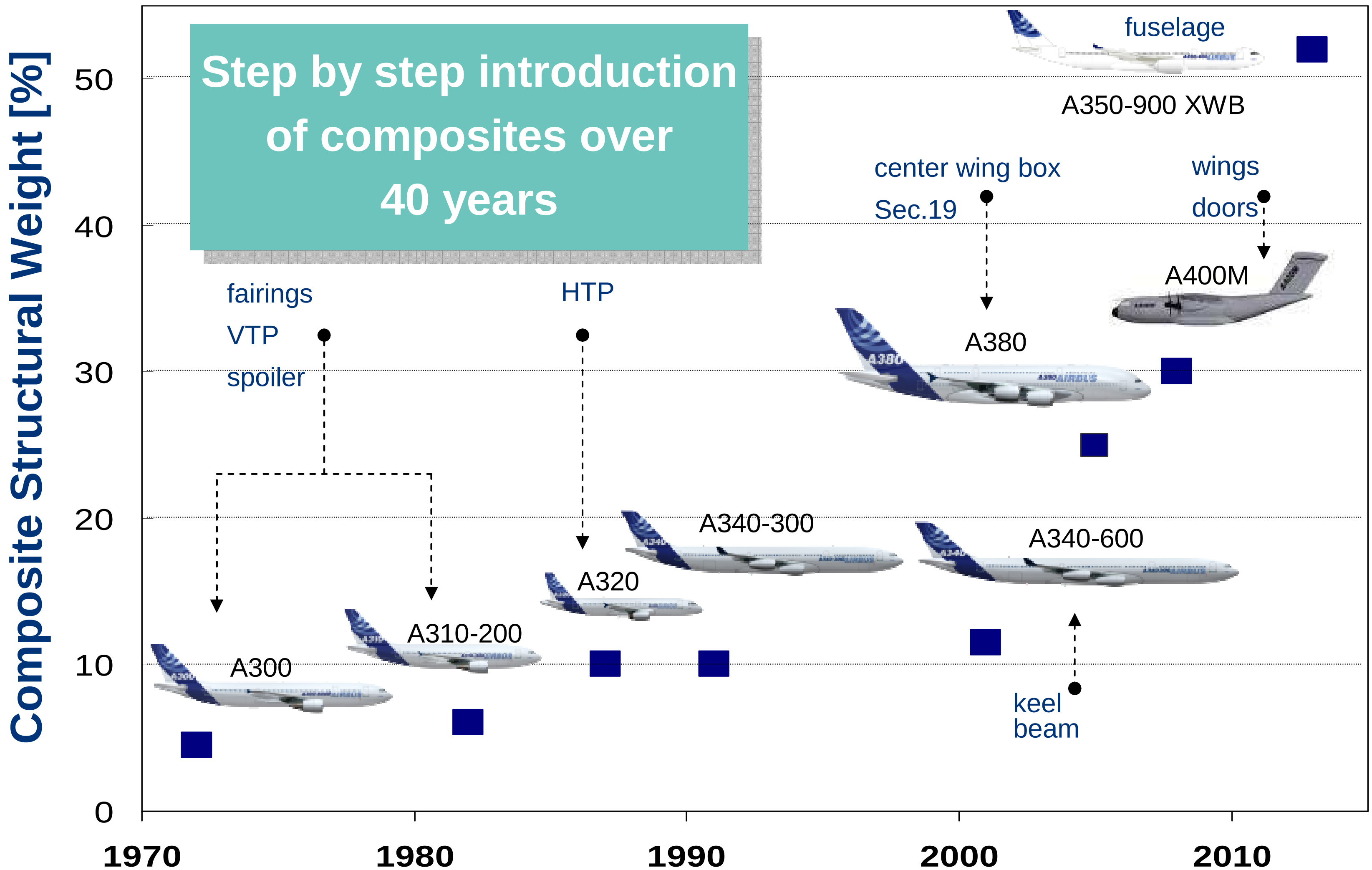
Typical aircraft structures



Composite structural weight development



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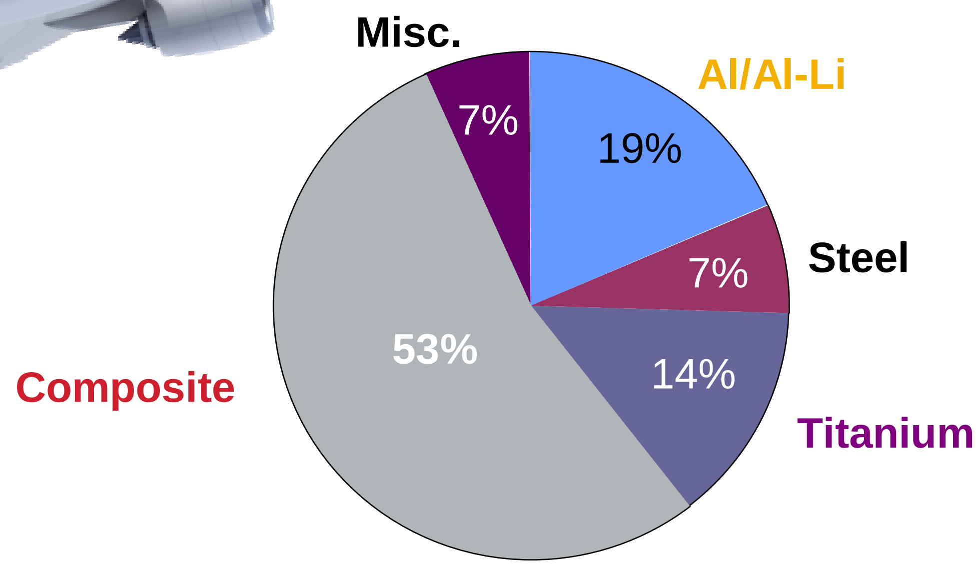
A350 XWB – Material breakdown

A350-900 XWB
(%) Including Landing Gear



A350 XWB puts the right material at the right place

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AIRCRAFT STRUCTURES EVOLUTION

A350 MSN1 wing panel

Market driven

- Increasing size
- Decreasing costs (purchase and use)
- Increasing production rate
- Reducing lead time

Social environment

- REACH compatibility, recycling
- Reduce environmental impact: Noise, fuel consumption, increasing comfort

Increased complexity

- Multi-disciplinary challenges
- Extended supply chain

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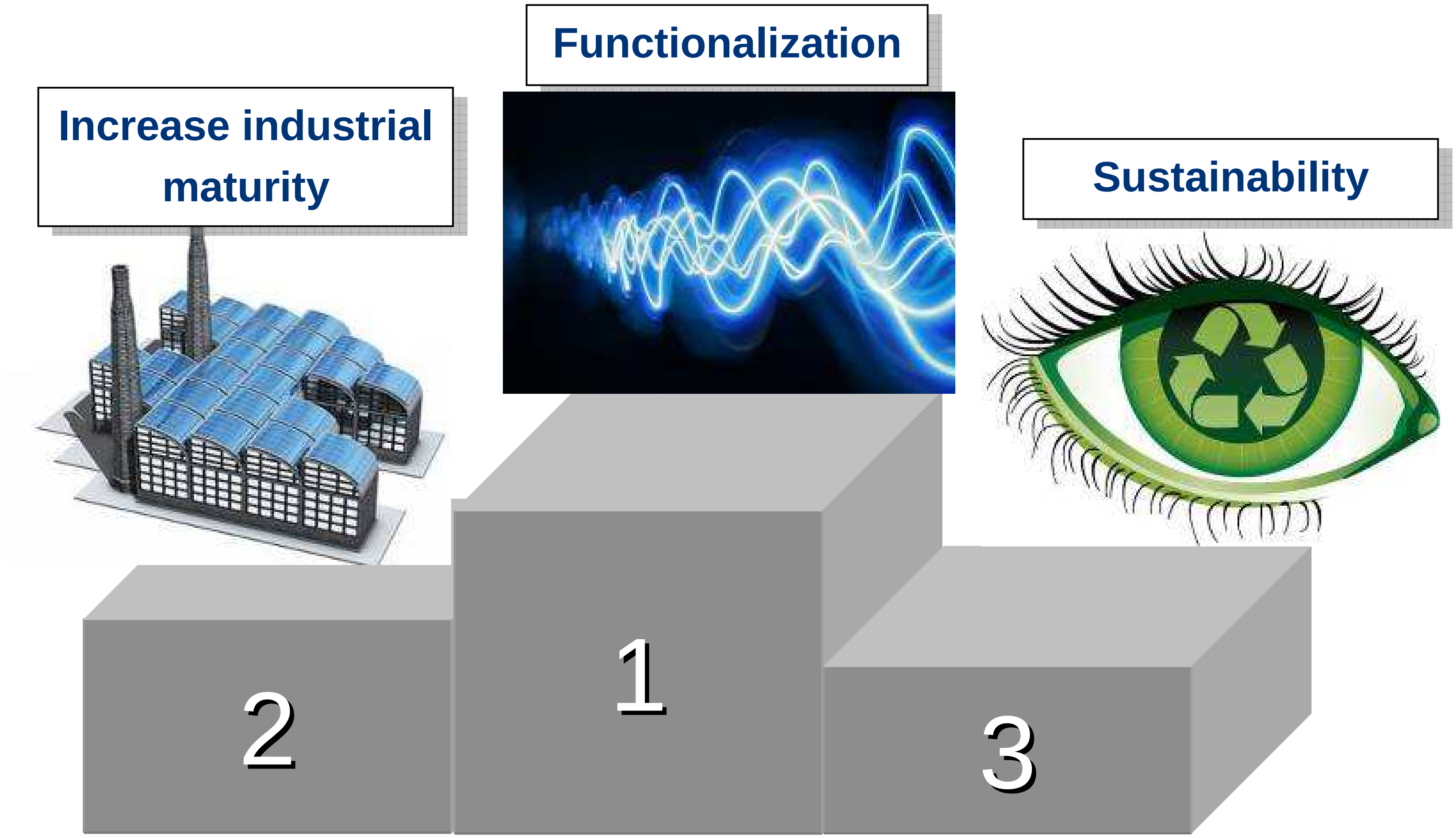
The 3 main challenges for a further development of composites

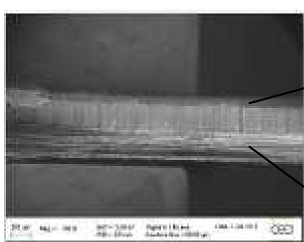


Functionalization
From material to design

Recover natural metallic properties

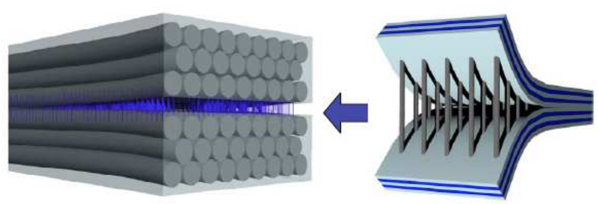
- Conductivities
- Tenacity / self healing
- Acoustic & vibration
- Fire Smoke & Toxicity
- Recyclable
- Damage indicator

Lightning strike impact

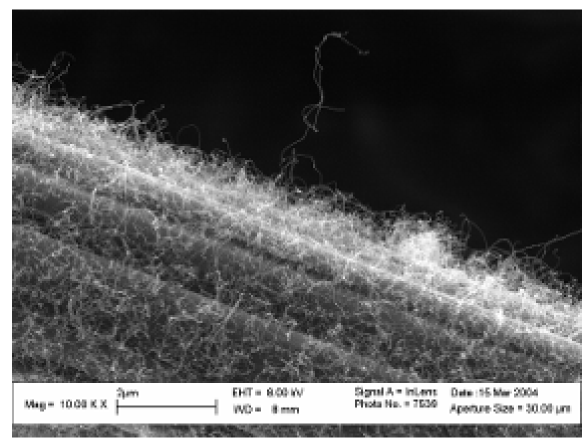


CNT forest

Prepreg



delamination

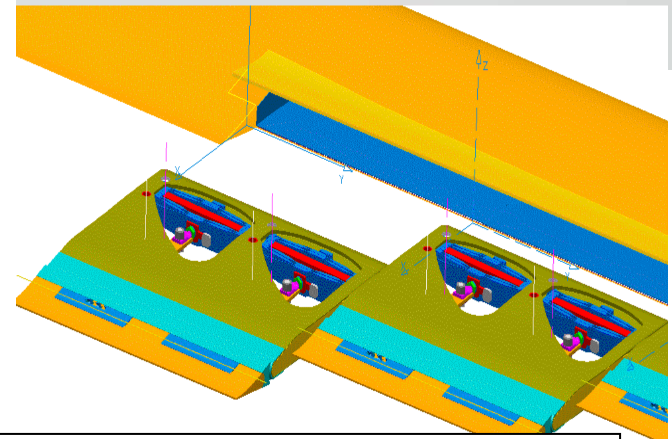


CNT growth on carbon fibre surface by CVD

Functionalization
From material to design

Integrate functions during manufacturing

- Morphing: Integrating actuators
- Sensing: Sensors integration for Structure Health Monitoring
- Antenna integration
- Integrate functional surfaces (coating, deicing, rain repellant…)
- Protection integrations (thermal barriers, impact shielding, …)



Eurocopter Blue Pulse Rotor

Ultimate challenge: It requires

- Material engineering knowledge

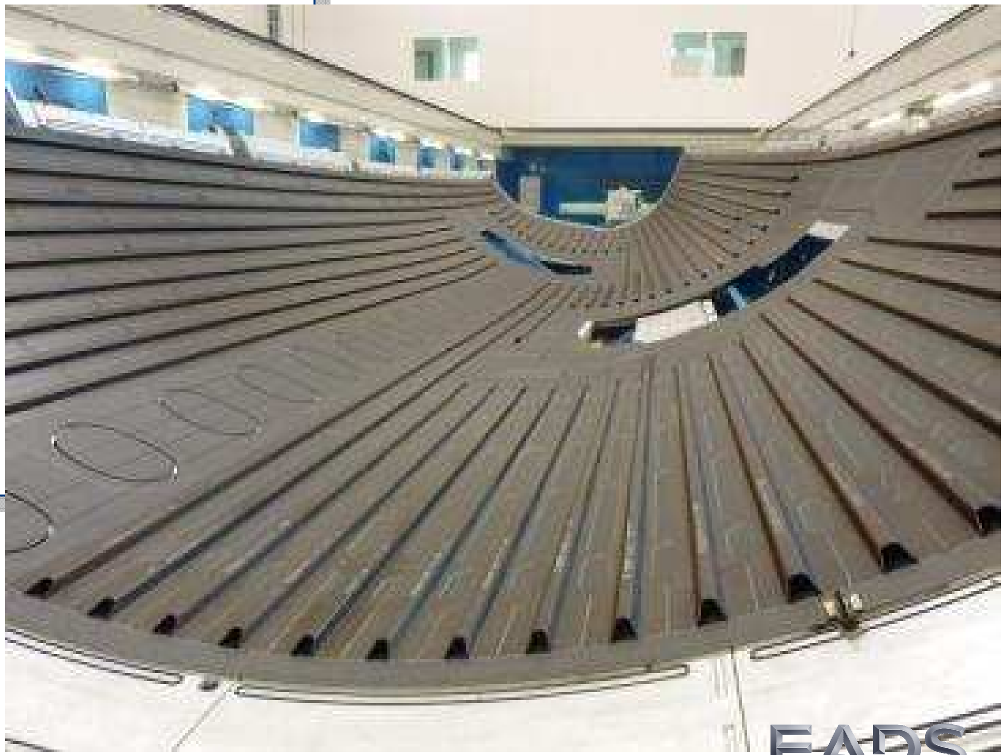
& **- Multi disciplinary skills**

Increase industrial maturity

Industrial maturity drivers

- Increasing size
- Increasing production rates & versatility
- Cost reduction pressure
- Increasing complexity / technical challenges
- Lead time reduction
- Supply chain reliability

A350 rear fuselage panel



Increase of automation

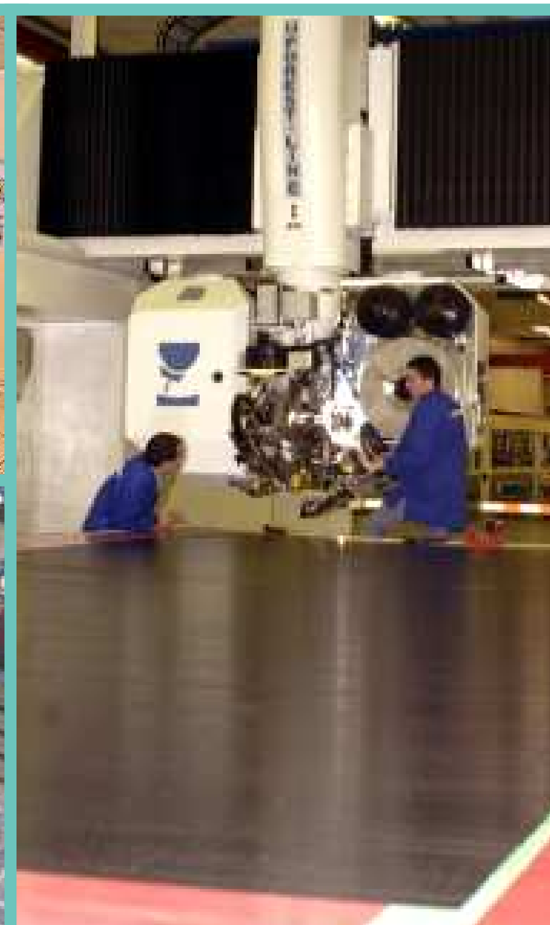
- ↗ size ☑
- ↗ production rates & versatility ☑
- Costs ↘ ☑
- ↗ complexity ☐
- Lead time ↘ ☐
- Supply chain reliability ☑

Technical challenges

- Handle dry fabric & wide prepreg rolls
- Increase deposition rate
- Bagging process

Filament Winding Telescope Cylinder

Increase of automation



Part integration - Infusion

- ↗ size ☐
- ↗ production rates & versatility ☐
- Costs ↘ ☑
- ↗ complexity ☐
- Lead time ↘ ☑
- Supply chain reliability ☐

One shot cargo door

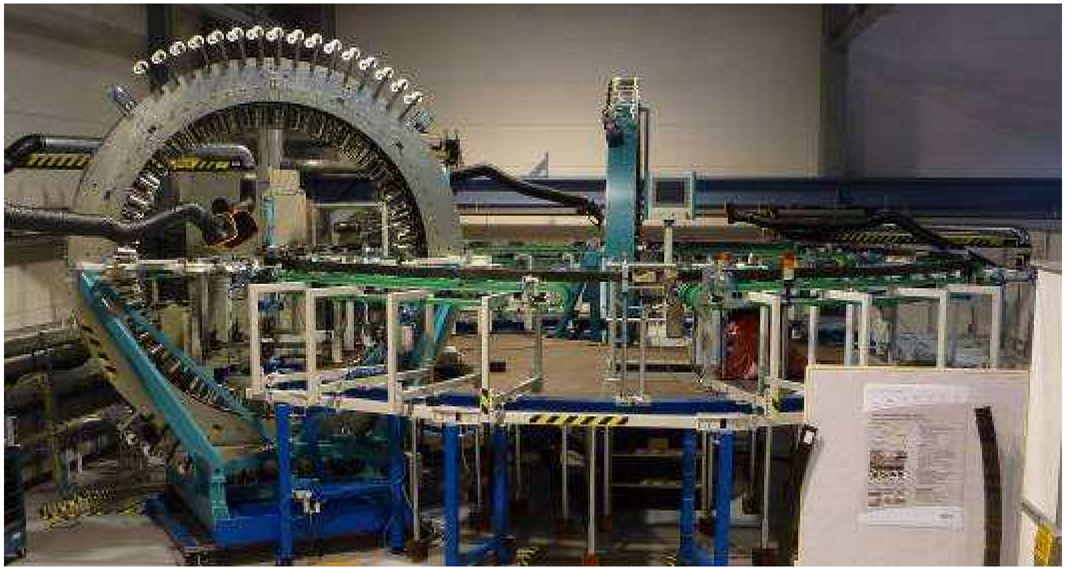
Pressure bulkhead

Challenges

- Material performance Improvement
- Tooling complexity
- Process robustness to mitigate risks of unacceptable defects
- Sizing methods !!!!

Part integration – Dry preforms for net shape infusion

dry fibers placement



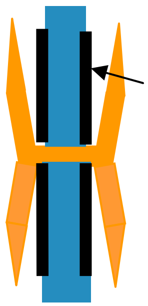
Braiding of frames

Sine web frame

Z pinning testing

Part integration – Bonding & Welding

- ↗ size ☐
- ↗ production rates & versatility ☐
- Costs ↘ ☑
- ↗ complexity ☐
- Lead time ↘ ☑
- Supply chain reliability ☐

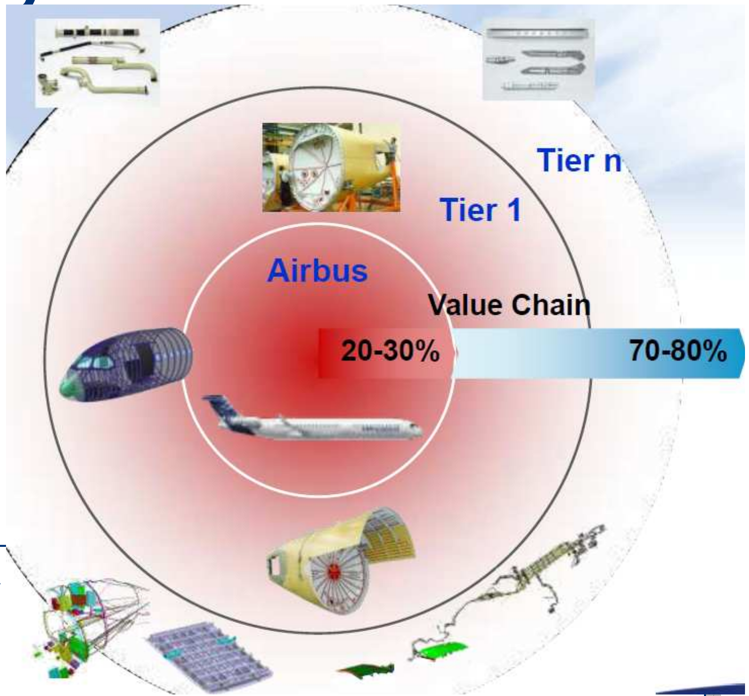


Example of Mojo FP7 project

➡ Extensively used for space for a long time

Reliable, cost effective & large supply chain

- ↗ size ☐
- ↗ production rates & versatility ☑
- Costs ↘ ☑
- ↗ complexity ☐
- Lead time ↘ ☐
- Supply chain reliability ☑



Limits of composites have been continuously extended over the last 40 years

- Knowhow & robustness had to be continuously enhanced for new processes
- Mastering "large & automated parts" more & more challenging for suppliers
- Design capabilities are lacking

➡ Standardization to be enhanced

➡ Robustness to be taken into account since the design

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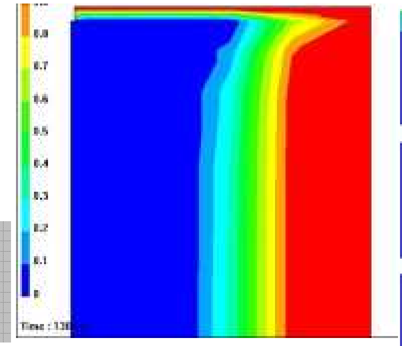
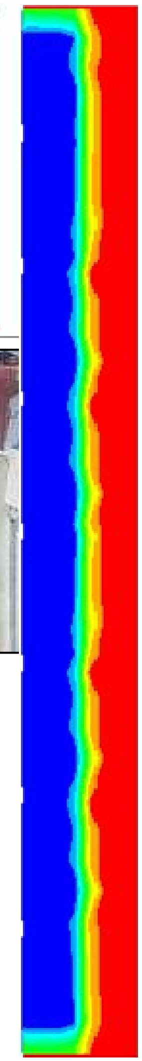
Manufacturing Process Simulation (MPS)

↗ size ☑
↗ production rates & versatility ☑
Costs ↘ ☑
↗ complexity ☑
Lead time ↘ ☑
Supply chain reliability ☑

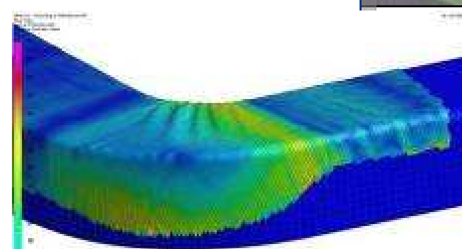
Edge effect on resin flow





MPS is undoubtedly an important means to Increase composite processes robustness

- ➡ Make composite process deterministic
- ➡ Master tolerances



But

- MPS remains complex
- Its own maturity needs to be improved
- It generally appears as an extra cost

Non Destructive Testing (NDT)

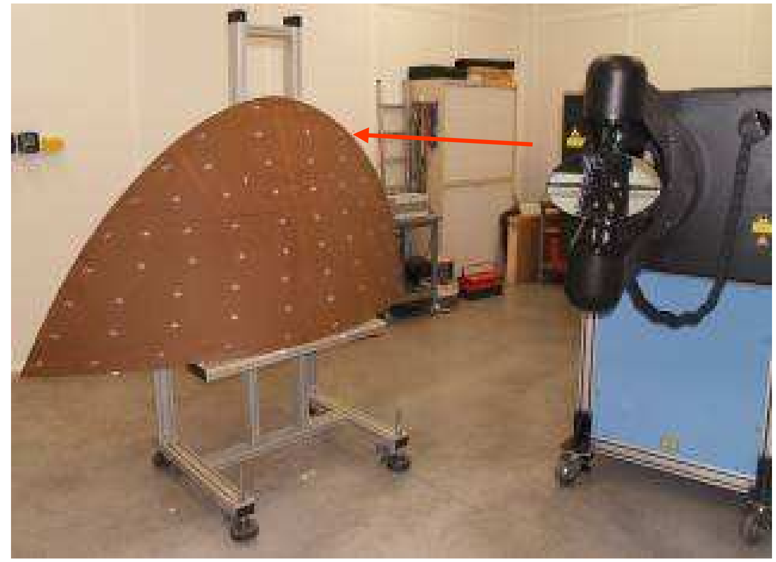
- ↗ size ☑
- ↗ production rates & versatility ☑
- Costs ↘ ☑
- ↗ complexity ☑
- Lead time ↘ ☑
- Supply chain reliability ☐

Challenges

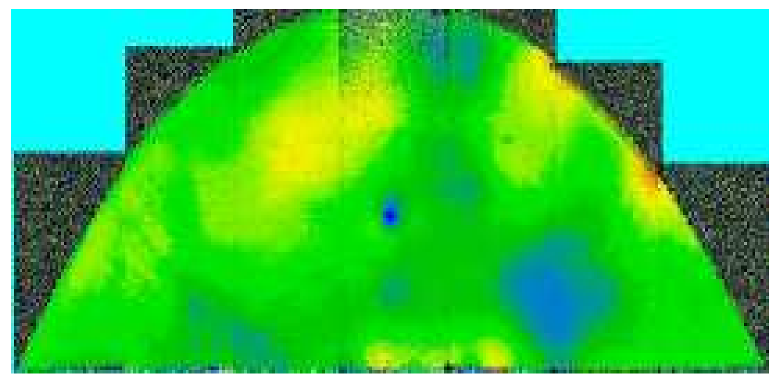
- Small defects / Complex shape / Fast
- Processing of a huge amount of data
- On-line monitoring

Avenues of research

- Contact-less NDT
- Automatic diagnostic tools



Laser US



Thickness C-Scan

A continuous improvement over several decades

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Sustainability

Stakes: Long term development

- Environment friendly products
- Environment friendly processes
- Material scarcity (Oil, …)
- Recyclability

Challenges

- High performance requirements
- Low energy, REACh compliant

Axis of research

- Natural fibers
- Non oil resins, low temperature or Out-of Autoclave curing resins
- Room temperature storage resin
- Material re-use

Flax fibers

Conclusion

- **Still a huge potential of improvement for composites**
- **Innovative approach involving the extended enterprise needed to**

1. **Increase industrial maturity**
2. **Develop multi-functional approach from day 1**
3. **Ensure a sustainable development of this business**

Thanks you for your attention

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