IMac-Pro

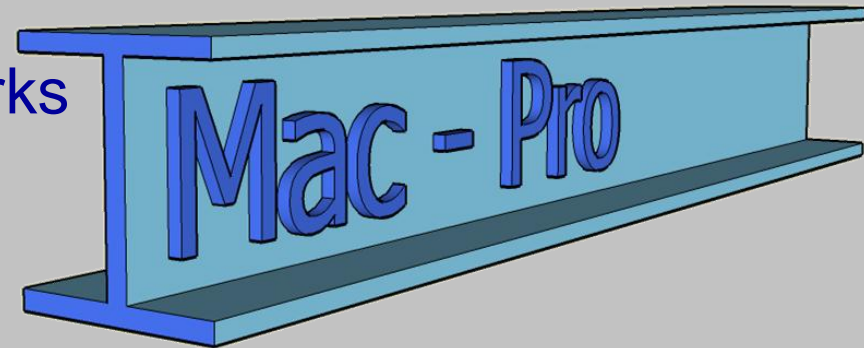**I**ndustrialization of **M**anuf**ac**turing Technologies for Composite **Pro**files for Aerospace Applications

Features and Highlights of IMac - Pro

Company: EADS Innovation Works
Department: IW-CT
Presenter: Christoph Breu

SETEC 12

Location: Lucerne
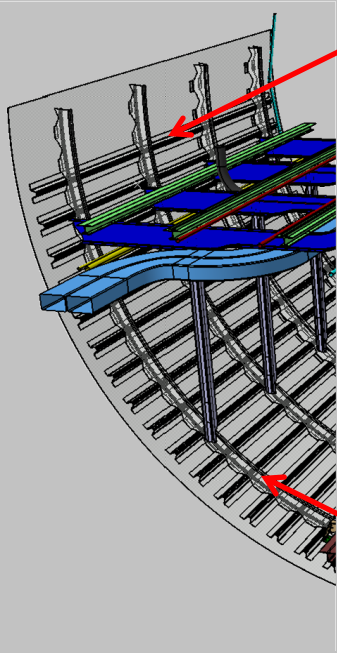
Date: 20th of September 2012

Content

- *Main Project targets*
- *Involved Partners and their role*
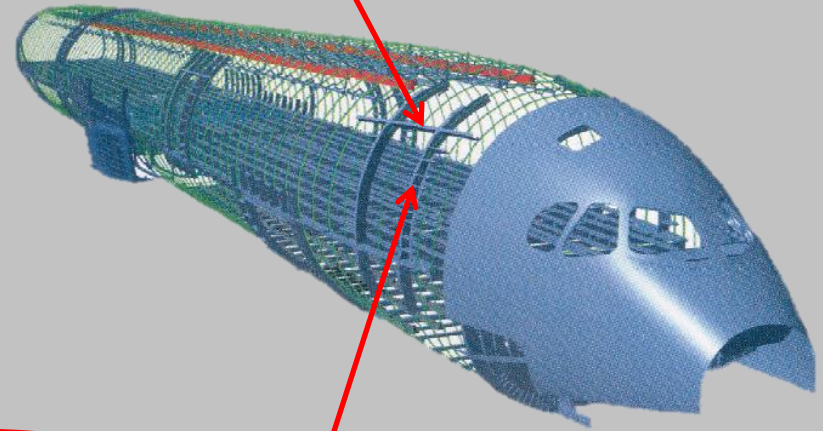- *Detailed technical topics*
- *Acknowledgment*

Content

- ***Main Project targets***
- *Involved Partners and their role*
- *Detailed technical topics*
- *Acknowledgment*

More than 1500 meters
of stringer in one AC

More than 600 meters
of frames in one AC

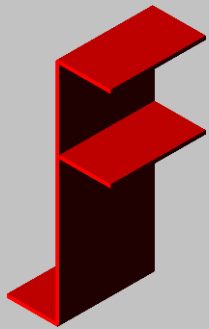# Main Project targets

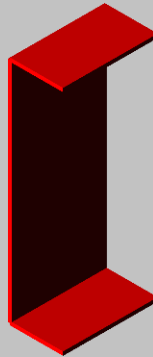**Funding:**   European commission

Main aim: *Main aim is the development of a complete, integrated process chain for the cost effective serial production of various aerospace CFRP stiffener profiles.*

Budget: *7.9 M€*

Timeframe: *From 2008 - 2012*

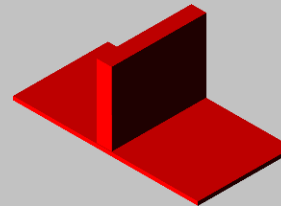**Nationality of partners:**   *Austria, Belgium, Czech Republic, France, Germany, Greece, Israel, Italy, Switzerland*
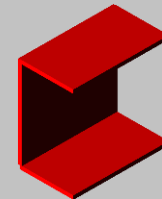
JF-Frame   **C-Beam**   **T-Stringer**   **C-Strut**

For all types of profiles RTM6, an Airbus qualified infusion resin system, will be used

Content

- *Main Project targets*
- **Involved Partners and their role**
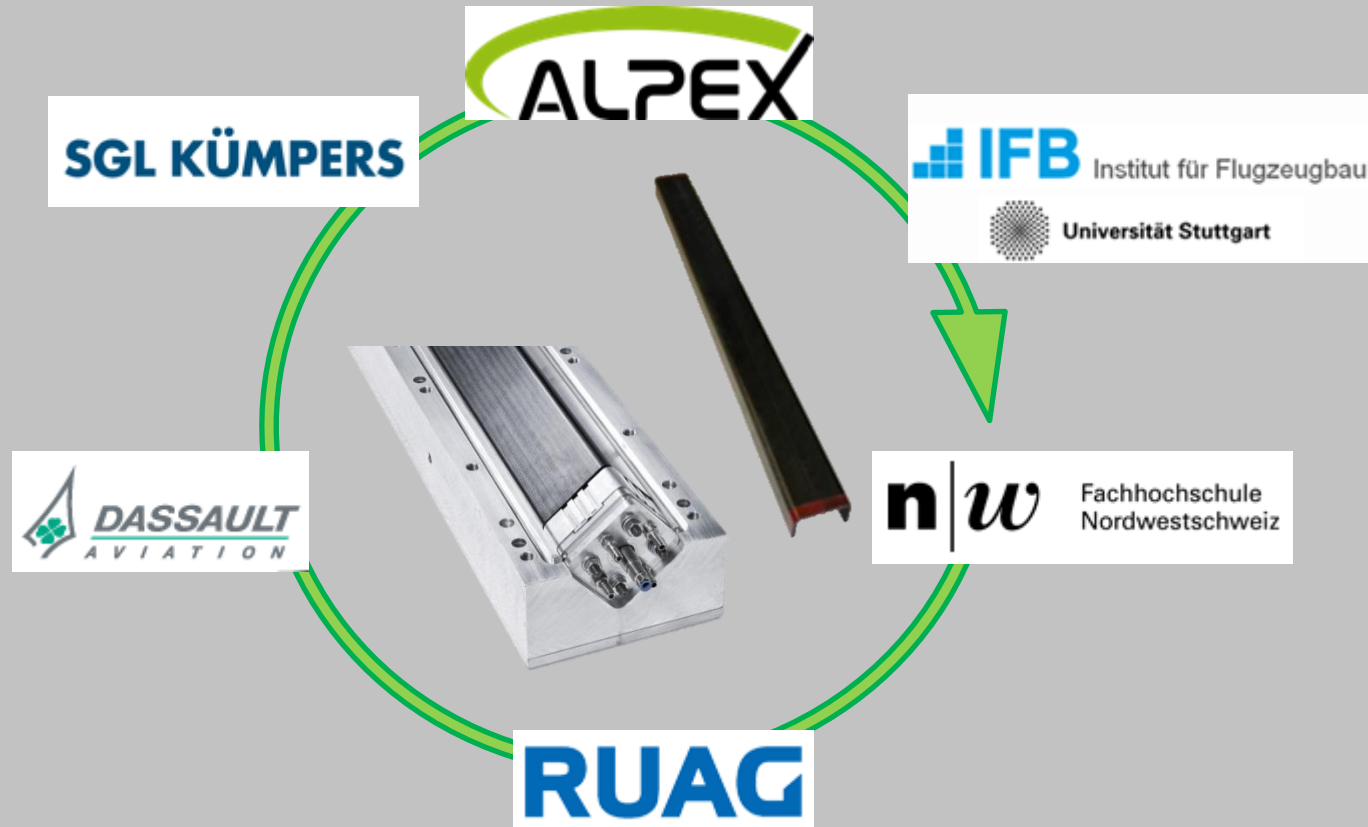- *Detailed technical topics*
- *Acknowledgment*

Stringer manufacturing

Frames and beams manufacturing
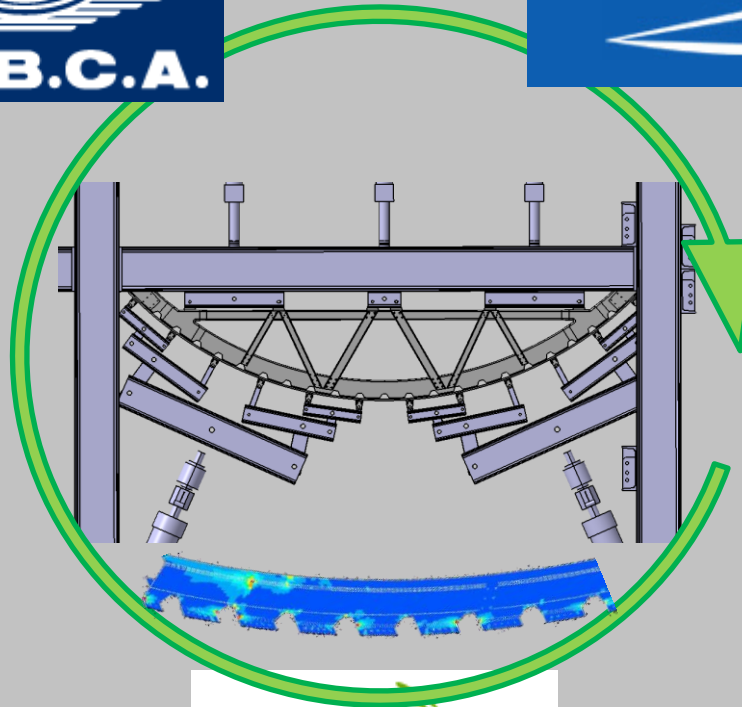
Design and testing

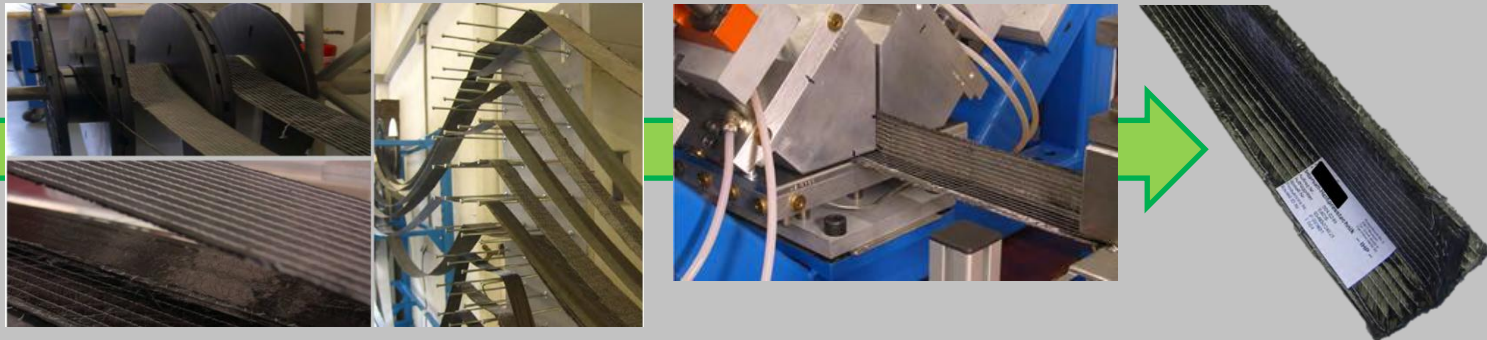# *Involved partners and their role*
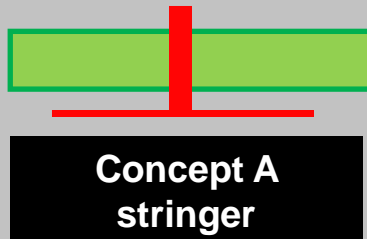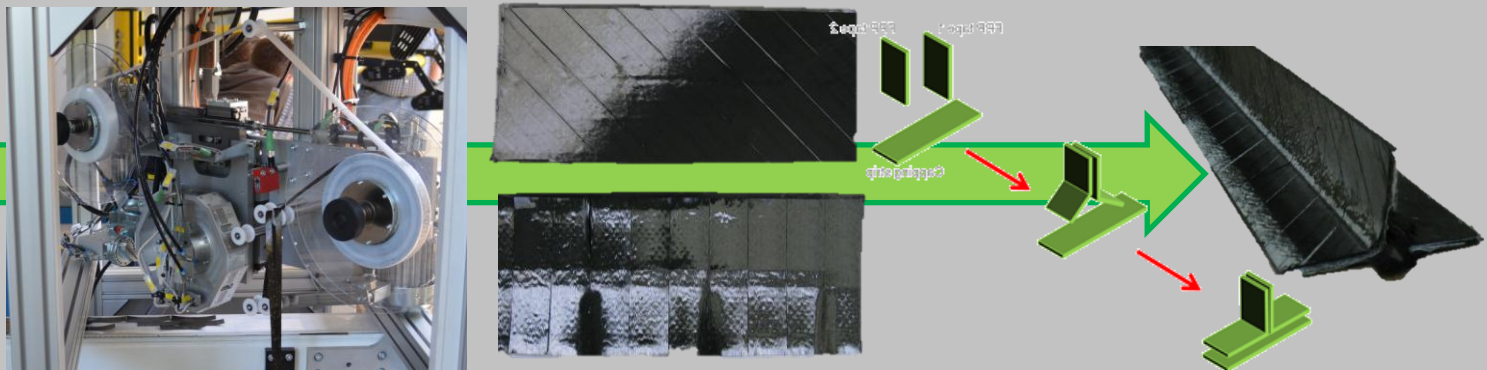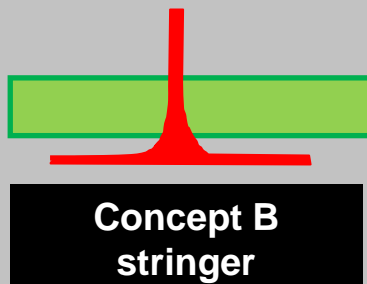
QA and cost analysis
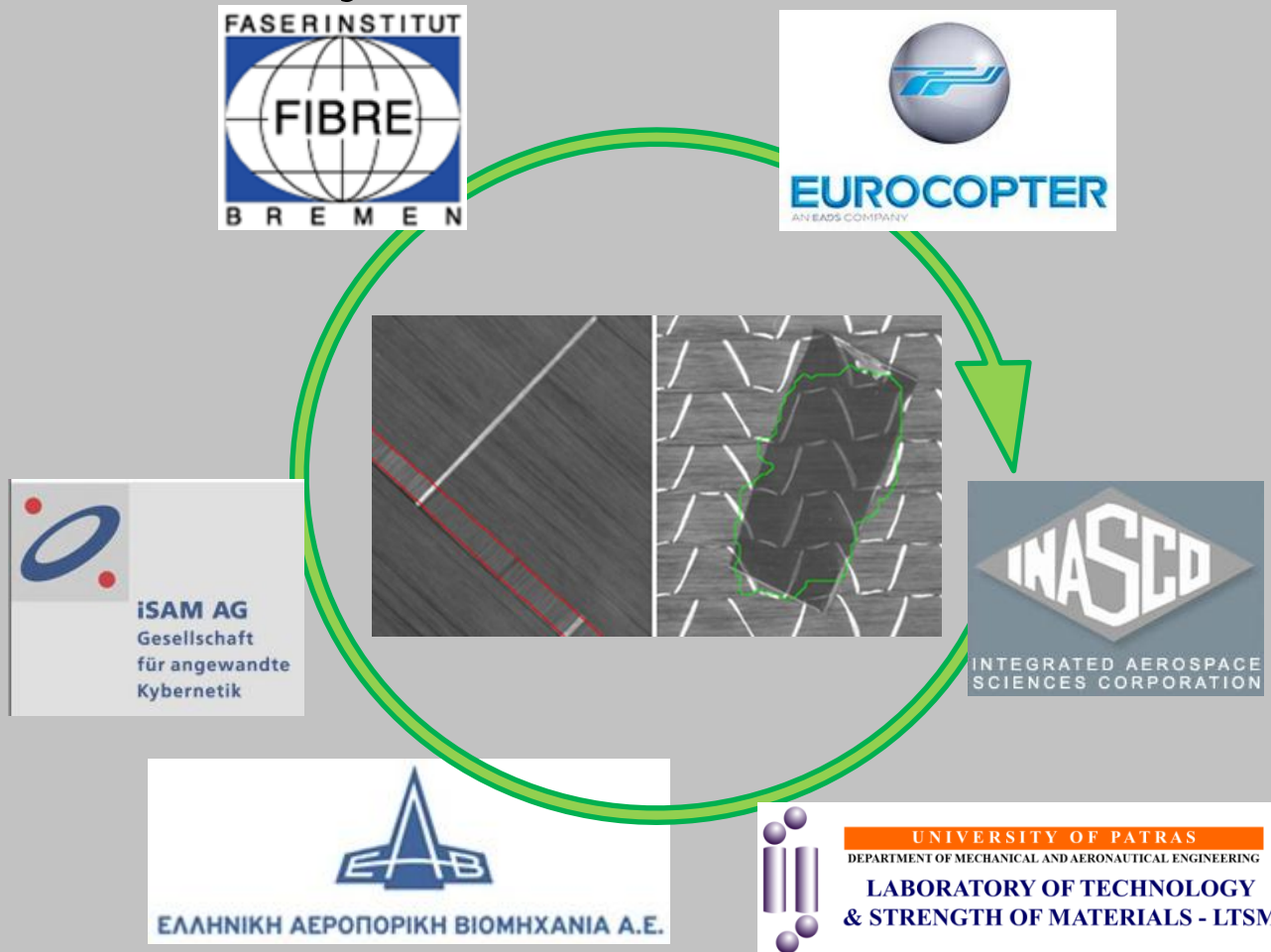
Content

- *Main Project targets*
- *Involved Partners and their role*
- **Detailed technical topics**
- *Acknowledgment*

Technical topic – T-stringer preforming

Concept A stringer

Material	Cutting of NCF	Preform production
NCF with IMS fiber	Secar continuous process	Xperion discontinuous hot pressing process

Concept B stringer

Material	Tape production	Preform production
Oxeon IM fiber tape 20mm/ 80g/m²	By EADS IW using MANZ FPP tape machine	manual folding by EADS IW. Automation possible

Technical topic– T-stringer curing

Concept A stringer
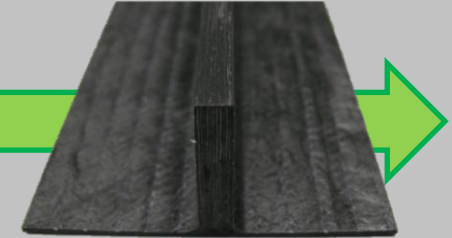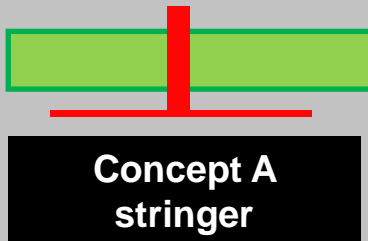
| Material	Tooling	Curing
Pultrusion	Injection tool for pultrusion	Combination of RTM6 and pultrusion critical.
Infusion	Tool for stringer with braiding hoses	Partly curved infusion tool → good quality

Concept B stringer
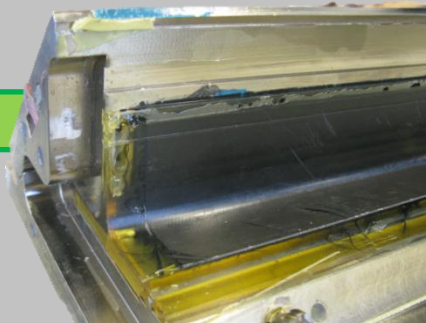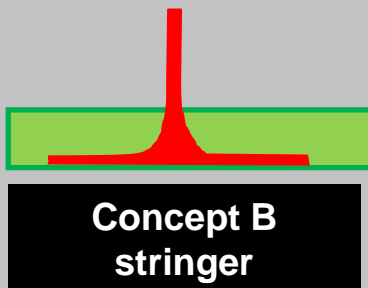
Material	Tooling	curing
RTM6/ Infusion	Closed mold	Reliable process. RTM could be also realized

Technical topic– Frames preforming

C-beam
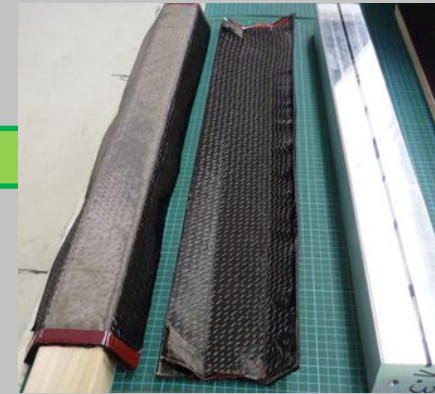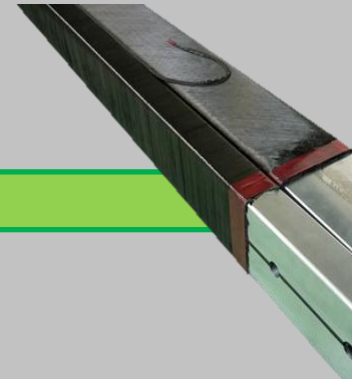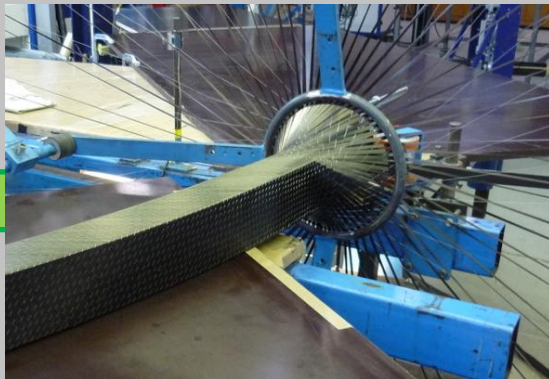
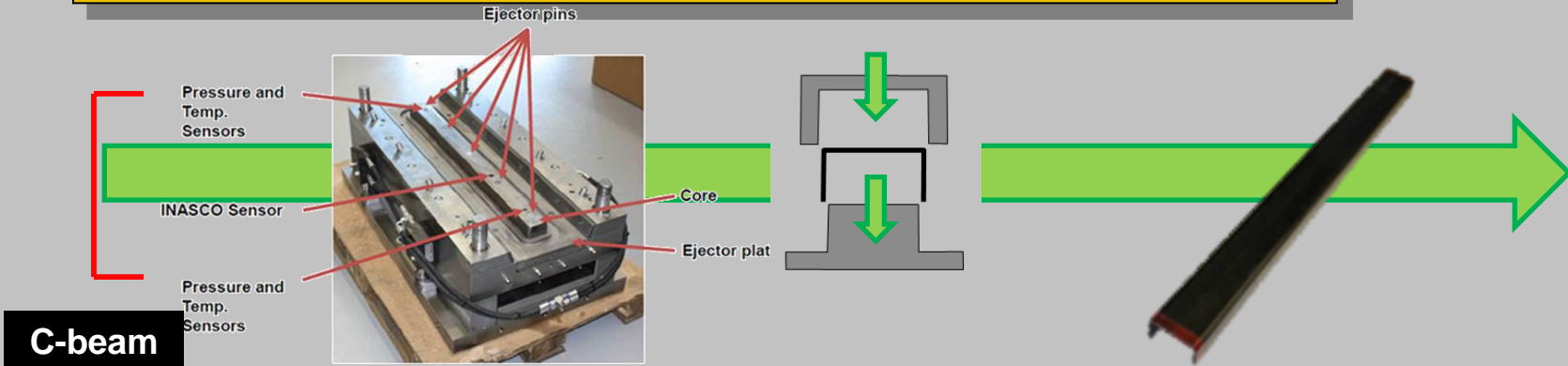| Material	Preforming	cutting
IMS fiber	UD braiding on mandrels	Stabilization of braid by binder. Cutting into two C-profiles.

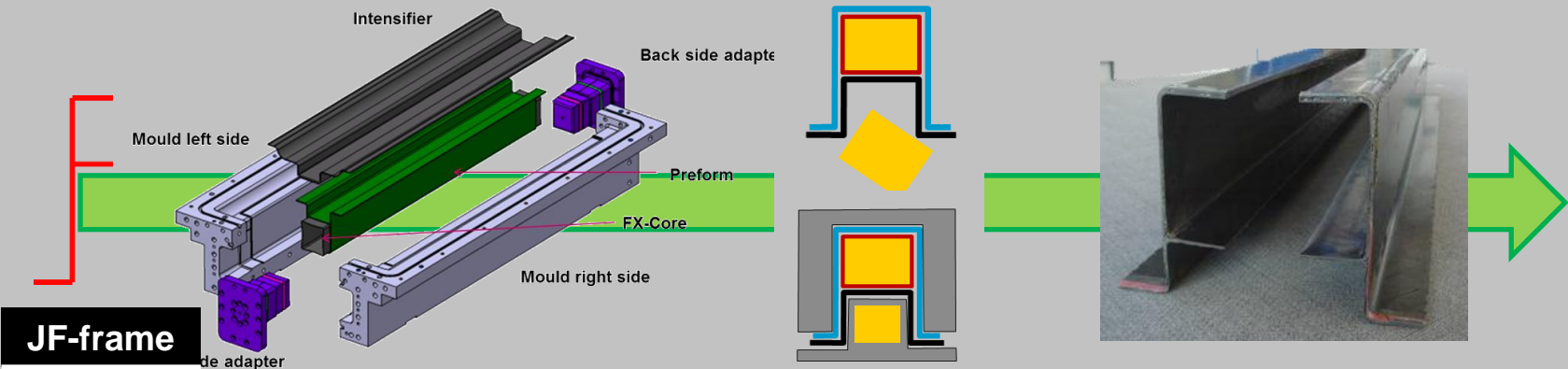**JF-frame**

Material	Preforming	cutting
IMS fiber	UD braiding on mandrels	Cutting preform only on one side. FX-core wont be removed

Technical topic– Frames curing tooling

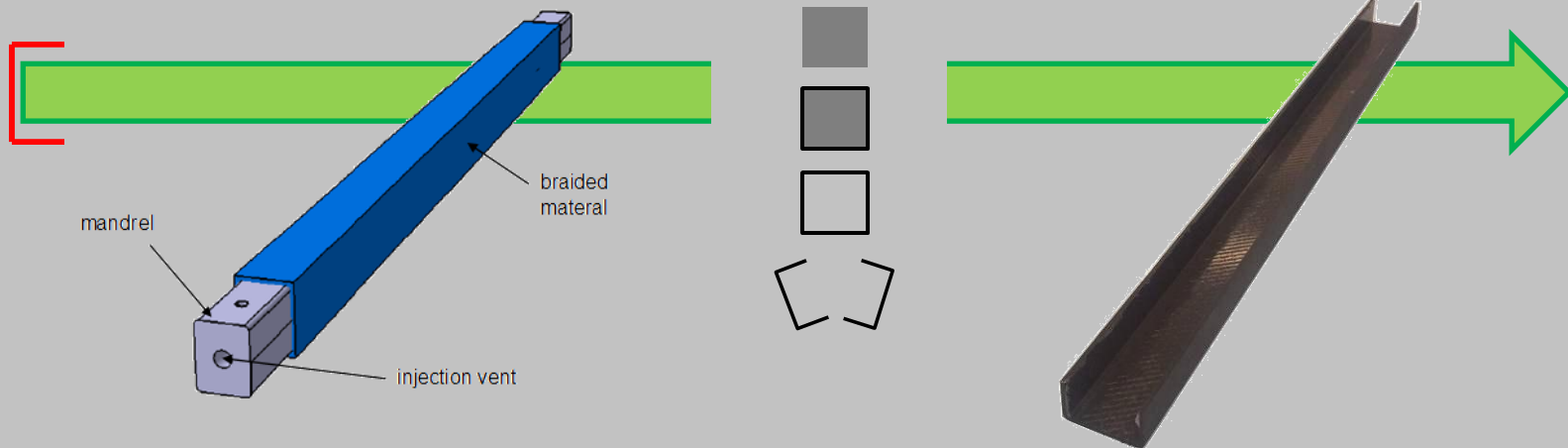**C-beam**

Material	Tooling	curing
RTM6	Gap infiltration for fast curing. Tool in Press	Fast infiltration realized. Good part quality.

JF-frame

| Material	Tooling	curing
RTM6	Consolidation by pressure. Stand alone Tool	Principle works. Still problems with tightness.

Technical topic– microwave curing

C-strut preforming

Material	Preforming	cutting
IMS fiber	UD braiding on mandrels	No cutting of preform. Braid cured on mandrel

C-strut curing

Material	Tooling	curing
RTM6	Curing on mandrel	Good temperature distribution, good part quality

Technical topic– QA - preform

Mac - Pro
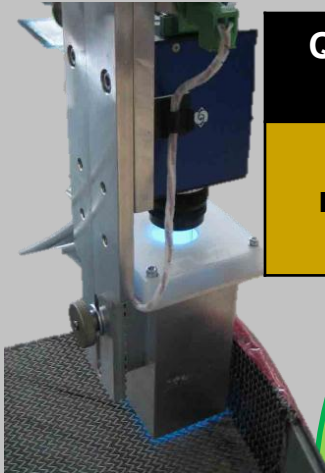
QA for single preforms — **Developed equipment**

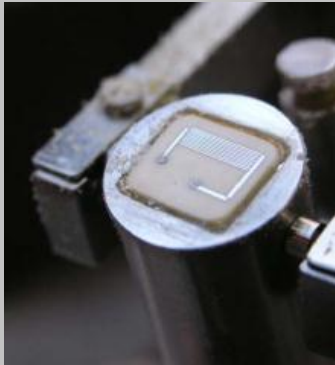| Device mounted on robot | Automated inspection after teaching geometry . Direct result for gaps/fuzz balls/angles/foreign objects |
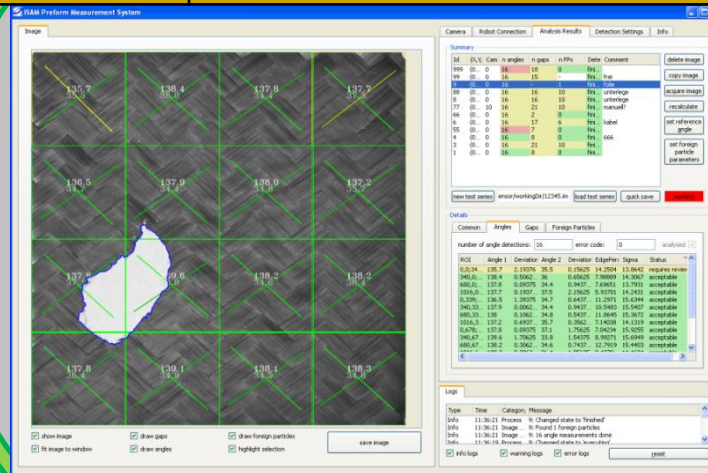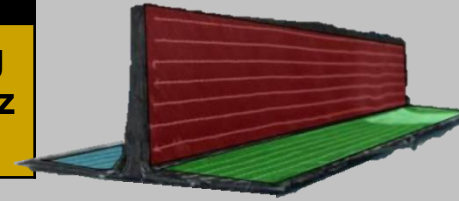
QA for braiding process — **Developed equipment**

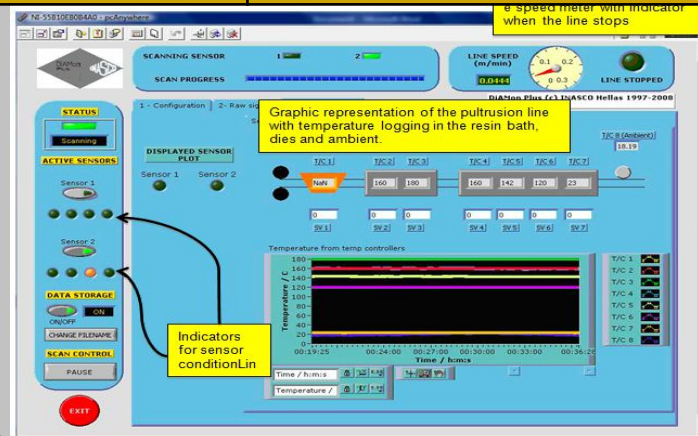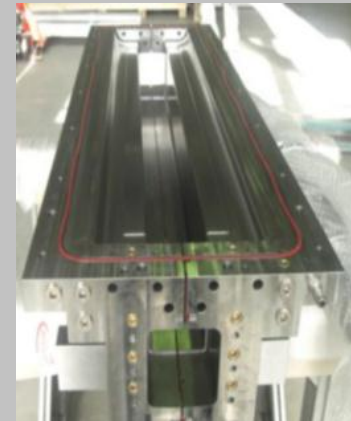| Device mounted on braiding machine | Braiding parameters are adjusted automatically → constant braiding angle. |

Technical topic– QA - curing

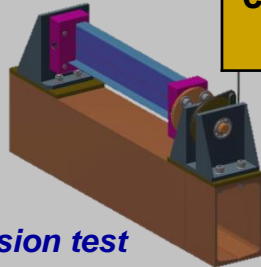| QA for degree of curing	Developed equipment
Device integrated in almost every tool	**Acquiring online, real time signals from dielectric sensors to check degree of curing**

Technical topic– testing D/C - level

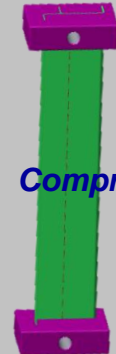| D-level tests	C-level tests
Several D-level test with coupons extracted out of profiles	**Several C-level test with profiles were performed to check quality of manufacturing concepts**

Torsion test

Compression test

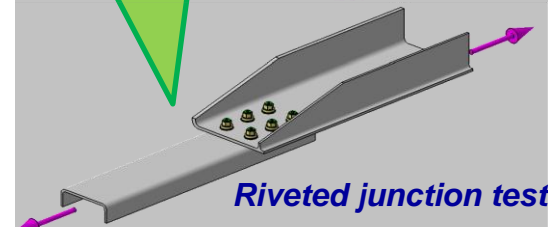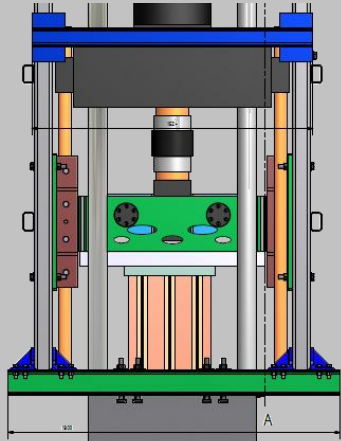*Riveted junction test*

3-Point bending test

4-Point bending test with impact
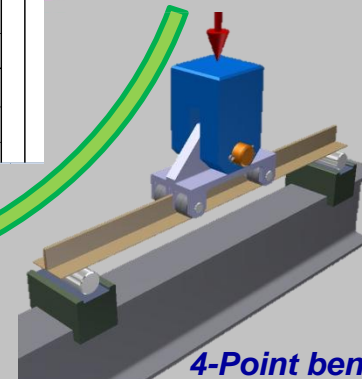
Technical topic– testing B/A - level

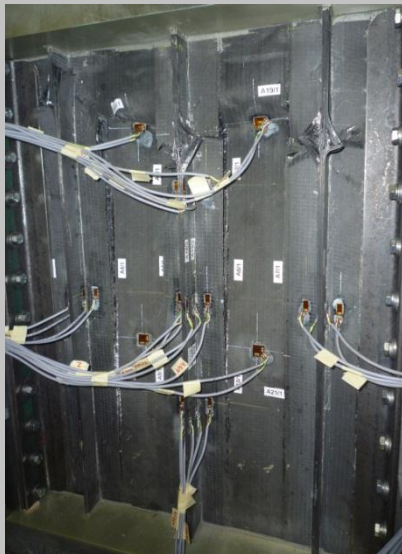| B-level panel tests	A-level cargo floor unit tests
Complete panels with concept A and B stringers were compression tested	A complete cargo frame unit will be tested under realistic load conditions
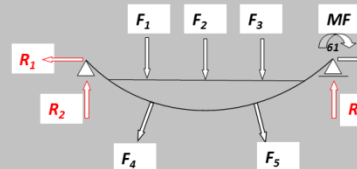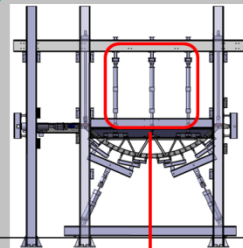
Loads to the floor is substituted by three actuators, to the skin (pressure simulation) by two actuators

Channel Nr.	Max. force tension [kN]	Max. force compression [kN]	Max. abs. static force [kN] J=1	Manufacturer	Standard VZLÚ/SN	Static stroke [mm]	Max. nominal force tens/compr [kN]	Manufacturer	Type	Nominal force [kN]
									Load Cell	
1a = F1			6x12 = 72	MTS	H147	500	50/50			
1b = F2	0,00	125,00		MTS	H147	500	50/50	Boundary-conditions		
1c = F3				MTS	H147	500	50/50			
3 = F6	0,00	250,00	156	AXL	H156	500	400/534	Schenck	PM250K	250
4 = F4	175,00	0,00	6x22 = 132	Technometra	H130P	160	260/260	MTS Hinge conditions	661.23B-01	250
5 = F5	175,00	0,00	6x22	Technometra	H130P	160	260/260	MTS	661.23B-01	250

No out-of-plane lateral movement for the 6 load introduction points (beam)
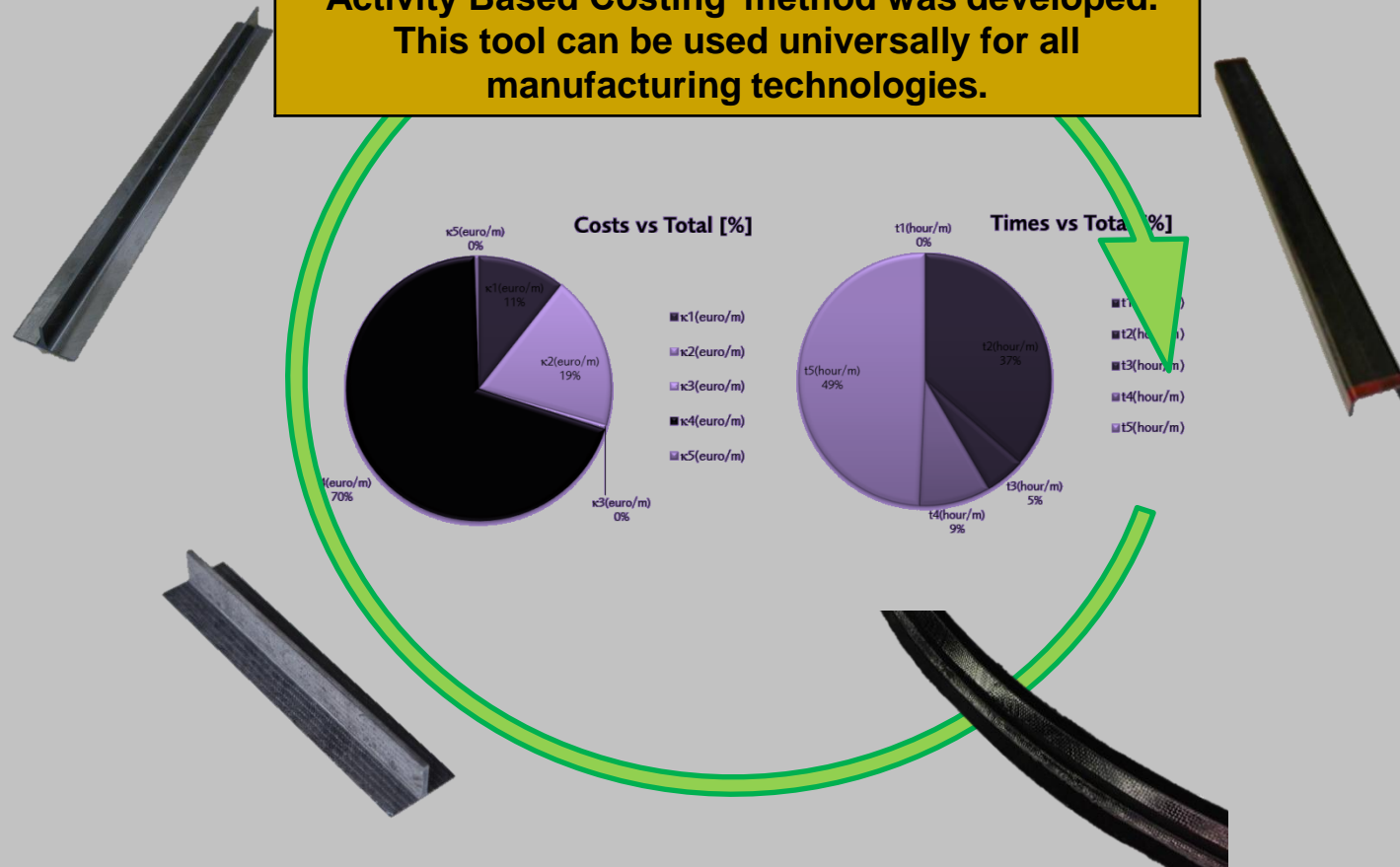
Simply supported conditions

No out-of-plane lateral movement in one point (frame centre)

Technical topic– costs

Cost analysis tool

An excel based cost analysis tool using the 'Activity Based Costing' method was developed. This tool can be used universally for all manufacturing technologies.

Acknowledgment

This project was funded by the European Commission within the 7th framework program

Find additional information on www.imac-pro.eu

Thank you for your attention!