GIFAS French Thermoplastics Initiative

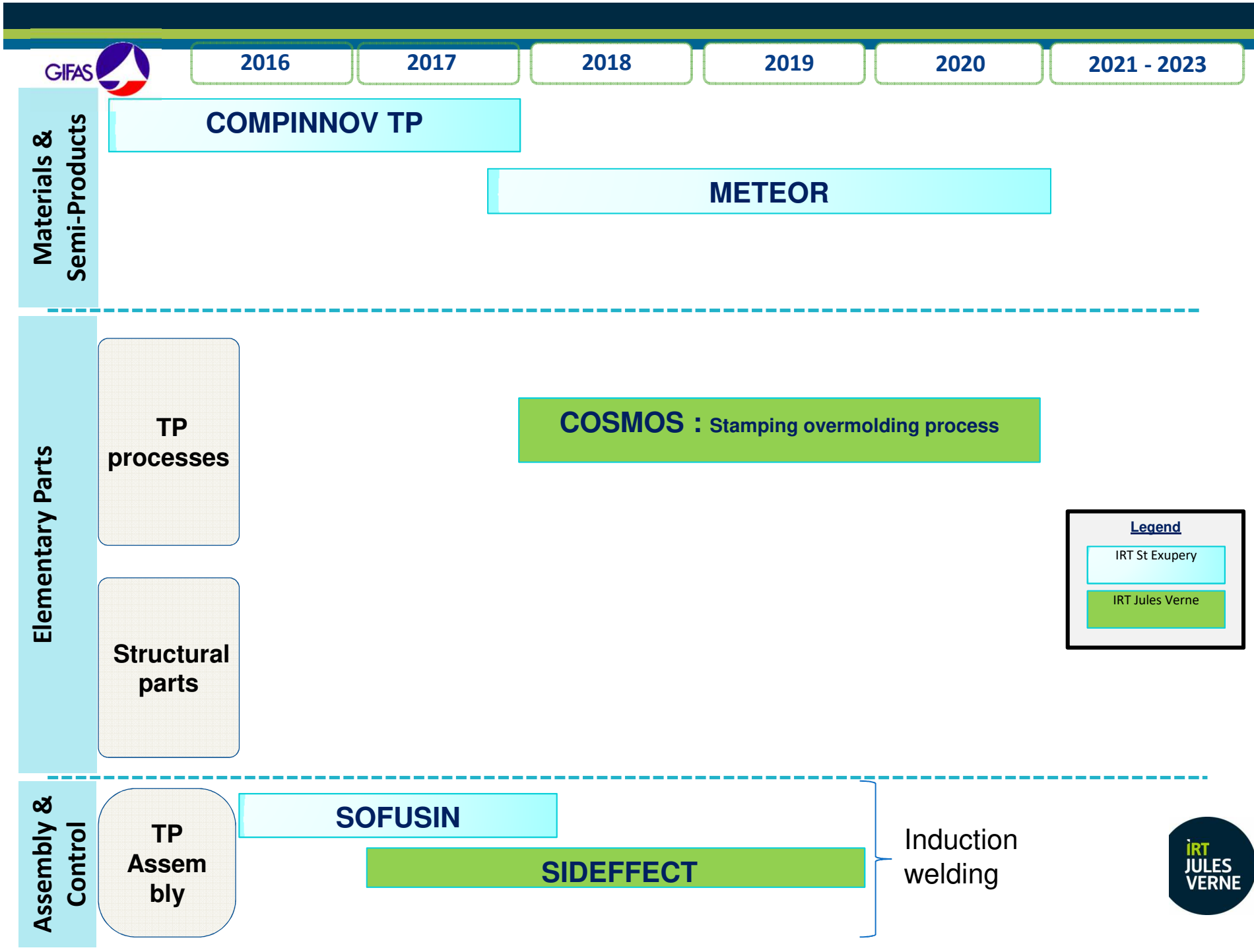
Philippe Le Bot, IRT Jules Verne
Research &Technology Center for Manufacturing

Thermoplastic composite demonstrators

+

GIFAS : French Initiative on Thermoplastic Composites for Aerospace Applications

Source : *Thermoplastic composite demonstrators — EU roadmap for future airframes - Ginger Gardiner, Compositeworld.com*


2016
2017
2018
2019
2020
2021 - 2023
Materials & Semi-Products
COMPINNOV TP
METEOR
Elementary Parts
TP processes
COSMOS : Stamping overmolding process
Structural parts
Legend
IRT St Exupery
IRT Jules Verne
Assembly & Control
TP Assembly
SOFUSIN
SIDEFFECT
Induction welding

Institutes of Technology

What is an IRT ?

8 IRTs created in 2012

Multi-disciplinary institutes

50/50 private public partnership

FRENCH INSTITUTES OF TECHNOLOGY

What is the IRT Jules Verne?

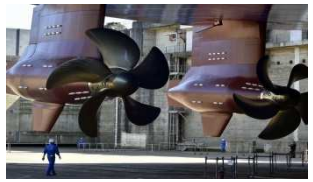
Plant Competitiveness

Manufacturing Process Optimization

High Performance Products & Processes

4 Industrial Sectors






34 OEMs	**17** SMEs	**16** Academics
24 M€ Yearly turnover	**87 M€** Ongoing projects	**16 M€** Mutualized Eqmt
100 Researchers	**73** R&D projects launched	

on 4 “Technocampus” technological platforms :

Composites
Composite manufacturing

Acoustics
NDTs - Monitoring

Ocean
Metal manufacturing

Smart Factory
Pilot production lines

IRT JULES VERNE

IRT Jules Verne Members & Partners :

34 Industrial companies (OEM, mid-cap) + 17 SME + 16 Technical Centers & Academics

IRT Thematics

IRT Jules Verne R&T Thematics

MOBILITY IN INDUSTRIAL ENVIRONMENT	Smart and Autonoumous mobility of Manufacturing Tools and Systems in Industrial Environment or Structures
MANUFACTURING FLEXIBILTY	Flexible and Agile Reconfigurable Manufacturing Processes
ASSEMBLY & JOINING TECHNOLOGIES	Multimaterials Joining Technologies Structure and Systems Assembly
FORMING & PREFORMING PROCESS	Composites Preforming and Forming Technologies Metal Forming
ADDITIVE MANUFACTURING	High Deposition Rate Metal Additve Manufacturing High Performance Composites Additive Manufacturing

IRT Thematics

Composite Technical Developments at IRT Jules Verne

Thematic Contribution

High Volume Complex Preform

High rate lay-up processes

Complex / multifunctional preforms

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Composites Shaping Process

Design, prototyping and validation of forming processes

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Multimaterial Structure & Assembly

Design of multimaterial structures and automated assembling processes

Technical developments

- Conception & Design
- Function integration
- Low cost manufacturing Process

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- Process Hybridation
- Thermal management
- Automation

.....

- Assembly conception & design
- Joining technologies

Stamping and Overmolding development processes and its simulation
COSMOS Project

Partnership :	IRT Jules Verne, LATECOERE, LIEBHERR, HUTCHINSON, ARKEMA, SINTEX NP, PORCHER, DAHER, COGIT, CEA, ARRK SHAPER	€ 3,5 M€	36 months 12/2017 |12/2020

Main issues To develop processes able to produce structural and semi-structural aeronautic parts in C/PEKK and C/PEEK materials adding functionalization

Objectives

- Optimize manufacturing process of stamping and overmolding in thermoplastic PEKK and PEEK
- Develop a tool concept compatible with process and materials
- Evaluate local overmolding process and mold development
- Develop a methodology of control of parts interfaces
- Develop a simulation tool to support process development

First prototype parts

Stamping and Overmolding development processes and its simulation
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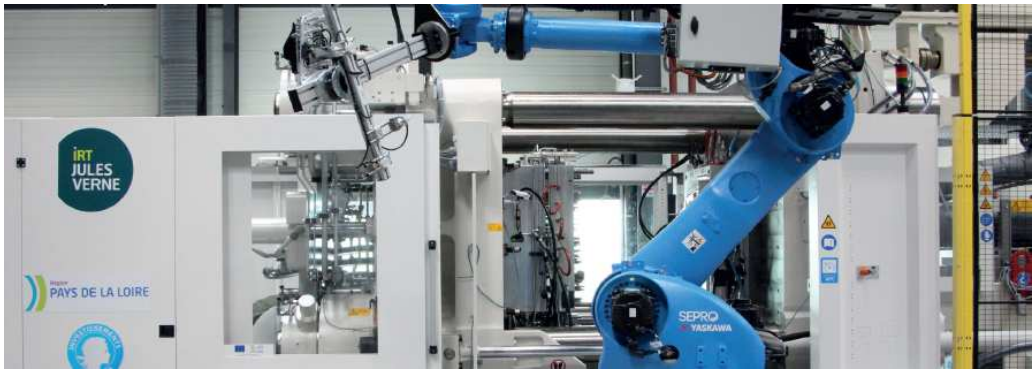
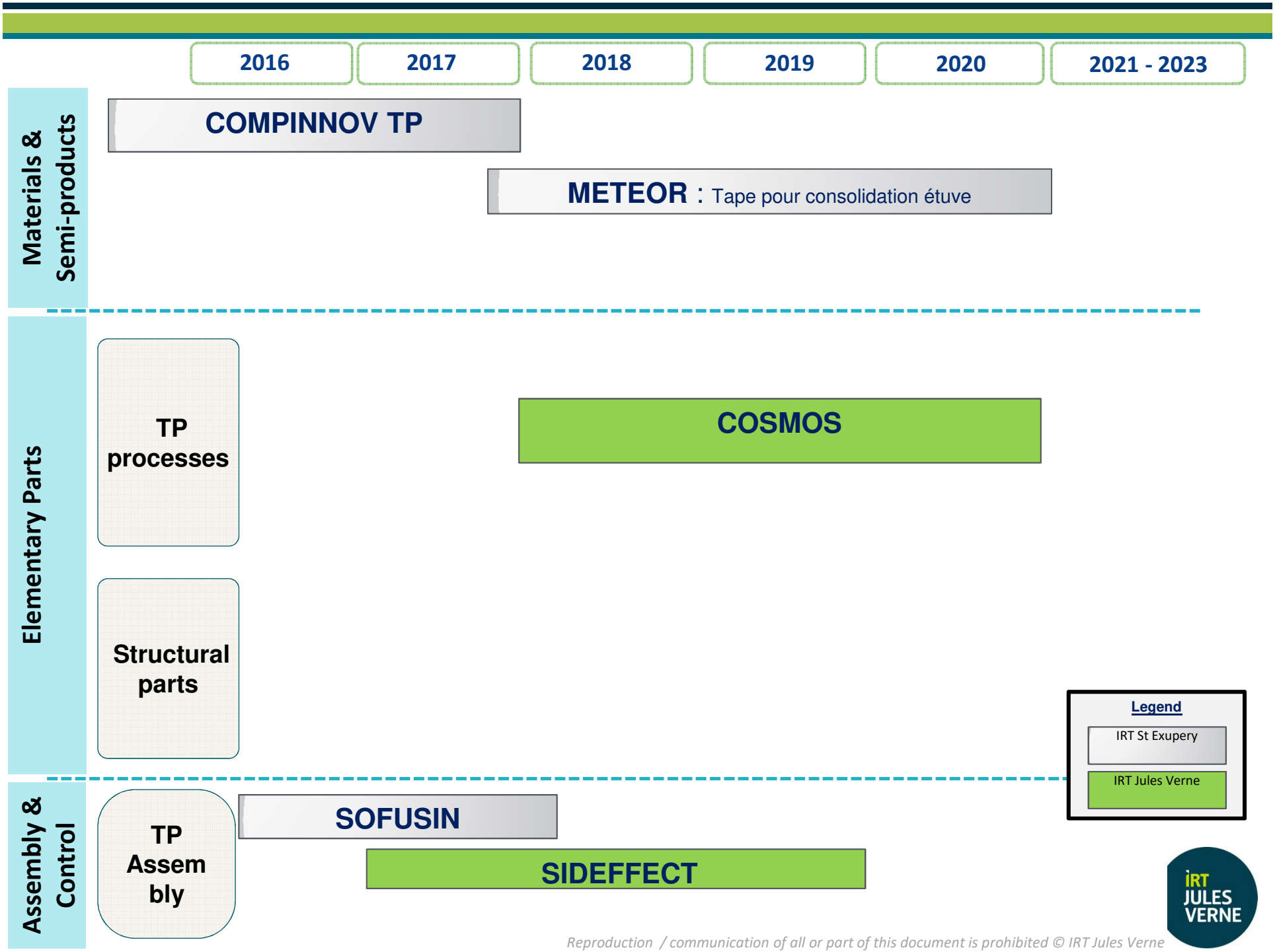
Different equipments

Stamping and overmolding platform 200T for first small parts
Stamping and overmolding platform 1300T for industrials parts
Mechanical test facility (multiaxial)





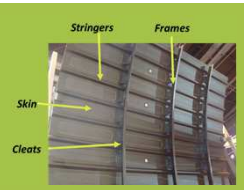
Induction welding of TP composites
SOFUSIN

Partnership : IRT Saint Exupéry, AIRBUS Operations, Aviacomp, Daher, Hutchinson, Stelia, LTeN

€ 1,6 M€ — 24 months
06/2016 |06/2018

Main issues

To demonstrate the feasibility of a susceptor less direct continuous induction welding process for fuselage applications



Objectives

- Induction welding demonstration platform implementation
- Welding process parameter optimization

Screening of the effect of several intrinsic and extrinsic process parameters

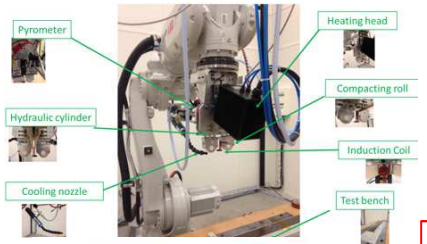
- Welded joint properties and microstructure

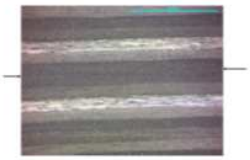
Comparison between welded coupons and autoclave co-consolidated ones

- Induction heating simulation

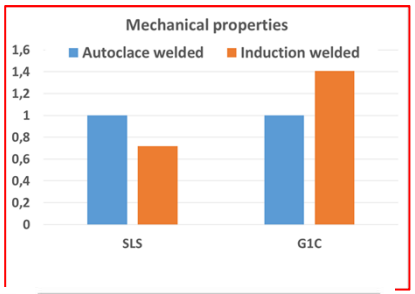
Comparison of static induction heating simulation capabilities of three simulation tools

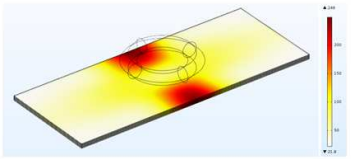
Achievements



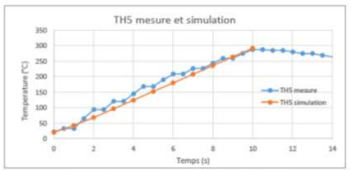


Optical micrography : cross section of a perfectly welded joint





Simulated temperature field (COMSOL)



Experimental-simulation rear temperature evolution (FLUX 3D)

Continuous induction welding for aerostructure

SIDEFFECT

Partnership : AIRBUS, aviaComp, cetim, EUROPE TECHNOLOGIES, HUTCHINSON, IRT JULES VERNE, LATÉCOÈRE, STELIA, UNIVERSITÉ DE NANTES

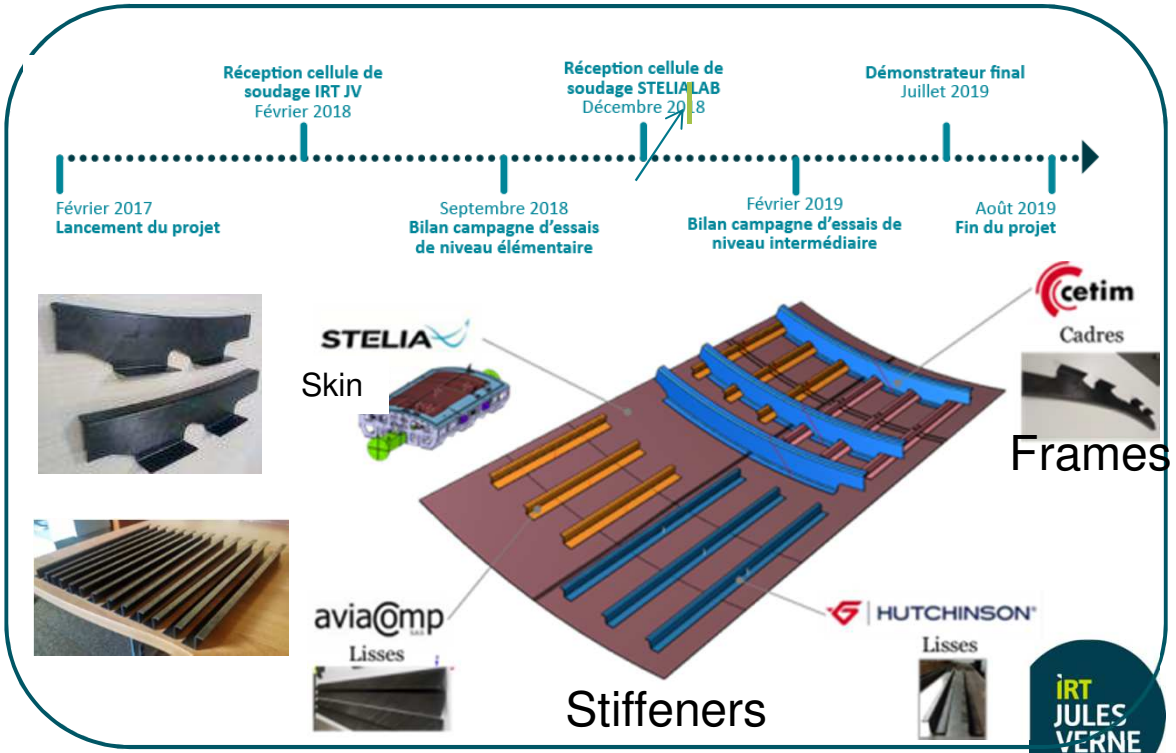
€ 5,0 M€ | **30 months** 02/2017 |08/2019

Main issues

- To demonstrate the feasibility of continuous induction welding process for fuselage applications
- To develop simulation tools for thermoplastic induction welding.

Objectives

- Process window evaluation concerning robotized TP induction welding
- Conception of inductors, effectors and tool holding in order to optimize the welding.
- Modelisation of dynamical induction welding for TP composites.
- Demonstrator representative to fuselage application.



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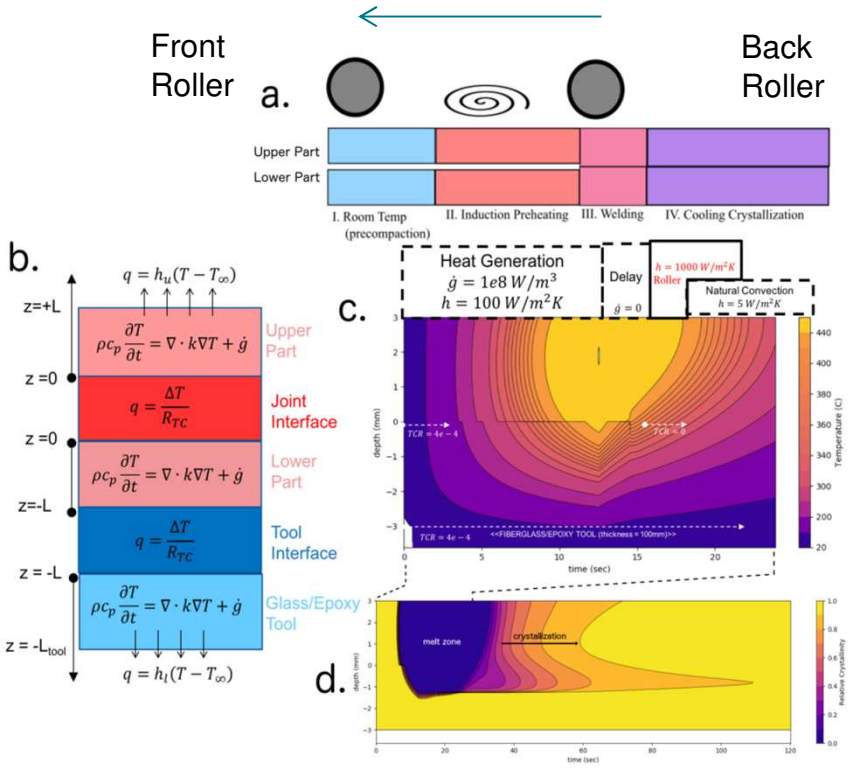
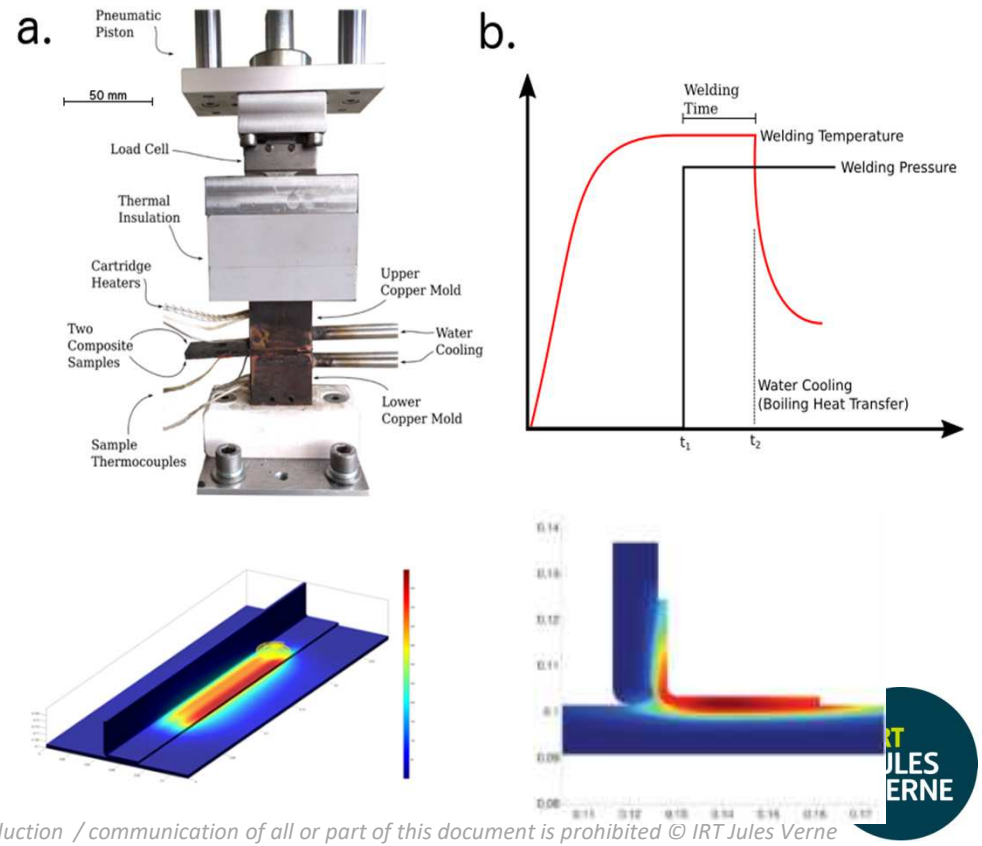
Numerical Simulation of induction welding





Continuous induction welding for aerostructure

SIDEFFECT

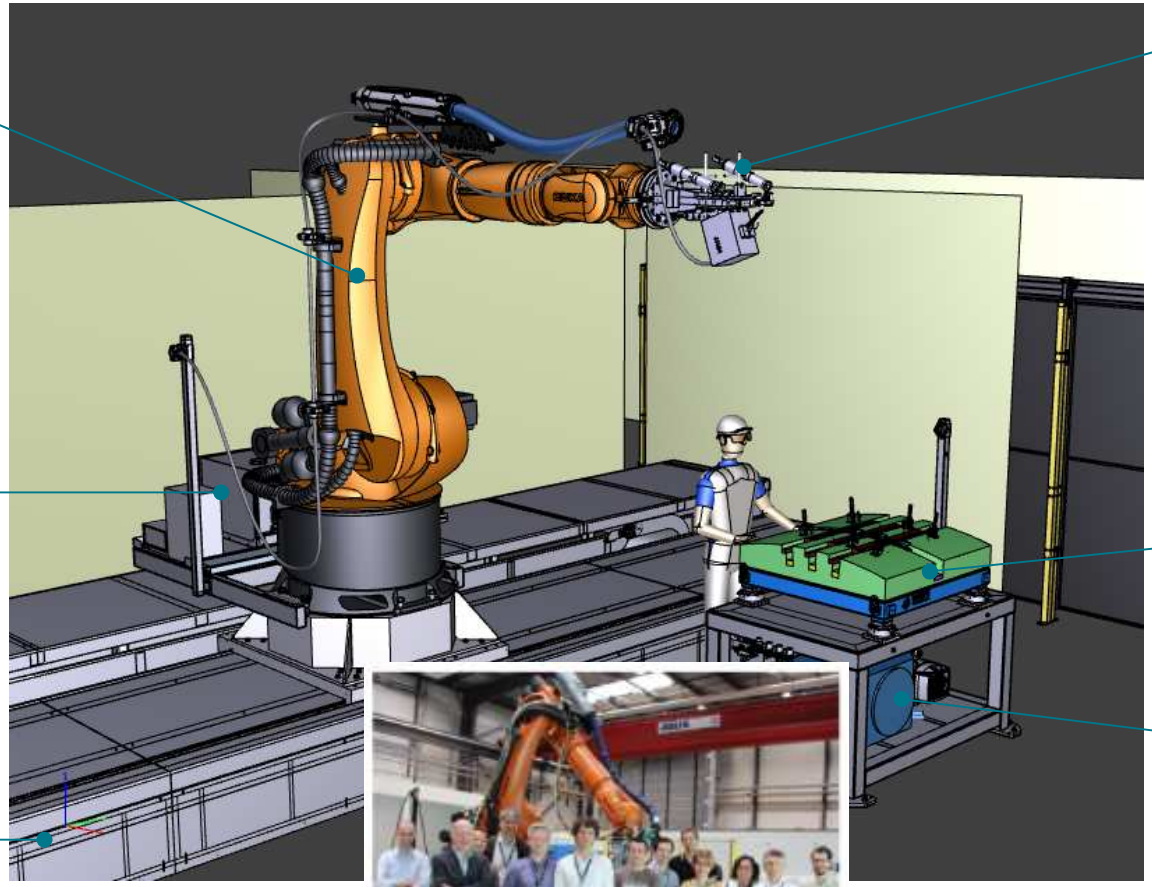
Partnership : AIRBUS, aviaCOMP, cetim, EUROPE TECHNOLOGIES, HUTCHINSON, IRT JULES VERNE, LATÉCOÈRE, STELIA, UNIVERSITÉ DE NANTES

€ 5,0 M€ | 30 months | 02/2017 |08/2019

Robot KUKA KR 480

Induction generator

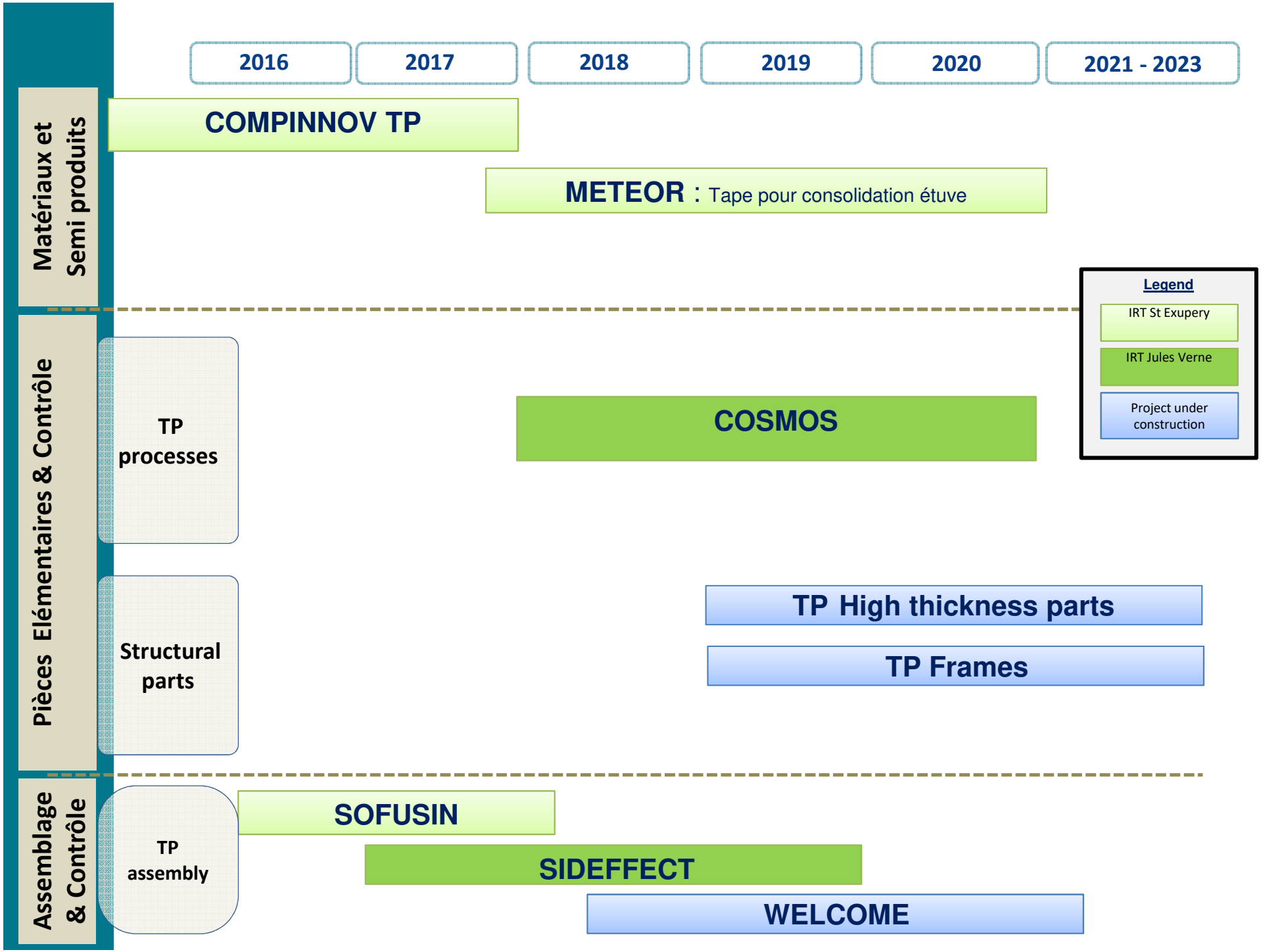
Rail 16 m



Effector

Tool holding

Vacuum pump & cooling device


2016
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2021 - 2023
Matériaux et Semi produits
COMPINNOV TP
METEOR : Tape pour consolidation étuve
Legend
IRT St Exupery
IRT Jules Verne
Project under construction
Pièces Elémentaires & Contrôle
TP processes
COSMOS
Structural parts
TP High thickness parts
TP Frames
Assemblage & Contrôle
TP assembly
SOFUSIN
SIDEFFECT
WELCOME

Induction welding of TP composites
WELCOME

Partnership :

AIRBUS GROUP · IRT JULES VERNE · DAHER · TESTIA · LATECOERE · IREENA · DynaS+ · aviaMP · STELIA · ARKEMA · SOGECLAIR · Institut Clément Ader

? M€ | **36 months** 2018 -2021

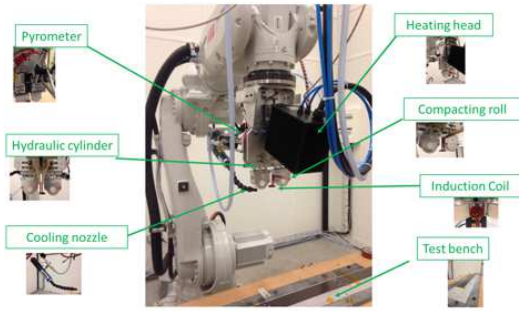
Main issues To increase robustness through a better understanding and mastering of technical and scientific aspects on induction welding process for TP composites

Objectives

- Material optimization
- Process optimization
- CND

Join us !

IRT St Exupery Facilities



IRT Jules Verne Facilities

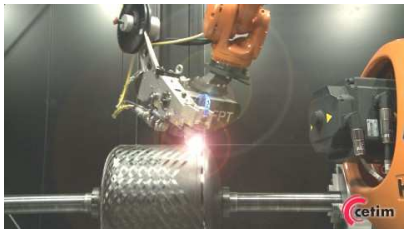
TP High Thickness parts

Partnership :	IRT JULES VERNE other partners	€ 5,5 M€ 36 months 2019 | 2021

Main issues Development of composite materials processes for the manufacturing of thick thermoplastic/carbon parts

User needs : Development of a manufacturing process for high thickness composite parts for primary structures focusing on :

- high volume
- low cost
- Thermoplastics
- Potential reduction of assembly tack time



Developments :

- Development of a composite demonstrator
- Simulation of the processes
- Development of NDC for thick parts
- Post treatments (machining, trimming, drilling) of thick parts
- Assembly of thick thermoplastic parts

Low Cost & High rate process for Thermoplastic Composite Fuselage Frames

Partnership : Other partners TBD

€ TBD | 36 months 10/2018 |10/2021

Main issues

- To design a standard constant-section frame in thermoplastic composite
- To develop a high rate and low cost manufacturing process

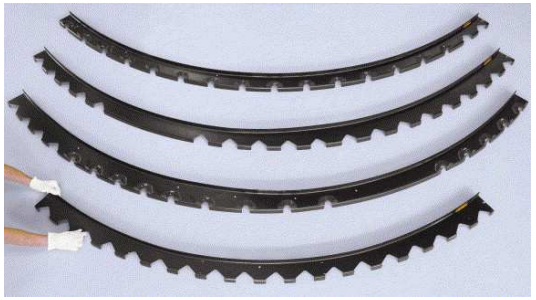
Objectives

Phase 1

- Comparative study of compatible composite processes
- Selection of processes/partners

Phase 2

- Development of selected process
- Scale 1 demonstration



IRT JULES VERNE

Thank you for your attention