

IRT
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VERNE

GIFAS French Thermoplastics Initiative

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Research & Technology Center for Manufacturing



Thermoplastic composite demonstrators

Thermoplastic Composite Demonstrators

PROGRAM	
TAPAS 1	TAPAS 2
PARTICIPANTS	
Dutch/Airbus Partnership Fokker, Airborne (The Hague), CoDef (Delft), Dutch Thermoplastic Components (Almere), KE-works (Delft), KVE Composites (Den Haag), NLR, Technobis (Alkmaar), TenCate, TUDelft, Univ. of Twente, Rijksoverheid	
STRUCTURE	
 Fuselage Panel with wing	 Wet Torsion Box
 Torsion Box (3m span)	 Larger, more integrated fuselage structure
 Engine Mount/Pylon (6m long)	 TA PA52 Targets: Primary stiffened-skin UD-barred structures


PROGRAM		
CLEAN SKY		
IN SITU CONSOLIDATION		
ISINTHER	GRA Green Regional Aircraft	OUTCOME Out of Autoclave Composite Wing
PARTICIPANTS		
Airbus Defense & Space (ADS, Getafe, Spain), FIDAMC (Getafe, Spain), MTorres (Navarra, Spain)	Leonardo Aircraft (previously Finmeccanica, Roma, Italy), ADS, FIDAMC, MTorres	ADS, FIDAMC, Tecnilia (Deric, Spain), CATEC (Seville, Spain), CTA (Mifano, Spain)
STRUCTURE		
 Window Frames	 TPC floor grid Cockpit frame Window frame	 Wing panel (4.2m x 0.9m)
 GOAL: Fuselage section with integrated window frames		

PROGRAM		
FRENCH CIVIL AVIATION RESEARCH COUNCIL (CORAC)		
Arches Box TP	Composite Aircraft of the Future	
PARTICIPANTS		
STELIA (Mésulha), Porcher (Lyon), AVIACOMP (La unguet), Cetim (Nantes), Groupe Institut de Soudure, SINTEX HP (Genas)	Daher (Marseille)	Dassault Aviation (Paris)
STRUCTURE		
 Fuselage with integrated lightning strike protection, welded stringers, frame, overmolded approach exit door	 Rib for test wing box	 Wing panel, composite wing demonstrator
Sized for business jets		

CLEAN SKY 2 + CORAC

CORAC will develop the THERMOSET center wing box design (one shot CFRP/CWB) via "Investing in the Future" PIA, PIA2 programs for input into Clean Sky WP2.3 and will also develop and validate next generation lower fuselage section subassemblies.

CORAC and Clean Sky 2 WP2.3.2 and WP2.3.3 will pursue smart fuselage and components using hybrid materials: CFRP, metal, prepreg, textile and TPC.




Clean Sky: Next Generation Aircraft Fuselage

WP2.1 Multifunctional Fuselage Demonstrator: thermoplastic, integration cabin-systems-structure



One-shot, one-piece center wingbox
 CORAC Investing in the Future Program (PIA, PIA2)



WP2.3.3 Full-size Lower Center Fuselage: center wing box + main landing gear structural interfaces



WP2.3.3 Full-size fuselage more center section to air + rear pressure bulkhead



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



What is an IRT ?

8 IRTs
created in
2012

Multi-
disciplinary
institutes

50/50 private
public
partnership

fit

FRENCH
INSTITUTES OF
TECHNOLOGY



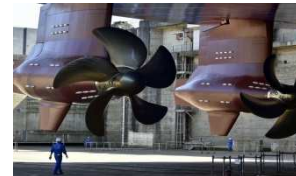
What is the IRT Jules Verne?

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 Members & Partners :

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



IRT Jules Verne R&T Thematics

MOBILITY IN INDUSTRIAL ENVIRONMENT

Smart and Autonomous mobility of Manufacturing Tools and Systems in Industrial Environment or Structures

MANUFACTURING FLEXIBILITY

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 Additive Manufacturing
High Performance Composites Additive Manufacturing

Composite Technical Developments at IRT Jules Verne

Thematic Contribution

High Volume Complex Preform

High rate lay-up processes
Complex / multifunctional preforms
.....

Composites Shaping Process

Design, prototyping and validation of
forming processes
.....

Multimaterial Structure & Assembly

Design of multimaterial structures and
automated assembling processes

Technical developments

- Conception & Design
- Function integration
- Low cost manufacturing Process
.....
- Process Hybridation
- Thermal management
- Automation
.....
- Assembly conception & design
- Joining technologies

Stamping and Overmolding development processes and its simulation

COSMOS Project

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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

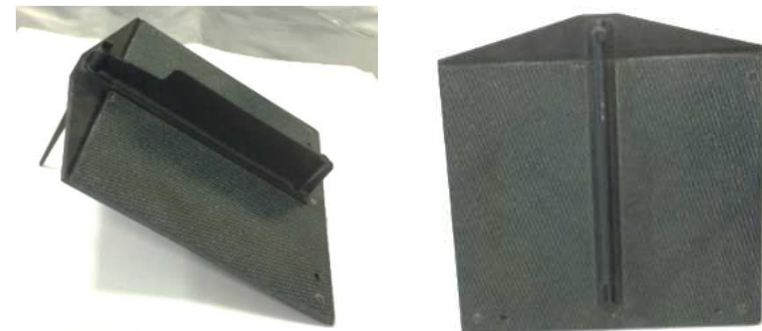
Main issues

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



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Stamping and Overmolding development processes and its simulation

COSMOS Project

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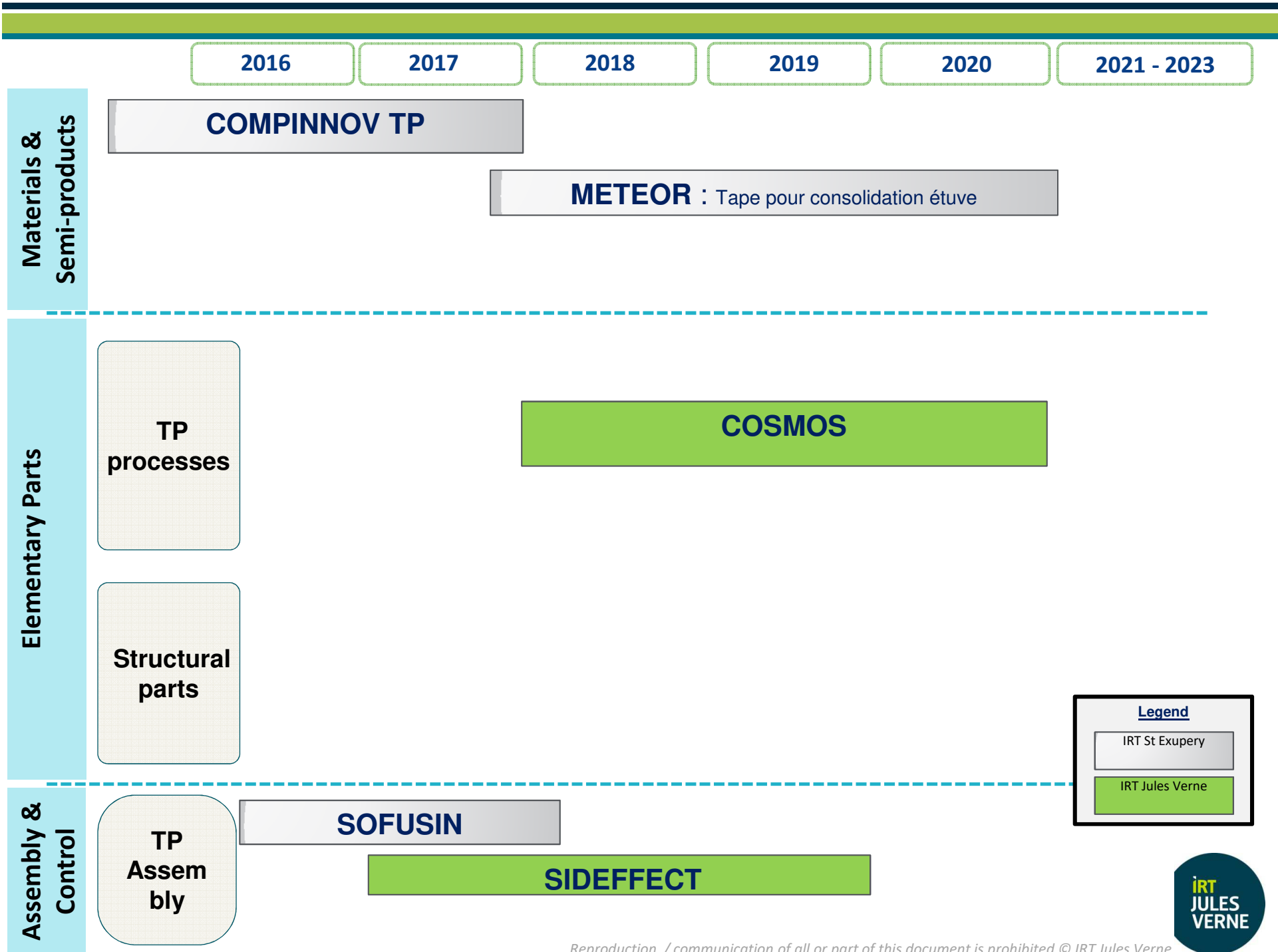
€ 3,5 M€  36 months
12/2017 | 12/2020

Different equipments

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



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Induction welding of TP composites

SOFUSIN

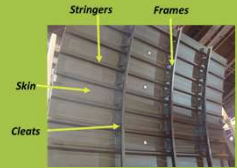


Partnership :

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

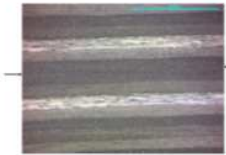
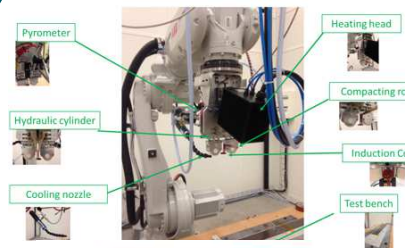
- Welded joint properties and microstructure

Comparison between welded coupons and autoclave co-consolidated ones

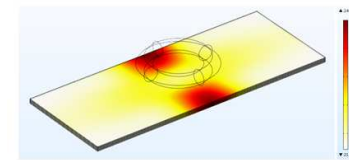
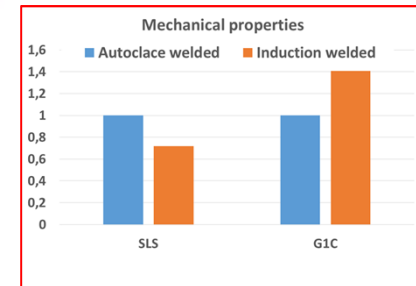
- Induction heating simulation

Comparison of static induction heating simulation capabilities of three simulation tools

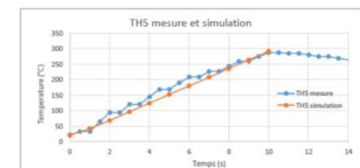
Achievements



Optical *micrograph* : cross section of a perfectly welded joint



Simulated temperature field (COMSOL)



Experimental-simulation rear temperature evolution (FLUX 3D)



Continuous induction welding for aerospace

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SIDEFFECT

Partnership :

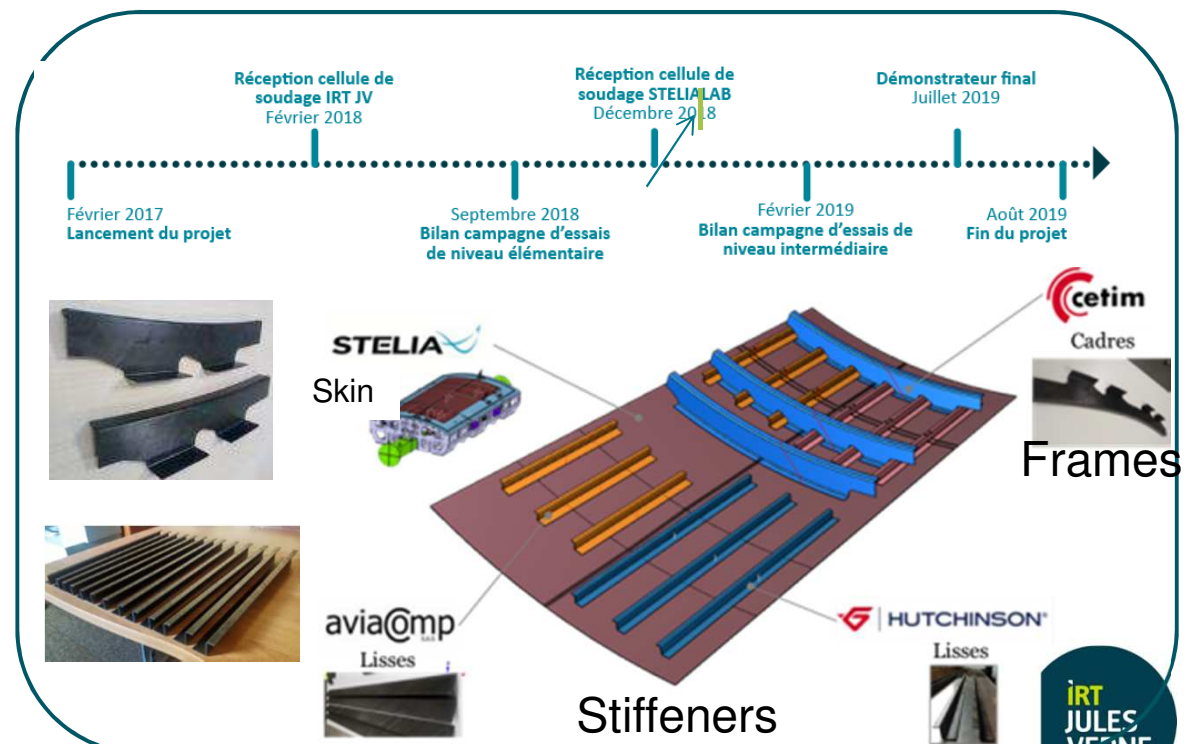


€ 5,0 M€ 30 months
02/2017 | 08/2019

- 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.



Continuous induction welding for aerostructure

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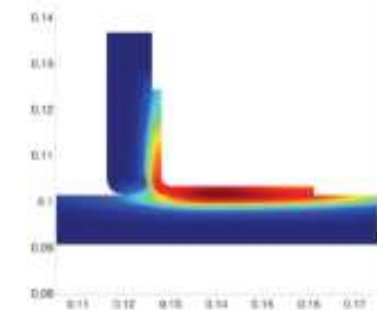
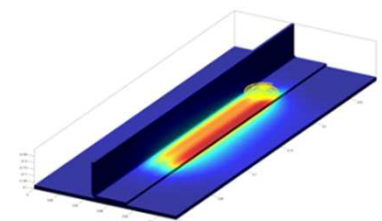
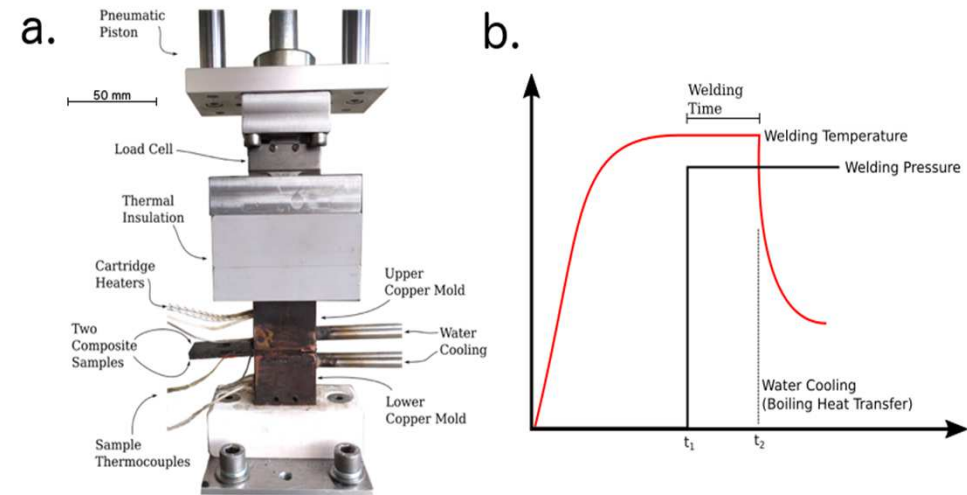
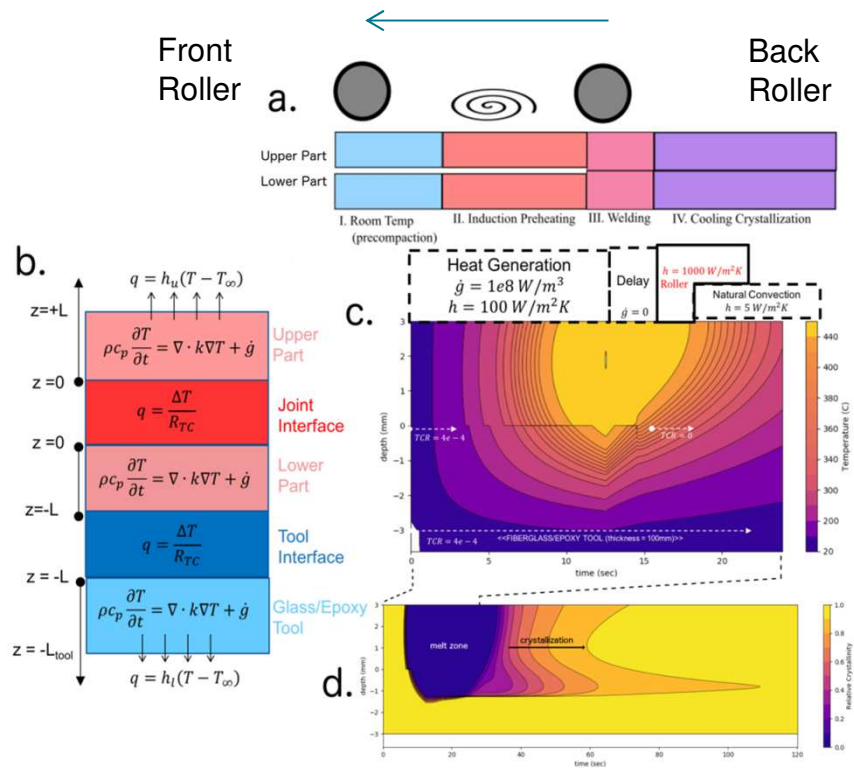
SIDEFFECT

Partnership :



€ 5,0 M€ 30 months
02/2017 | 08/2019

Numerical Simulation of induction welding



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Continuous induction welding for aerostructure

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SIDEFFECT

Partnership :

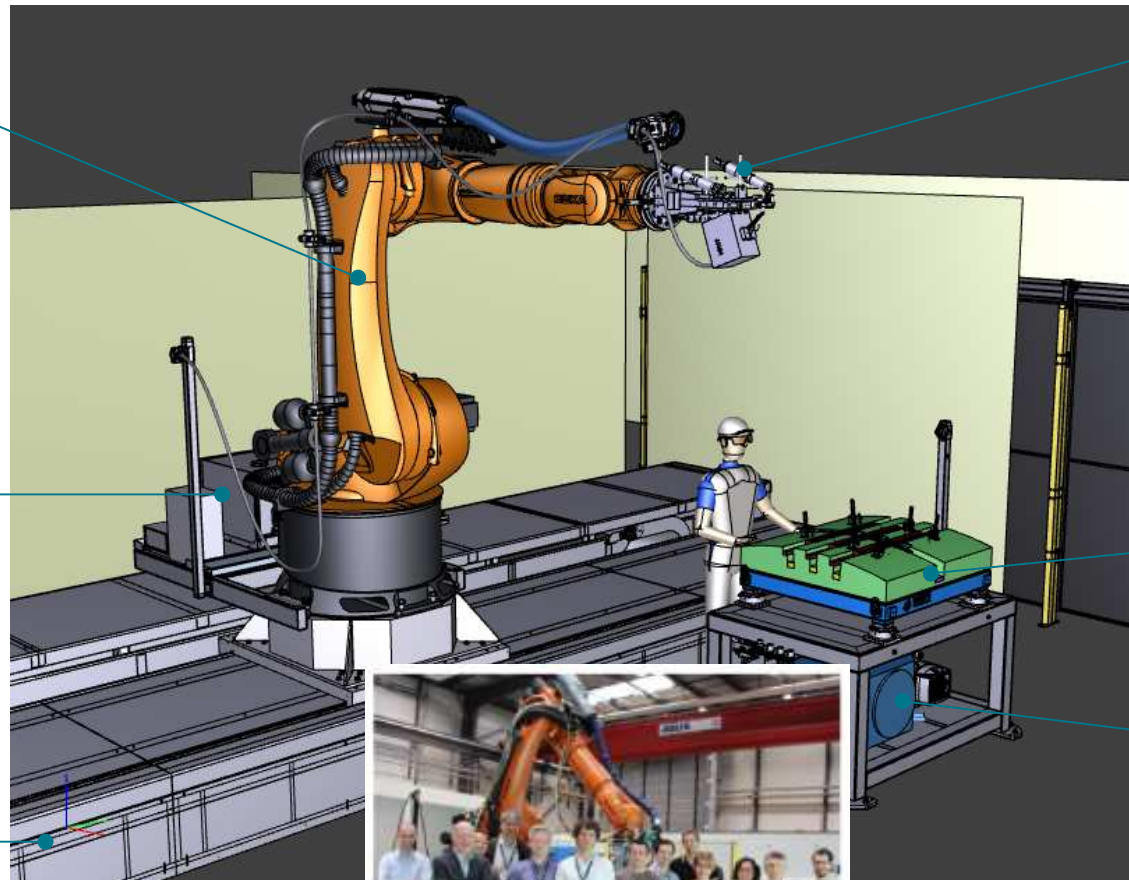


€ 5,0 M€ 30 months
02/2017 | 08/2019

Robot KUKA
KR 480

Induction
generator

Rail 16 m



Effector

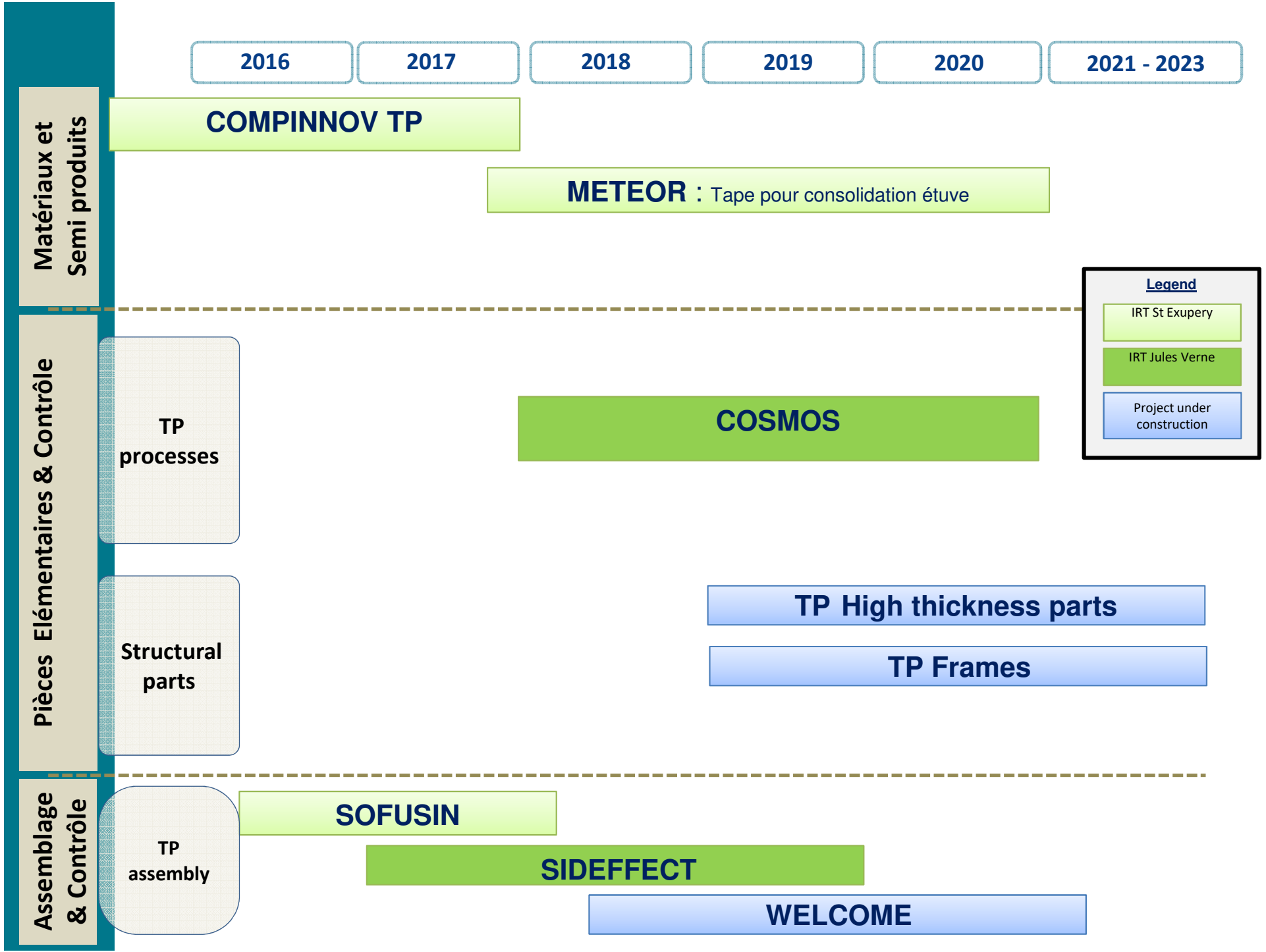


Tool holding

Vacuum pump
& cooling
device



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Induction welding of TP composites

WELCOME



Partnership :



€ ? M€ 36 months
2018 -2021

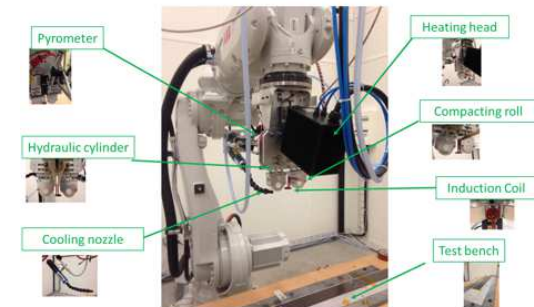
Main issues To increase robustness through a better understanding and mastering of technical and scientific aspects on induction welding process for TP composites

Objectives

- Material optimization
- Process optimization
- **CND**

Join us!

IRT St Exupery Facilities



IRT Jules Verne Facilities



TP High Thickness parts

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Partnership :



other partners

€ 5,5 M€  36 months
2019 | 2021

Main issues

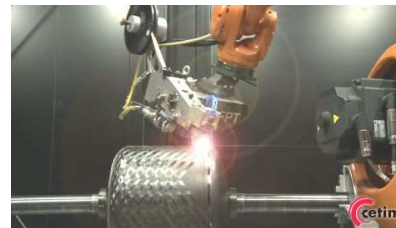
Development of composite materials processes for the manufacturing of thick thermoplastic/carbon parts

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



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Low Cost & High rate process for Thermoplastic Composite Fuselage Frames

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Partnership :



Other partners TBD

€ TBD



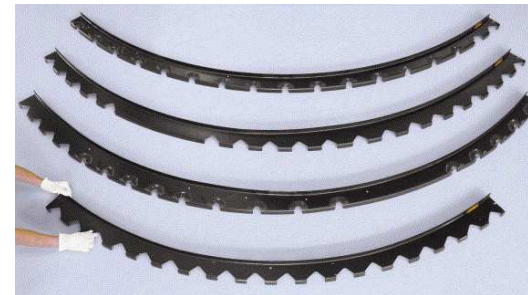
36 months
10/2018 | 10/2021

Main issues

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

Objectives

- Comparative study of compatible composite processes
 - Selection of processes/partners
 - Development of selected process
 - Scale 1 demonstration
- Phase 1
- Phase 2



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**Thank you for your
attention**