

# domminio

Digital method for improved manufacturing of next-generation  
multifunctional airframe parts

**12<sup>th</sup> EASN Conference**

October 18<sup>th</sup> 2022



This project has received funding from the European Union's Horizon 2020  
research and innovation programme under grant agreement No 101007022.

DOMMINIO is the acronym of: ‘Digital method for imprOved Manufacturing of next-generation MultifuNctIOnal airframe parts’

**Topic MG-3-5-2020:** ‘Next generation multifunctional and intelligent airframe and engine parts, with emphasis on **manufacturing, maintenance and recycling**’ (RIA, TRL 2-4)  
Call within - Work Programme 2018-2020 Smart, green and integrated transport

Starting Date: First of January 2021

Duration: 42 months (July 2024)



# domminio

Consortium: 13 partners from 7 countries



## Introduction



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42 months

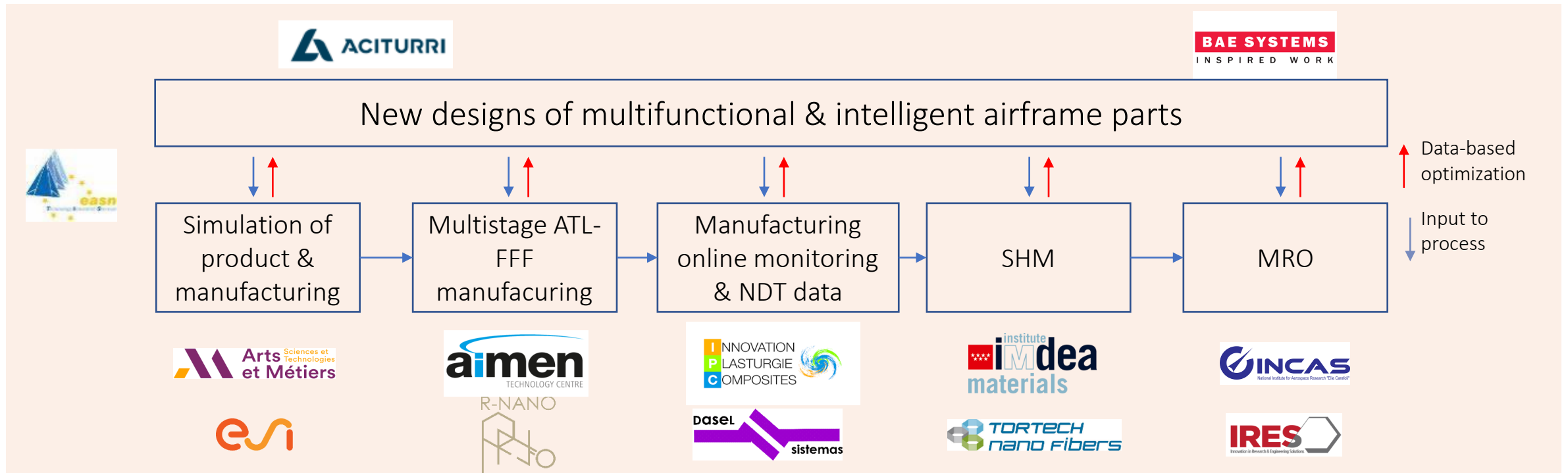
9 WP's: 6 technical +  
general specs,  
dissemination and  
management

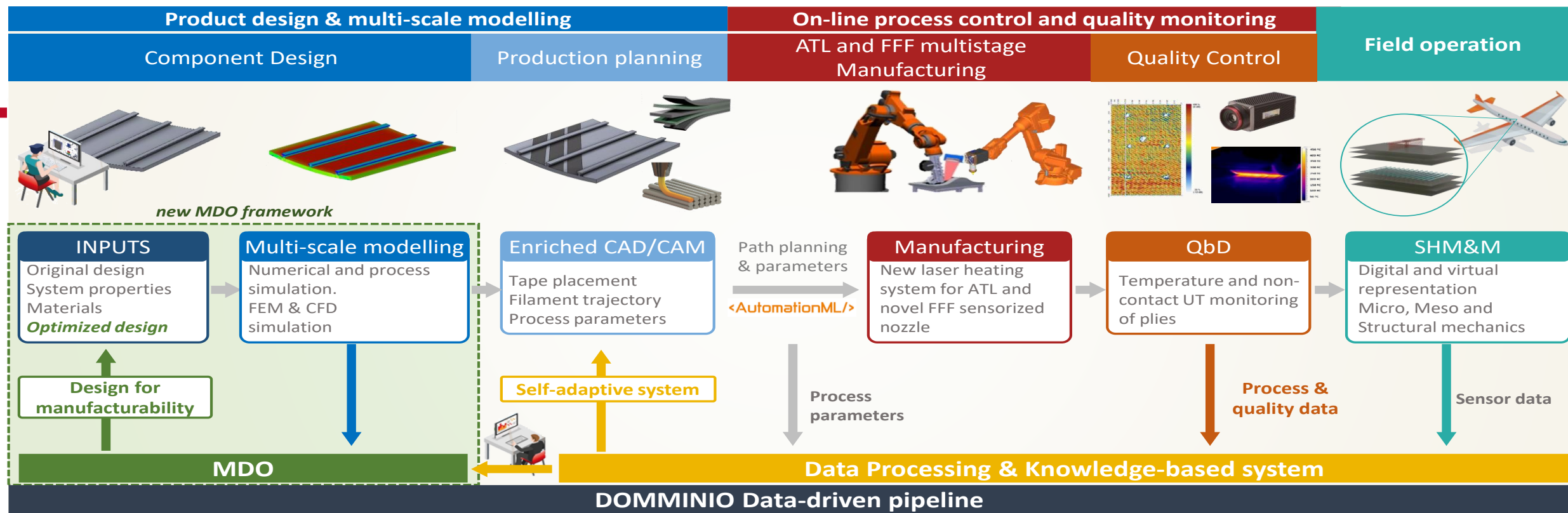
			2021												2022												2023																		
			ene	feb	mar	abr	may	jun	jul	ago	sep	oct	nov	dic	ene	feb	mar	abr	may	jun	jul	ago	sep	oct	nov	dic	ene	feb	mar	abr	may	jun													
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	
WP1	Manufacturing systems specifications and conceptual design framework	INCAS	6							MS1																																			
T1.1	Functional requirements and process engineering																																												
T1.2	Specifications for functional materials and sensors					D1.1																																							
T1.3	Use case definition									D1.2																																			
T1.4	MDO and MRO framework									D1.3																																			
WP2	Process numerical modelling and multifunctional prototypes design	ENSAM	3,5																																										
T2.1	Physical specifications and characterization																																												
T2.2	Lay-up and consolidation process simulation																																												
T2.3	FFF process and material deposition simulation																																												
T2.4	Design of multifunctional representative prototypes																																												
WP3	Functional materials engineering and manufacturing systems	AIMEN	22																																										
T3.1	Materials engineering																																												
T3.2	Characterization of TP filaments and TP tapes																																												
T3.3	Development of ATL process window																																												
T3.4	Development of FFF process window																																												
T3.5	Disassembly process window																																												
T3.6	ATL combined with FFF processes window																																												
WP4	On-line process control for high-quality automated manufacturing	IPC	16																																										
T4.1	Laser-based heating system for ATL process																																												
T4.2	Sensorized FFF-extrusion nozzle																																												
T4.3	Temperature monitoring of tape lay-up and FFF processes																																												
T4.4	In-line quality monitoring of plies lay-up																																												
WP5	Sensor development and SHM of multifunctional composite laminates	IMDEA	13																																										
T5.1	Multiscale modelling representation development																																												
T5.2	Digital Twin representation																																												
T5.3	Piezoresistive strain sensors development																																												
T5.4	Wireless piezoresistive sensor node																																												
WP6	Laboratory integration and data pipeline realization	AIMEN	32																																										
T6.1	Multi-stage manufacturing laboratory integration																																												
T6.2	Multi-stage data interoperability and extension																																												
T6.3	Data analytics and Knowledge-based system																																												
T6.4	Representative prototypes realization																																												
T6.5	Functional and Digital Twin validation																																												
WP7	Multidisciplinary optimization and virtual certification	BAE	6																																										
T7.1	MDO and Data-driven pipeline implementation																																												
T7.2	SHM&M for real-time MRO planning																													</															

The goal of DOMMINIO is to develop a new knowledge-based methodology to produce cost-effective multifunctional airframe parts, ensuring the quality and performance of the target components

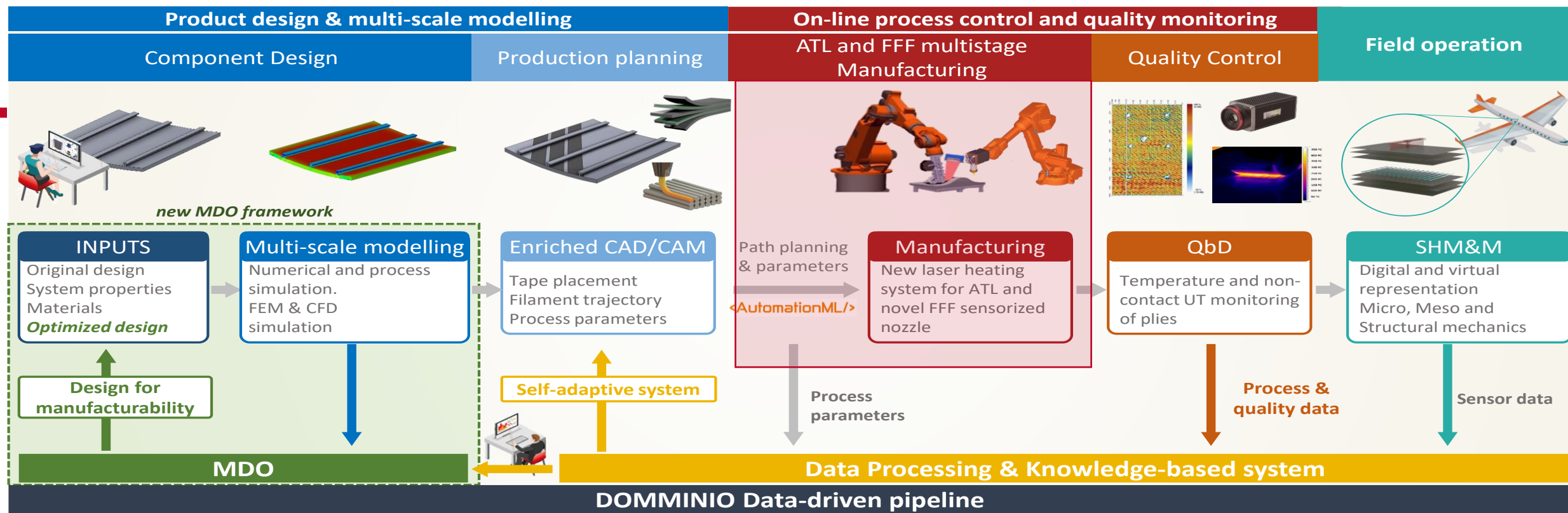
- To enable flexible multistage robotic-based manufacturing production processes
- To develop a Quality-by-Design (QbD) manufacturing strategy.
- To set a data-driven pipeline supporting the design, simulation and production planning.
- To build a combined digital-physical driven methodology for Monitoring and Management of the Health of multifunctional airframe parts.

## Materials | Manufacturing | Digital Thread







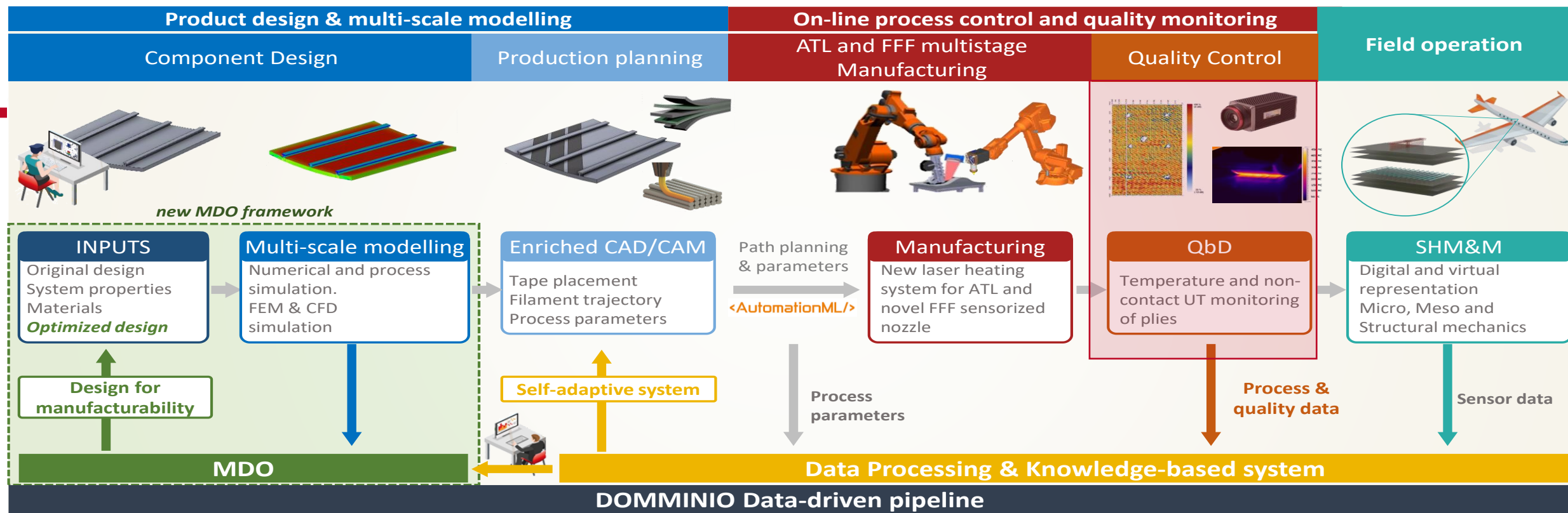


## MATERIALS & MANUFACTURING

- Flexible multistage robotic-based production processes
  - ❖ Combining ATL and FFF
  - ❖ cCNT filaments (SHM), CCF and NPs reinforced filaments

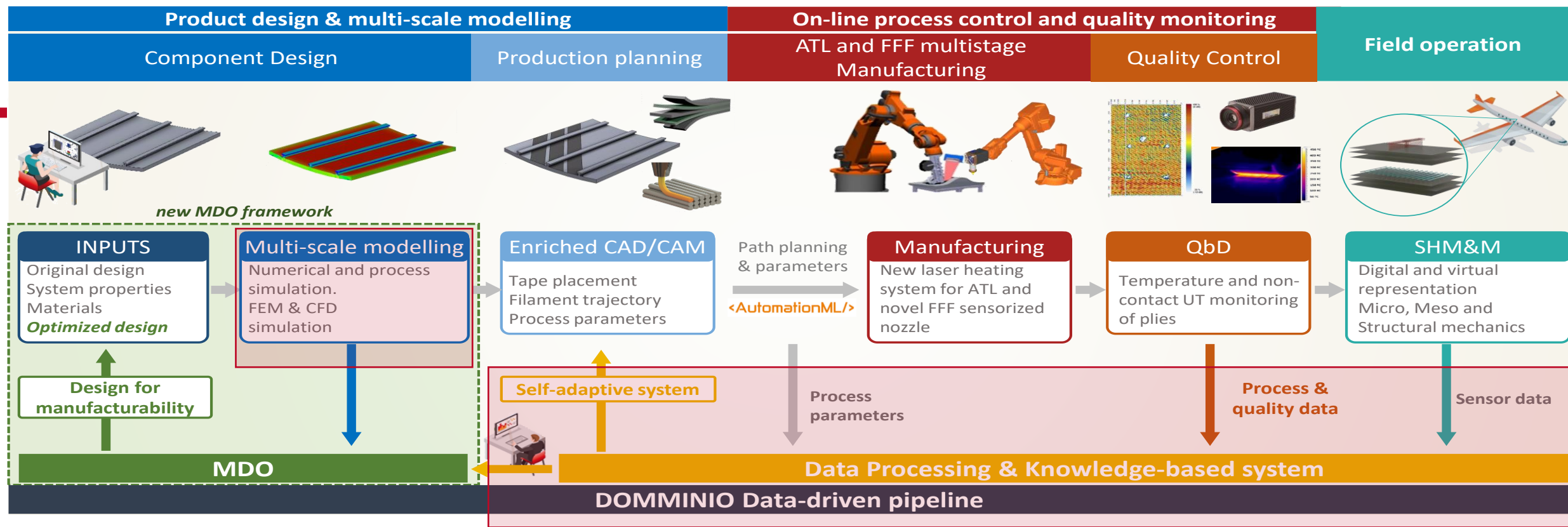






## MATERIALS & MANUFACTURING

- Flexible multistage robotic-based production processes
  - ❖ Combining ATL and FFF
  - ❖ cCNT filaments (SHM), CCF and NPs reinforced filaments
- Quality-by-Design (QbD) manufacturing strategy
  - ❖ Laser scanning-assisted heating
  - ❖ FFF nozzle with improved thermal control
  - ❖ Non-contact ultrasound method for in-line

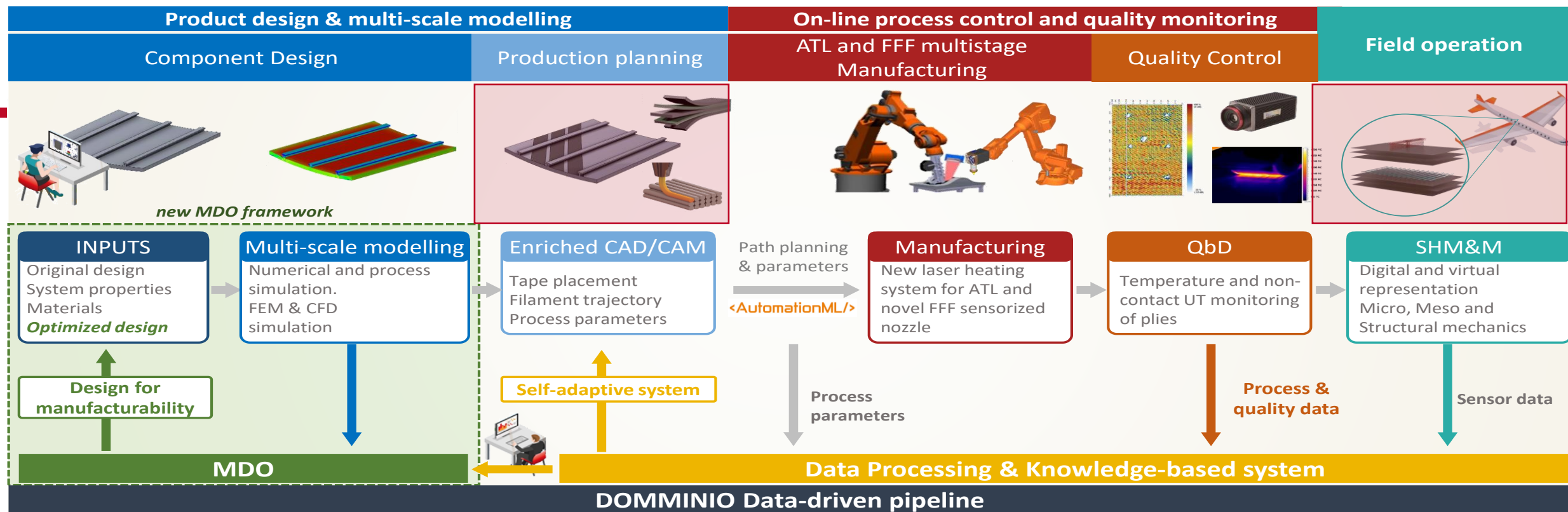


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## DIGITAL

- Data-driven pipeline supporting the design, simulation and production planning
  - ❖ Numerical simulation of ATL describing in-situ consolidation and FFF quality
  - ❖ Data processing & Knowledge-based system

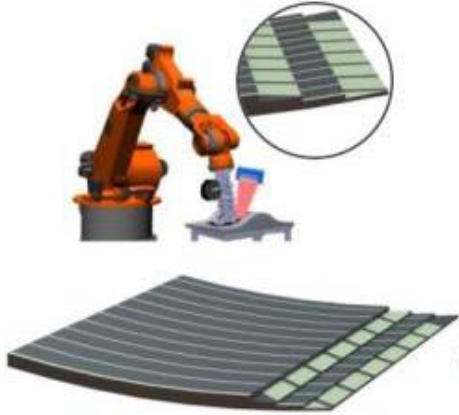


## MATERIALS & MANUFACTURING

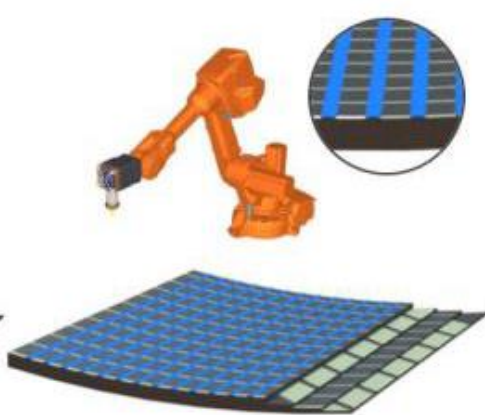
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## DIGITAL

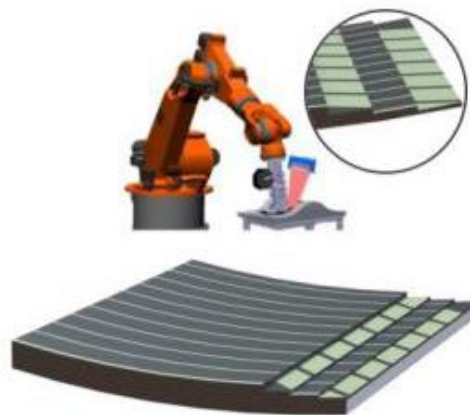
- Data-driven pipeline supporting the design, simulation and production planning
  - ❖ Numerical simulation of ATL describing in-situ consolidation and FFF quality
  - ❖ Data processing & Knowledge-based system
- Monitoring and Management of the Health of multifunctional
  - ❖ Strain sensor based on cCNT-fibres
  - ❖ Digital Twin technology for SHM&M of the multifunctional composite
  - ❖ Develop advanced multi-scale models for virtual testing



1- AFP.  
Laying up UD  
tapes



2- FFF.  
cCNT reinforced  
filaments for SHM



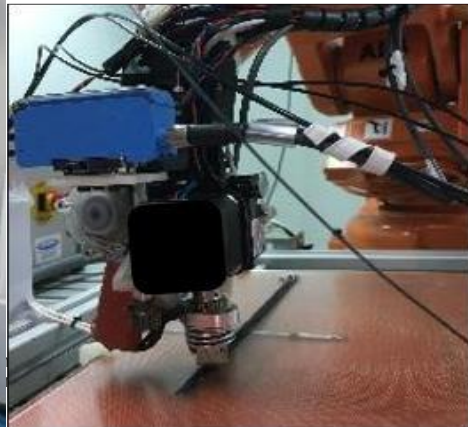
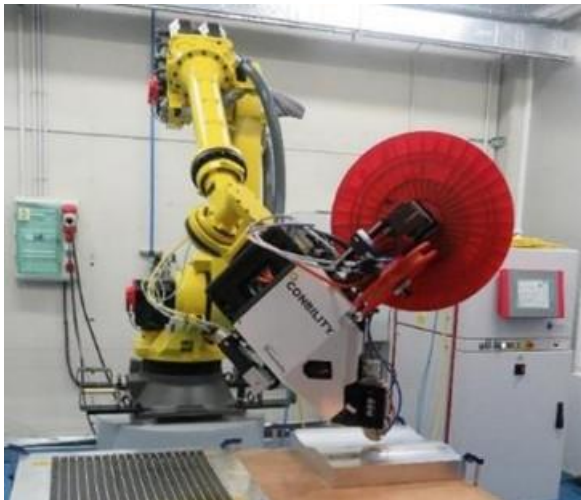
3- ATL.  
Laying up UD  
tapes



4- FFF.  
a) Filaments reinforced with  
MNp's (disassembly)  
b) Filaments reinforced with  
cCF (structural  
reinforcement)

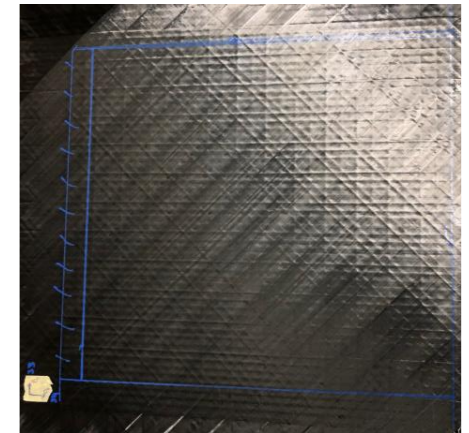
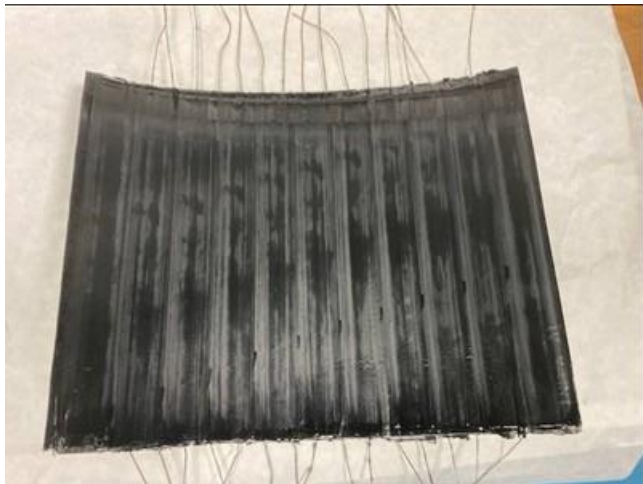
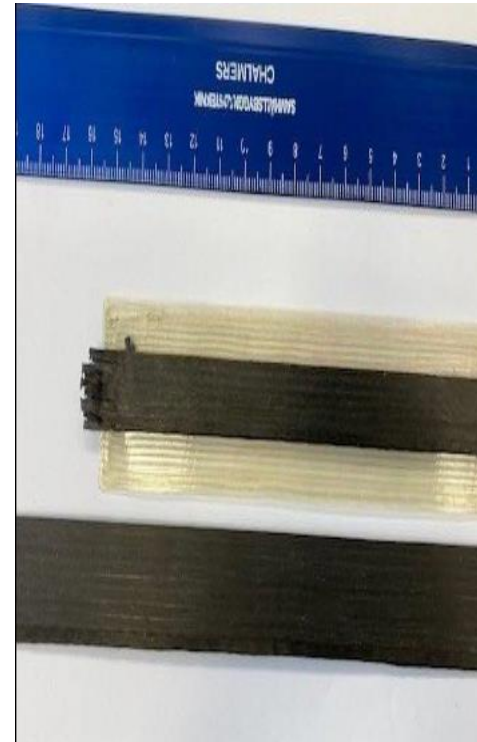


Multifunctional  
component

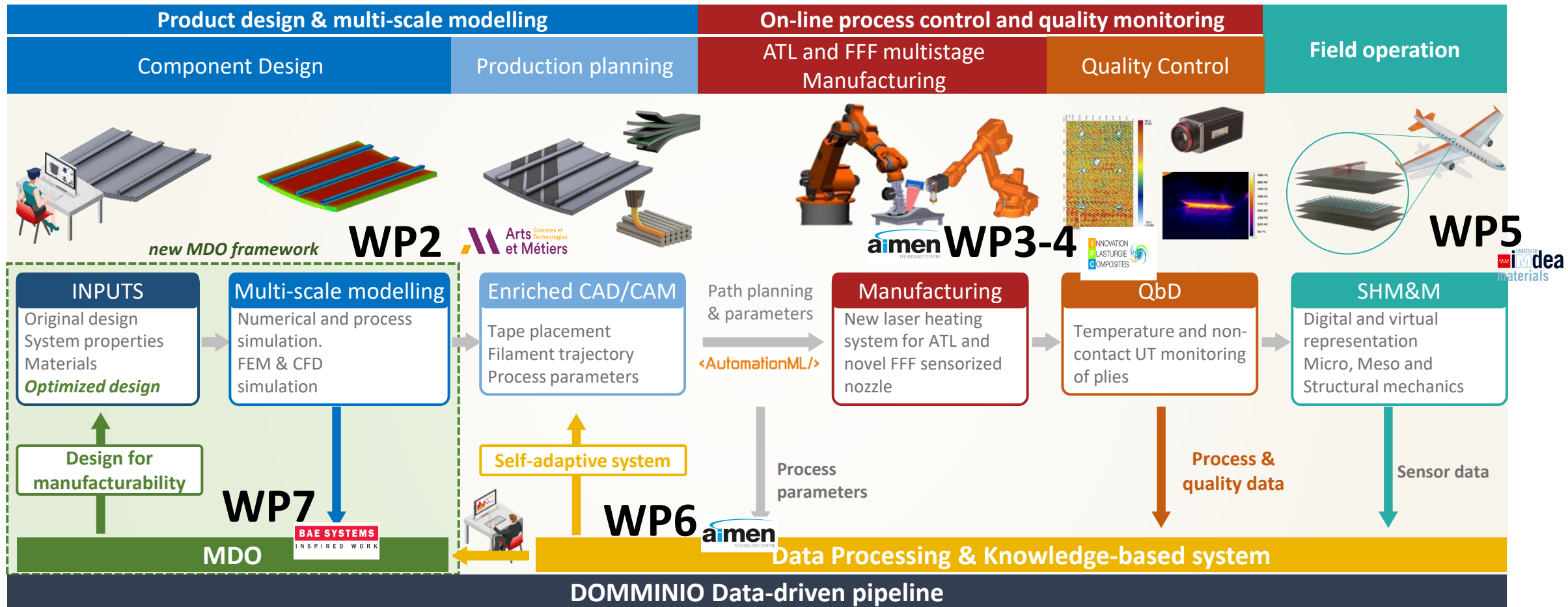


Easy to disassembly,  
reduction of the  
maintenance and  
reparation costs





## DOMMINIO: Digital method for imprOved Manufacturing of next-generation Multifunctional airframe parts







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Taken from: [https://raisbeck.com/raisbeck\\_product/high-flotation-gear-doors/](https://raisbeck.com/raisbeck_product/high-flotation-gear-doors/)

Milestone number	Milestone title	WP number	Lead beneficiary	Due Date (months)
MS1	Framework to start project development	1	INCAS	8
<b>MS2</b>	<b>Process numerical models developed and preliminary design of prototypes elaborated</b>	<b>2</b>	<b>ENSAM</b>	<b>25</b>
<b>MS3</b>	<b>Process window assuring optimal quality of multifunctional composite specimens manufactured through the combination of ATL and FFF processes attained</b>	<b>3</b>	<b>AIMEN</b>	<b>27</b>
MS4	Systems for process and quality monitoring developed	4	IPC	30
MS5	Digital Twin models and physical SHM system developed	5	IMDEA	34
MS6	DOMMINIO representative prototypes manufactured	6	AIMEN	38
MS7	MDO and MRO assessment after incorporation of DOMMINIO datadriven methodology realized	7	BAE	42



- ✓ Reduction of manufacturing cost through the use of Flexible multistage robotic-based production processes.
- ✓ Reduction of design time through data analytics and knowledge-based decision support system.
- ✓ Reduction in scrap during manufacturing using online process control and advanced quality monitoring.
- ✓ Cost reduction in MRO operations enabled by the easy-to-disassembly designs, and using embedded SHM systems and component digital twin

# Thank you for your attention

[www.domminioproject.eu](http://www.domminioproject.eu)

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