

# Inspection 4.0 Now : in-line quality assessment

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# Summary

The 4.0 era leads to data digitalization, better traceability & time savings. TESTIA & INFACTORY SOLUTIONS develop technological bricks to cover all the value chain dimensions to this end: from data acquisition & analysis to remote assistance & data management software. These bricks make Inspection 4.0 accessible to companies of all sizes that are adapting to their own challenges.



INDUSTRY 4.0 FRAMEWORK - THE DIGITAL TECHNOLOGIES



# Content

I4<sup>2</sup>: Inspection 4.0 within Industry 4.0

Inspection 4.0 - Process Monitoring

Inspection 4.0 - AVI & NDT

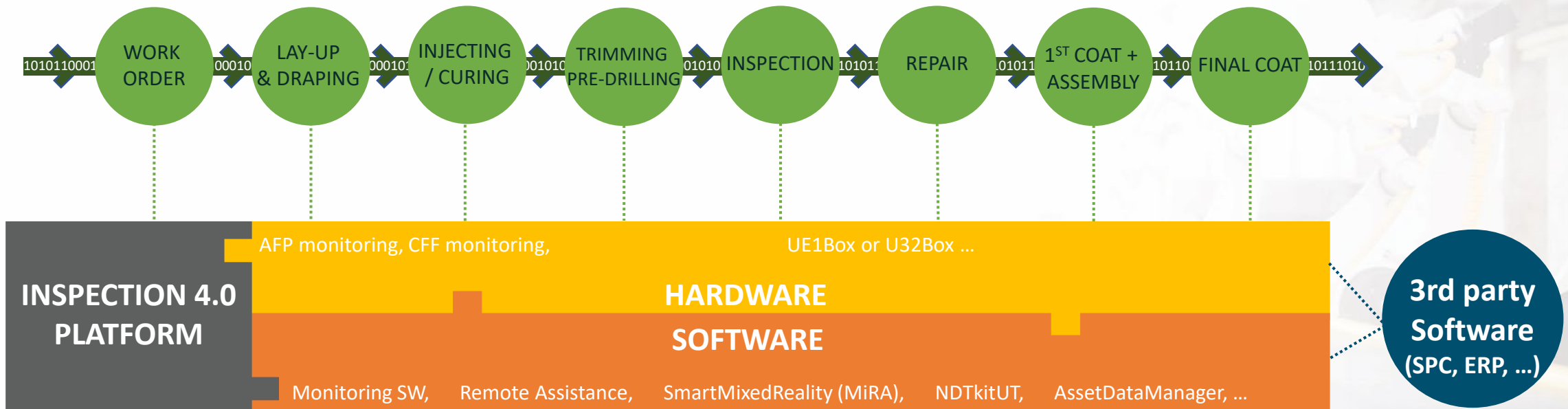
Inspection 4.0 - Democratization



# I4<sup>2</sup>: Inspection 4.0 within Industry 4.0

# Composite manufacturing & Digital continuity

Typical AFP/RTM/LRI production for airframes:

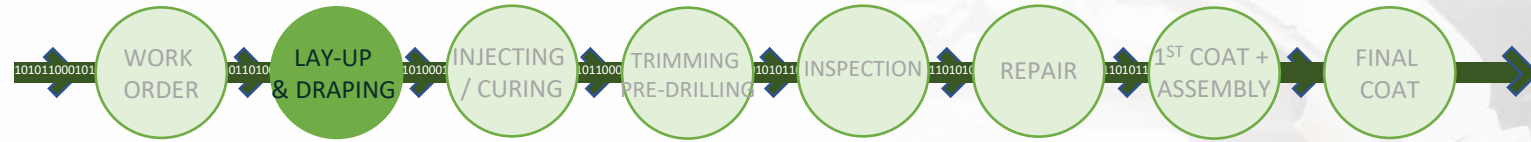


Benefits of I4<sup>2</sup>: Earlier detection of anomalies  
+ Faster optimization of manufacturing processes + Non-quality cost reduction



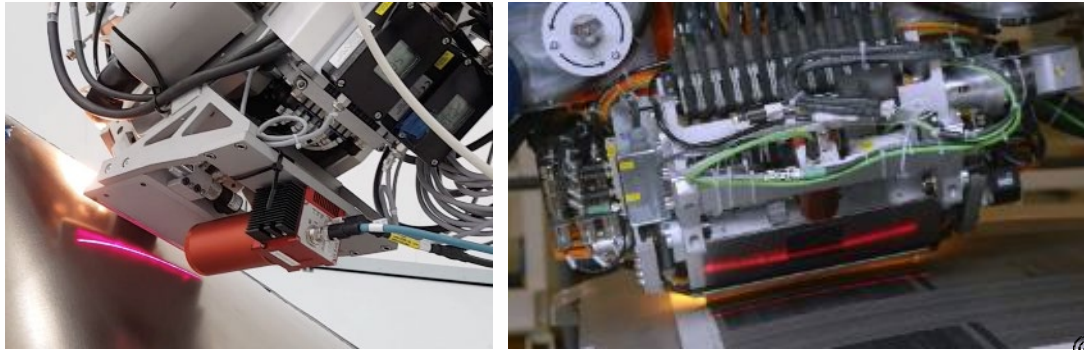
# Inspection 4.0 Processes Monitoring

# Lay-up & Draping



## AFP (Automated Fiber Placement) monitoring

### Objective

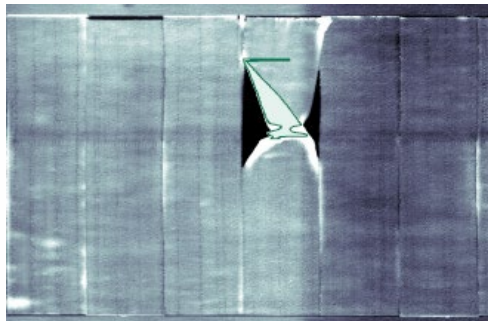


- Reduce visual inspection time
- Increase defect recognition rate

### Fundamentals

Automated in-process inspection with laser triangulation sensors.

Live Defect Detection



Tow Pose Reconstruction



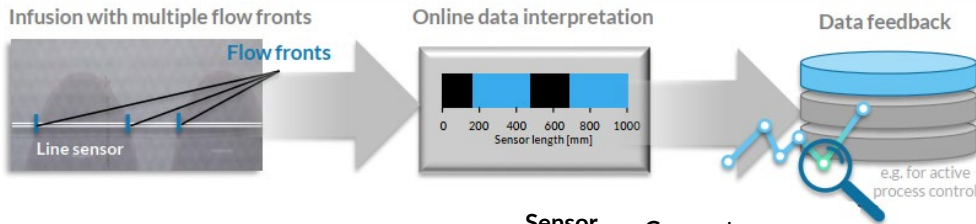
### Industrial benefits

- Manufacturing: Reduced visual inspection time
- Quality: Improved, early defect recognition
- Engineering: As-built digital twin
- Servicing: Predictive maintenance

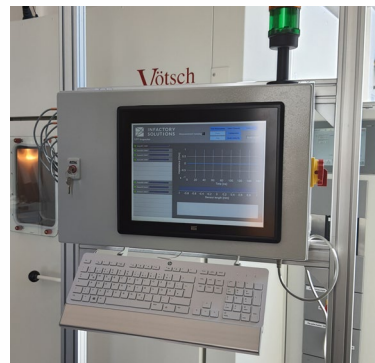
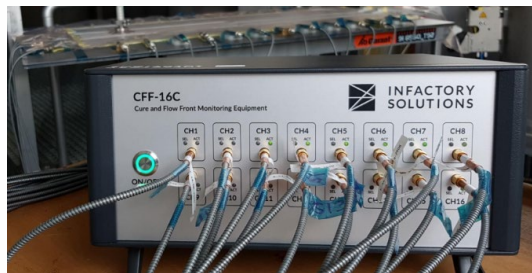
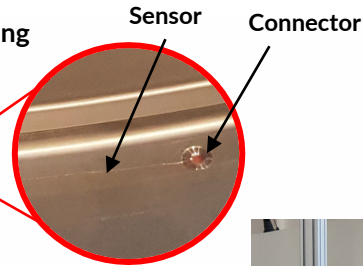
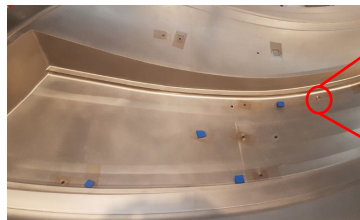
# Injecting / Curing



## CFF (Cure and Flow Front) monitoring



### Sensor integration in RTM tooling



## Objective & Fundamentals

- Monitoring of infusion and cure with line sensors
  - ➔ Faster process introduction & reduced cycle times
- Spatial sensor evaluation using electrical reflectometry
  - ➔ One sensor to monitor over up to multiple meters of length

## Industrial benefits

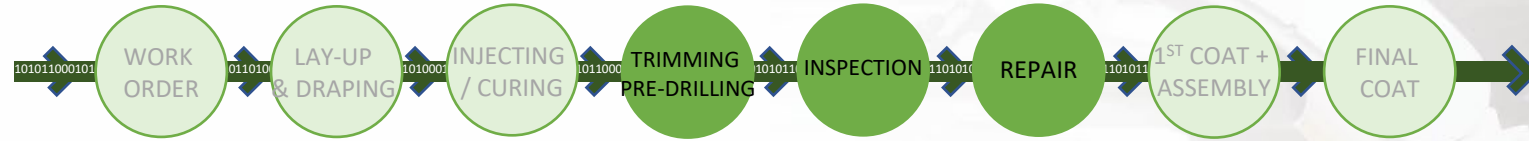
- Miniature or tooling integrated line sensors
  - ➔ No effect on infusion or cure behaviour
- Parallel evaluation of up to 16 channels
  - ➔ detailed coverage of large & complex parts
- Intuitive software with customizable interfaces
  - ➔ fast interpretation of results & easy integration into manufacturing systems
- Embedding of sensors without mechanical weakening
  - ➔ sensors usable for life cycle monitoring & SHM





# Inspection 4.0 AVI (Automatic Visual Inspection) & NDT (Non-Destructive Testing)

# Post-Curing (1/4)



## Automatic Visual Inspection



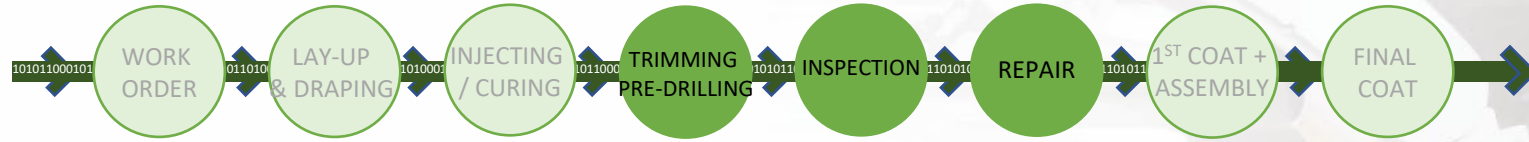
## Objective & Fundamentals

- Multi-sensors head (sensors, illumination,...)
- Full coverage of defects for CFRP (air/immersion)
- Automatic defect recognition, categorization and sizing

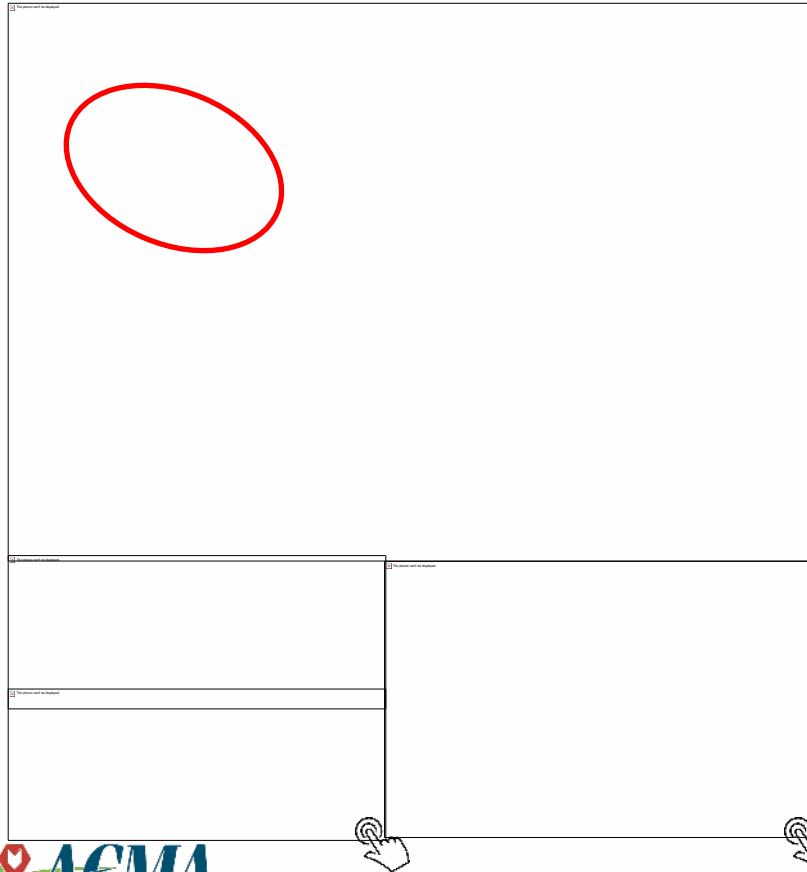
## Industrial benefits

- Reduced workload & lead time for inspection process
- Automatic defects detection & documentation creation
- Standardise and secure objective assessment of defects
- Enabler for data continuity & digital twin

# Post-Curing (2/4)



## AUT (Automatic Ultrasonic Testing)



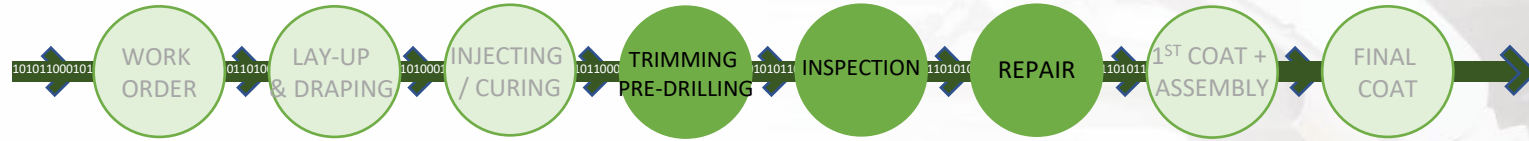
### Objective & Fundamentals

- Detection of foreign objects, delaminations, disbondings and porosity
- Optional thickness measurements
- Pulse-echo or through transmission techniques
- Full or local immersion – Sprayers or squirters

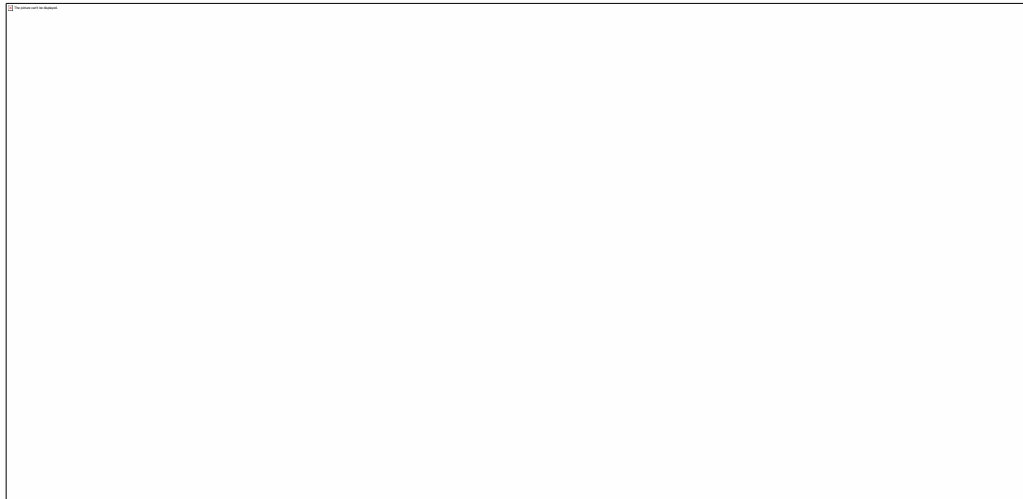
### Industrial benefits

- [UE1Box](#) & [U32Box](#): ultra-compact instruments ready to be mounted on effectors (if automatic changing tool)
- Compatible with standard gantries, crawlers or complex robots
- Intuitive software suite ready to be used or dedicated SDK package for integrators

# Post-Curing (3/4)



## UT data post-processing & Reporting



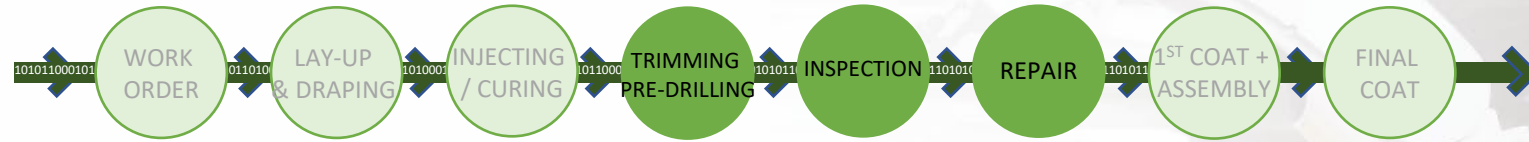
## Objective & Fundamentals

- Assist UT2 certified operators to make the right diagnosis + Focus their attention on suspicious areas
- Export automatically all the results into reports, 3D CAD files, EPR and/or SPC software
- [NDTkitUT](#): 1 software to process any data format

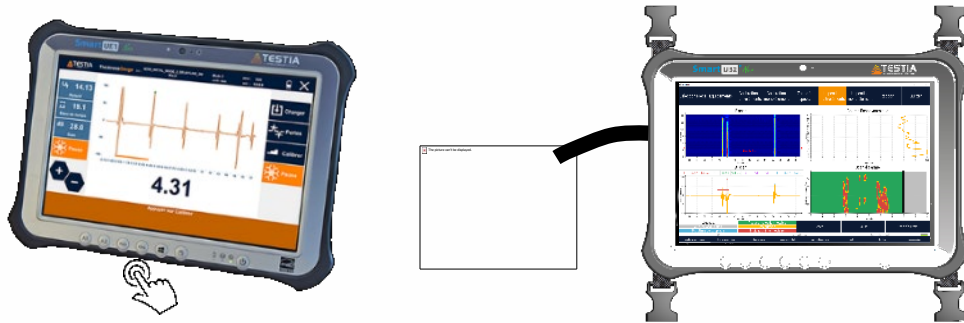
## Industrial benefits

- Reduce human factor + Save time & money
- Facilitate concessions management process & predictive maintenance
- Develop & capitalize your own dedicated analysis tools for CFRP in 1 single reliable software
- Invest in automatic scanning machines without caring post-processing features

# Post-Curing (4/4)



## Manual UT/PAUT



## Objective & Fundamentals

- Inspect components / areas which automatic scanning is not cost-effective
- Confirm defects detected by AUT
- Check the quality of repairs

## Industrial benefits

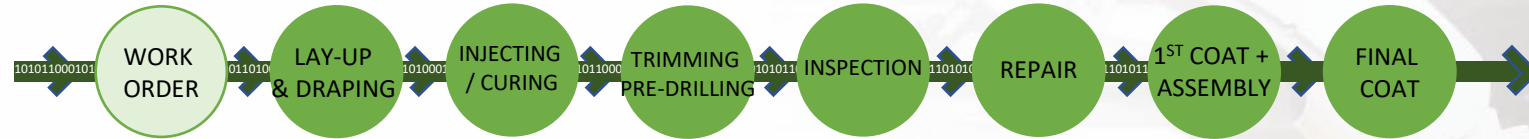
- Make digital continuity true after connecting [Smart UE1](#) & [Smart U32](#) (battery-operated UT & PAUT instruments running with Microsoft OS) to your network & your ERP
- Use our intuitive software suite or customize it to the list of components references



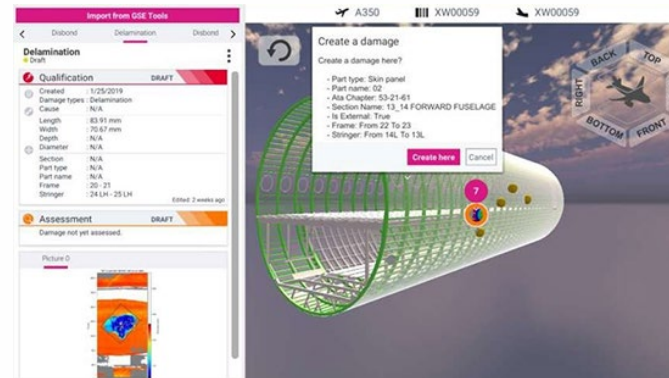


# Inspection 4.0 Democratization

# Democratization



## Mixed Reality



## Digital Twin, Cloud Hosting & Remote Assistance

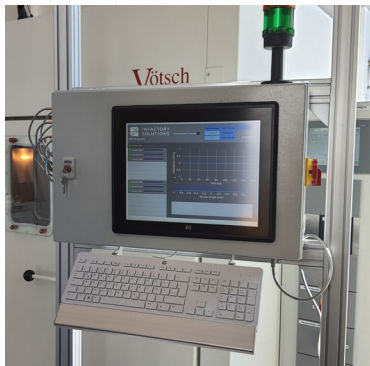
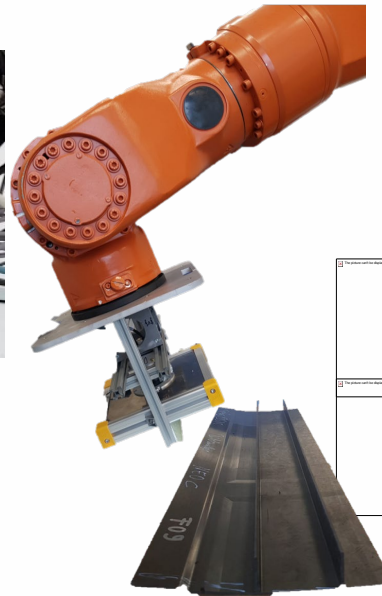
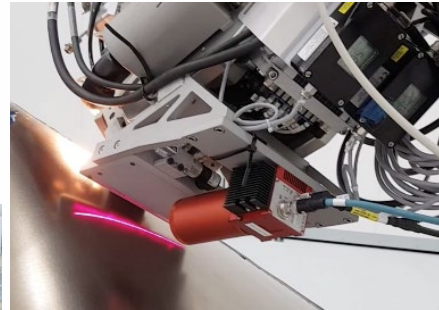
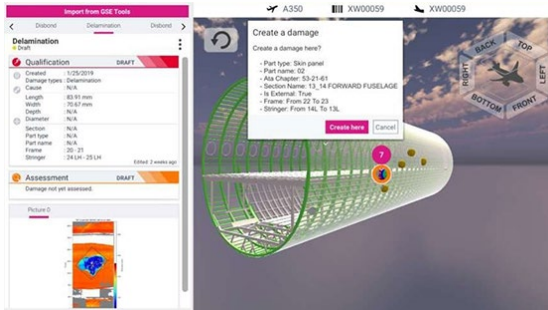
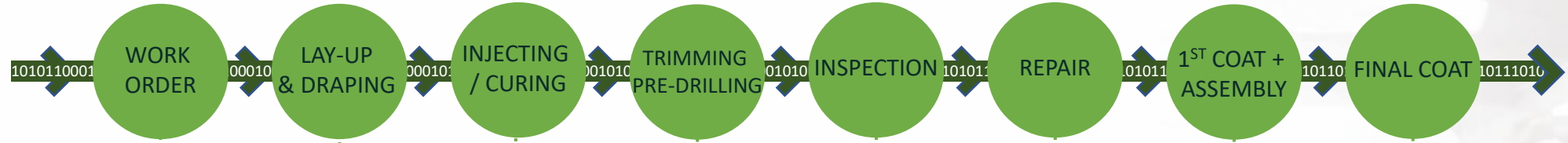
## Objective & Fundamentals

- Digitalize inspection work flows using Mixed Reality thanks to MiRA a.k.a. [SmartMixedReality](#)
- Link non-conformities to Digital Twins
- Export all the data to cloud solutions such as [eTech 3D Repair](#) by Airbus.
- Assist remotely operators by experts in back-office thanks to [RemoteAssistance](#)

## Industrial benefits

- Reduce human factor + Save time & money
- Improve traceability
- Facilitate concessions management process & predictive maintenance

# Conclusion





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**INFACTORY  
SOLUTIONS**



# Glossary

- AFP: Automatic Fiber Placement
- AUT: Automatic Ultrasonic Testing
- AVI: Automated Visual Inspection
- CAD: Computer Aided Design
- CFF: Cure and Flow Front
- CFRP: Carbon Fiber Reinforced Plastic
- ERP: Enterprise Resource Planning
- GFRP: Glass Fiber Reinforced Plastic
- I4: Industry 4.0
- I4<sup>2</sup>: Inspection 4.0 within Industry 4.0
- IRT: Infra-Red Thermography
- LRI: Liquid Resin Infusion
- NDT: Non-Destructive Testing
- PA: Phased Array
- PE: Pulse-Echo
- RTM: Resin Transfer Molding
- SDK: Software Development Kit
- SPC: Statistical Process Control
- SW: SoftWare
- TTU: Through Transmission Ultrasonic
- UT: Ultrasonic Testing