

# Turning high-end composite manufacturing systems into Printers

AZL Work Group – 9 October 2019



**Airborne**

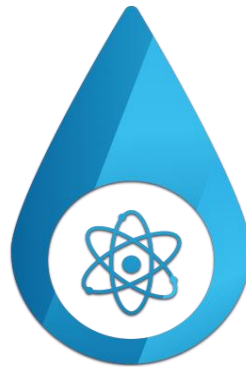
# Airborne group



≈ 125 employees



Facilities in  
The Netherlands  
and the UK



20+ year legacy in design  
and manufacturing of  
Advanced Composites:  
Aerospace, Marine,  
Renewables, Industrial  
and Oil & Gas

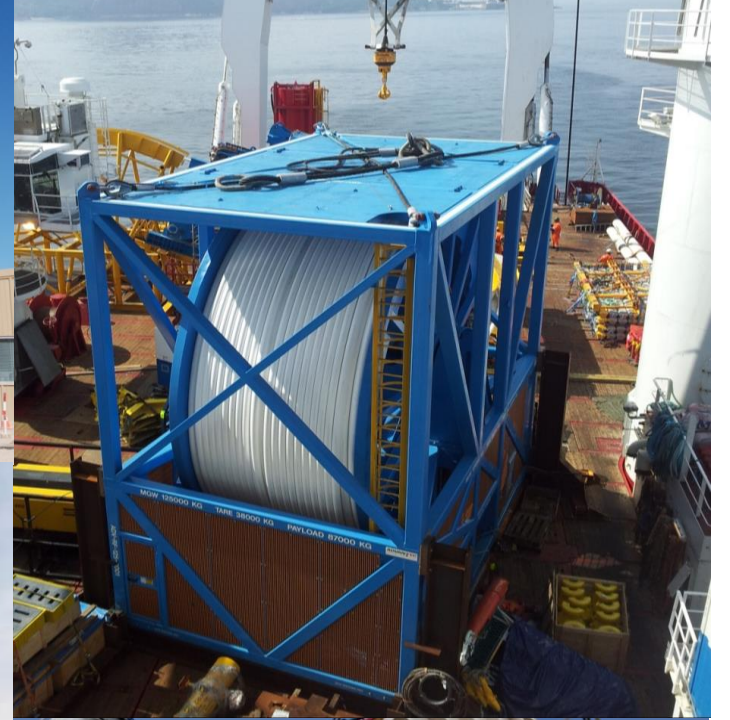


Supplying automated and  
digital manufacturing  
systems, to radically  
industrialise composite  
manufacturing

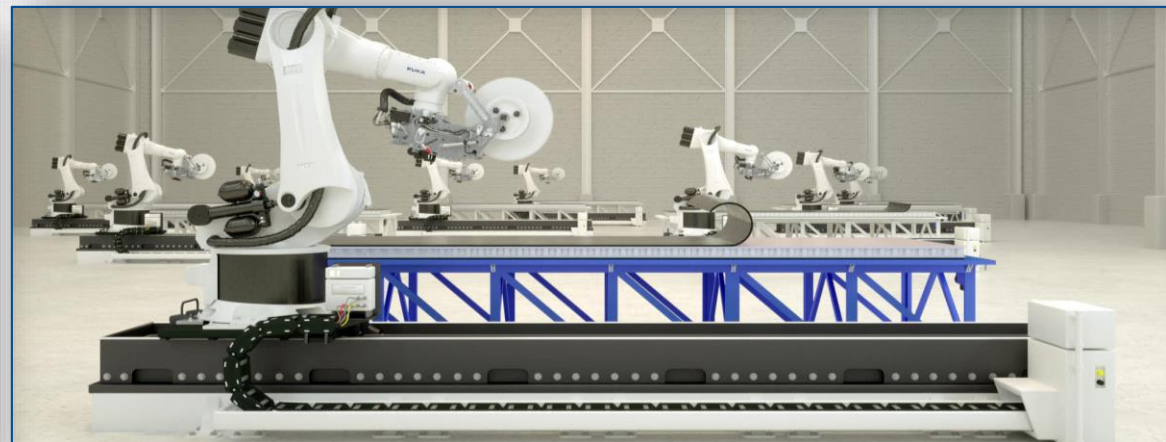
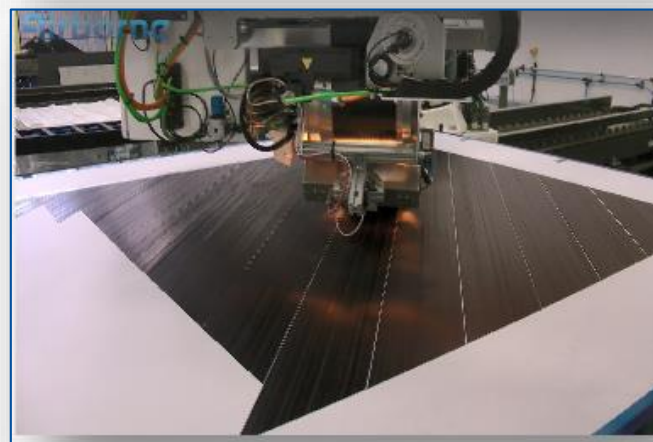
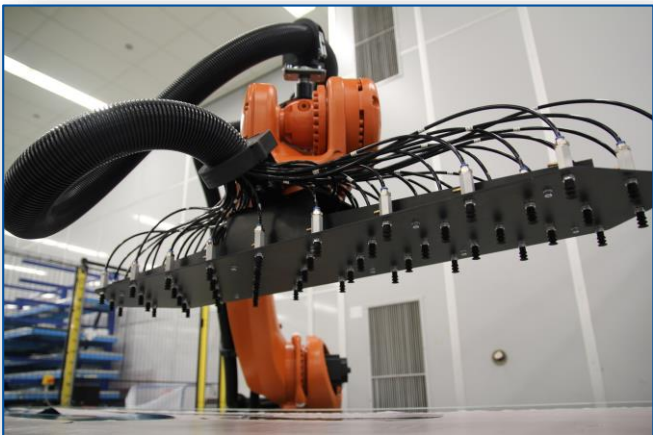


Vision:  
Digital, on-demand  
manufacturing platform











# Composite manufacturing know-how



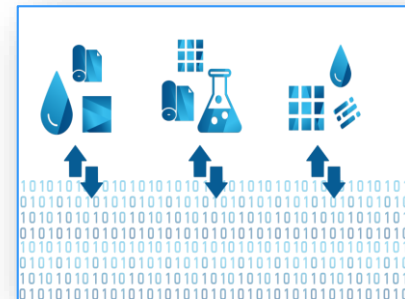
Know-how of Composite Manufacturing



Part manufacturing

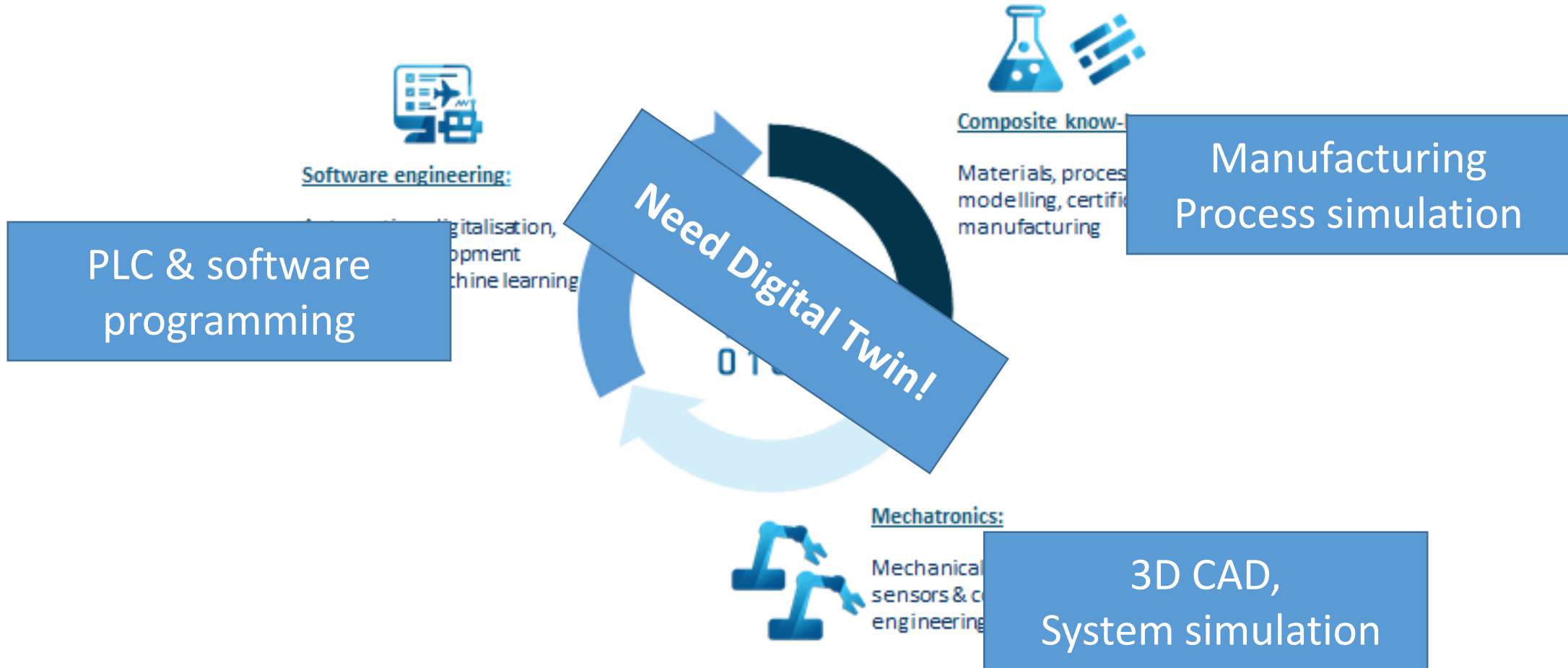


Automated processes

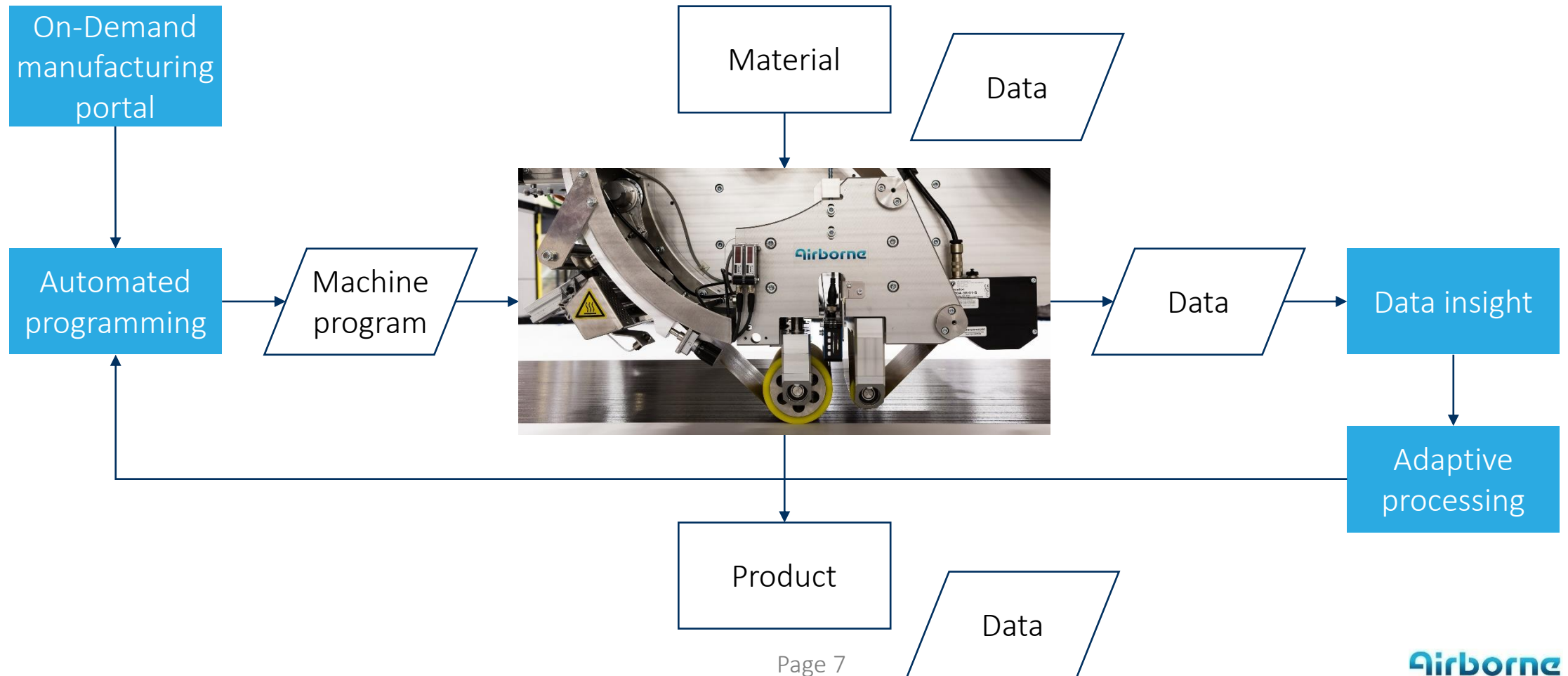


Digital manufacturing

# Unique combination of skills



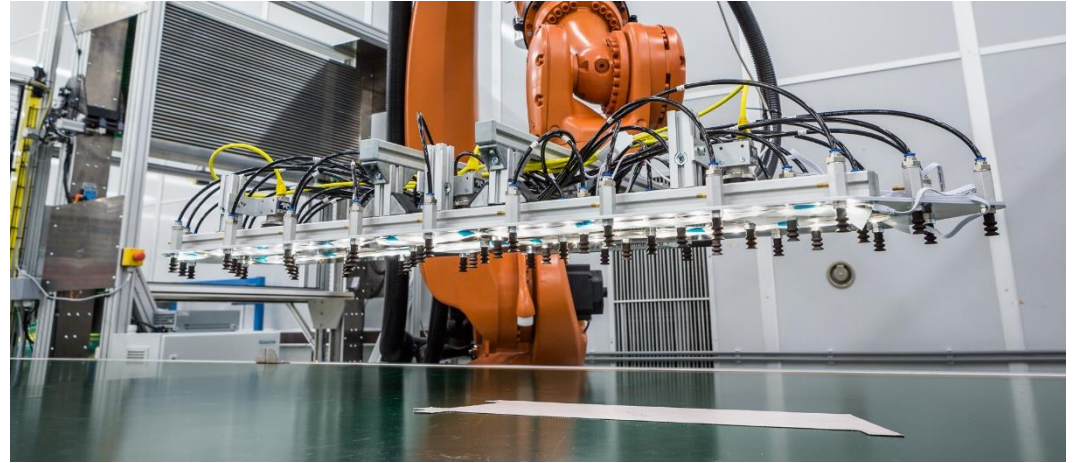
# Airborne's digital framework



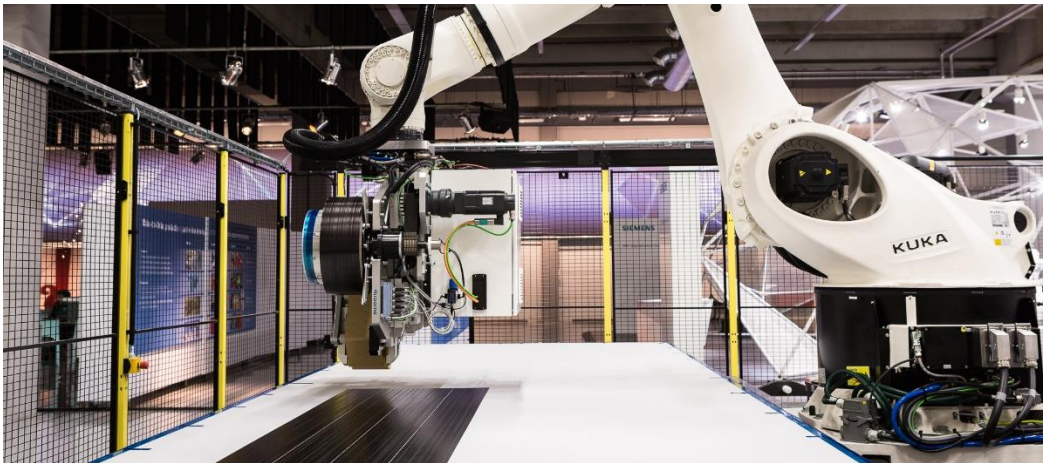




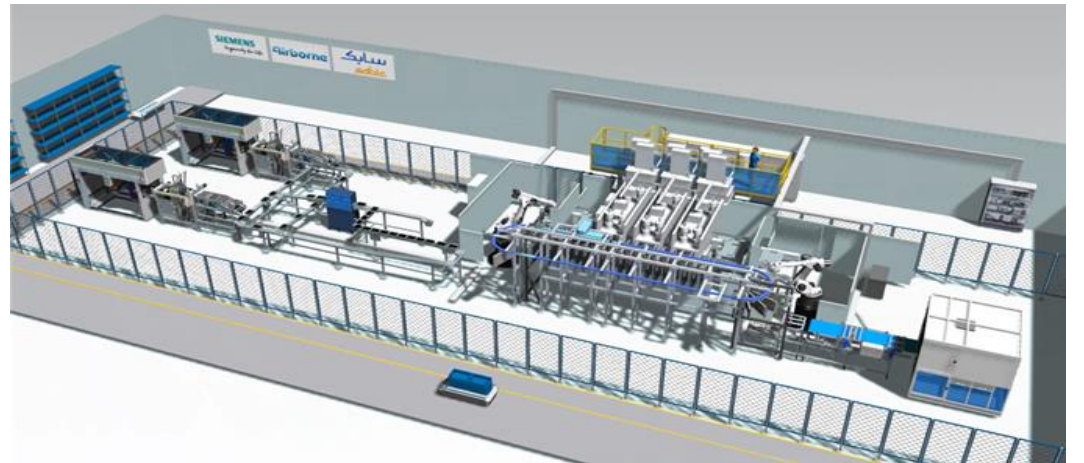
Automated Honeycomb Potting



Automated Ply Kitting

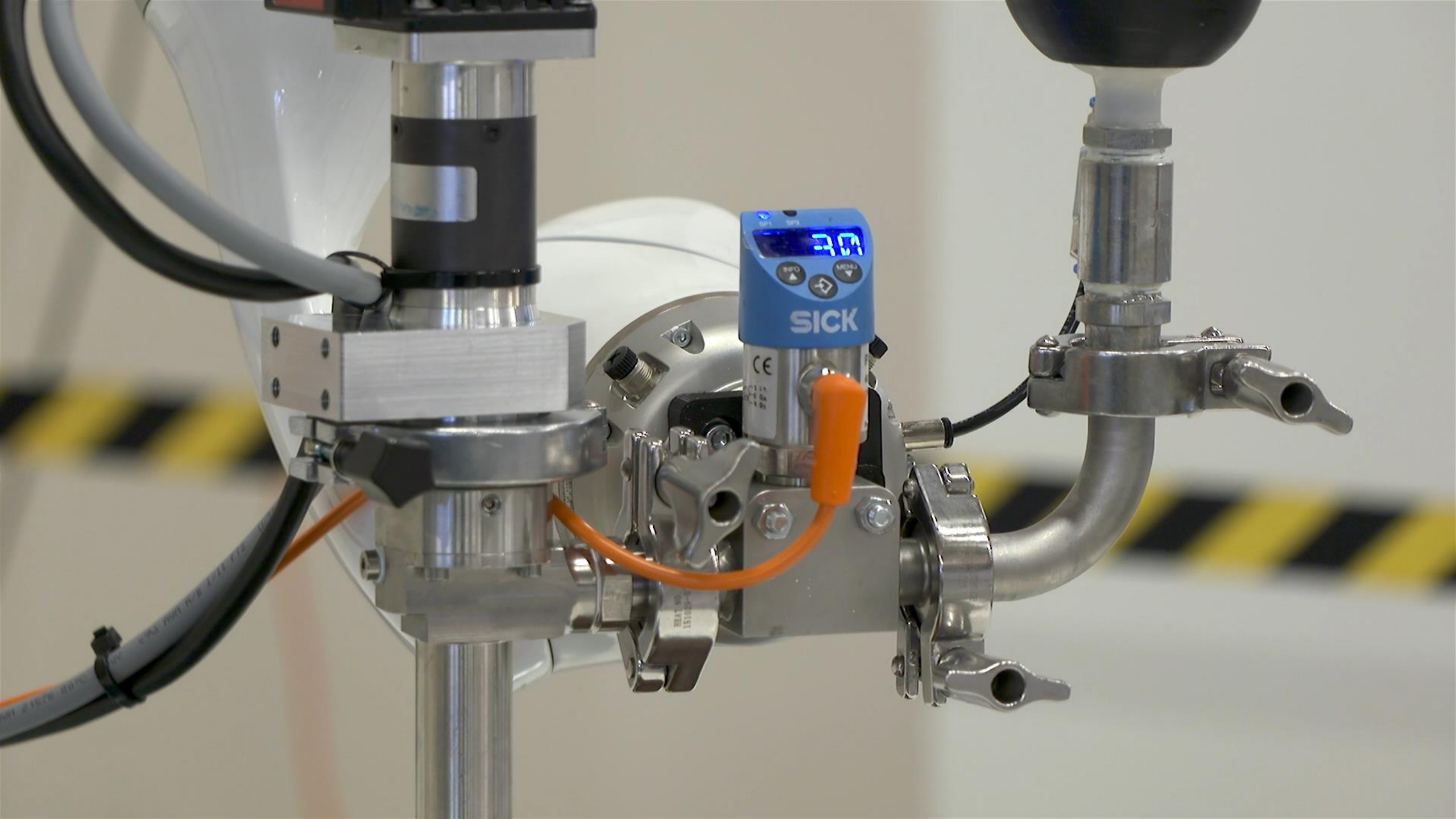


Automated Lamination



High Volume Thermoplastic





SICK

3.0

INFO MENU

CE

RELT. NO.  
151029-1

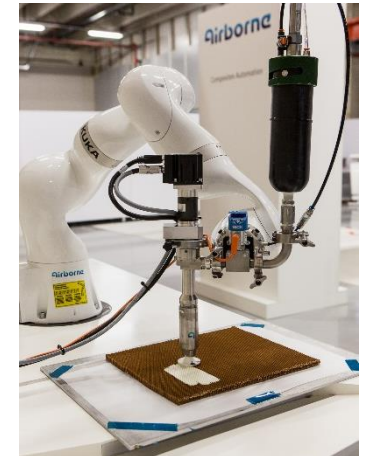
# Automated Honeycomb Potting



<https://vimeo.com/337519192/1e24ac890f>

<https://www.youtube.com/watch?v=0h0hDeo-p9Y>

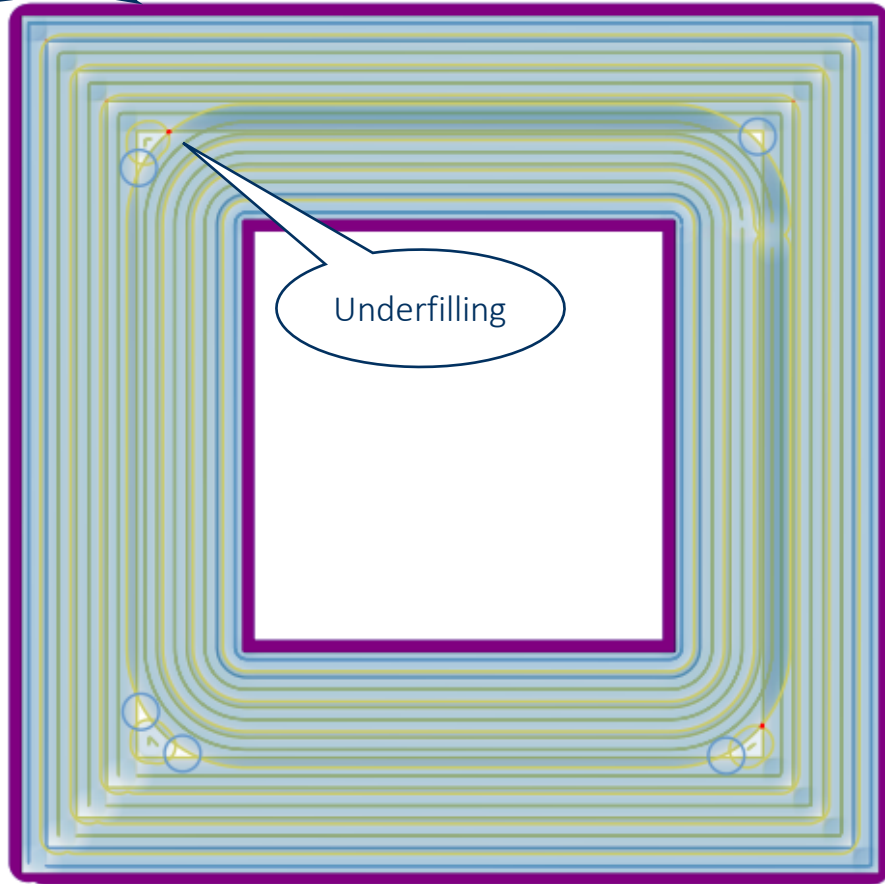
- High material efficiency
- Repeatable process
- Easy to setup, no programming needed
- Avoids toxic exposure



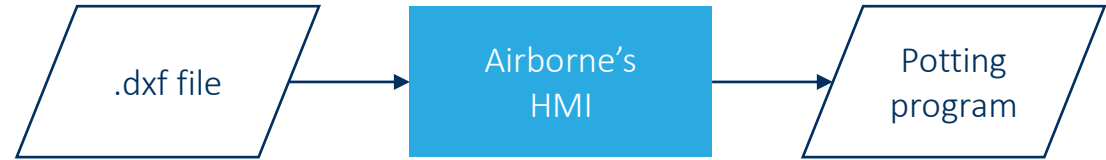


# Automated programming

Out of bound filling



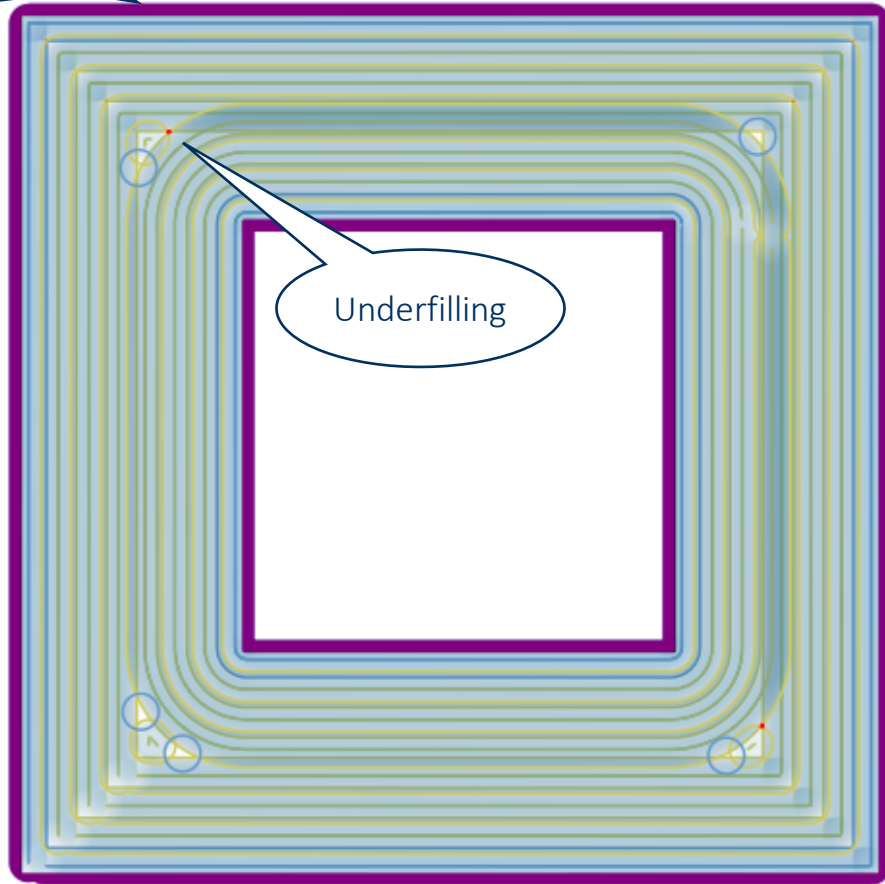
100 mm



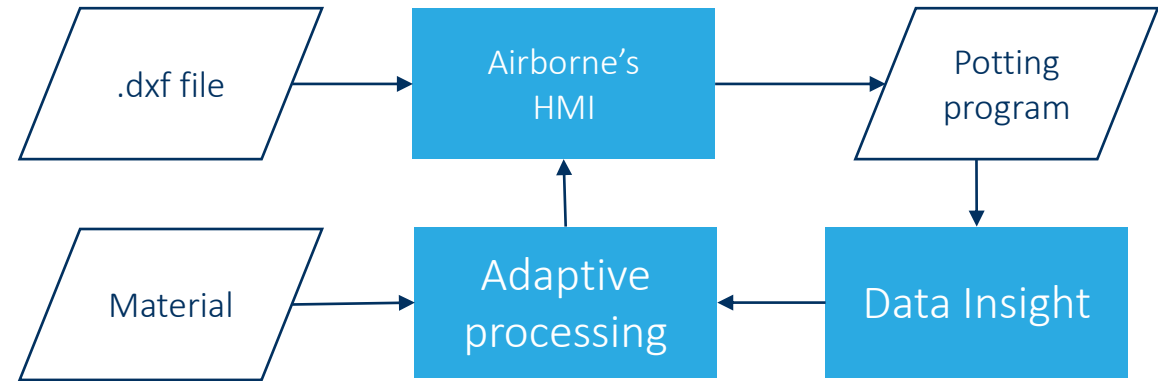
- Potting path determined using an advanced optimisation algorithm
- Potting path optimized to minimise material use and optimise potting speed
- Dispensing algorithm automatically adjusted as a function of the path

# Adaptive processing

Out of bound filling



100 mm



- Developing material model, to be able to predict output quality and filling rate
  - Highly viscous, changing over time, thixotropic, glass spheres

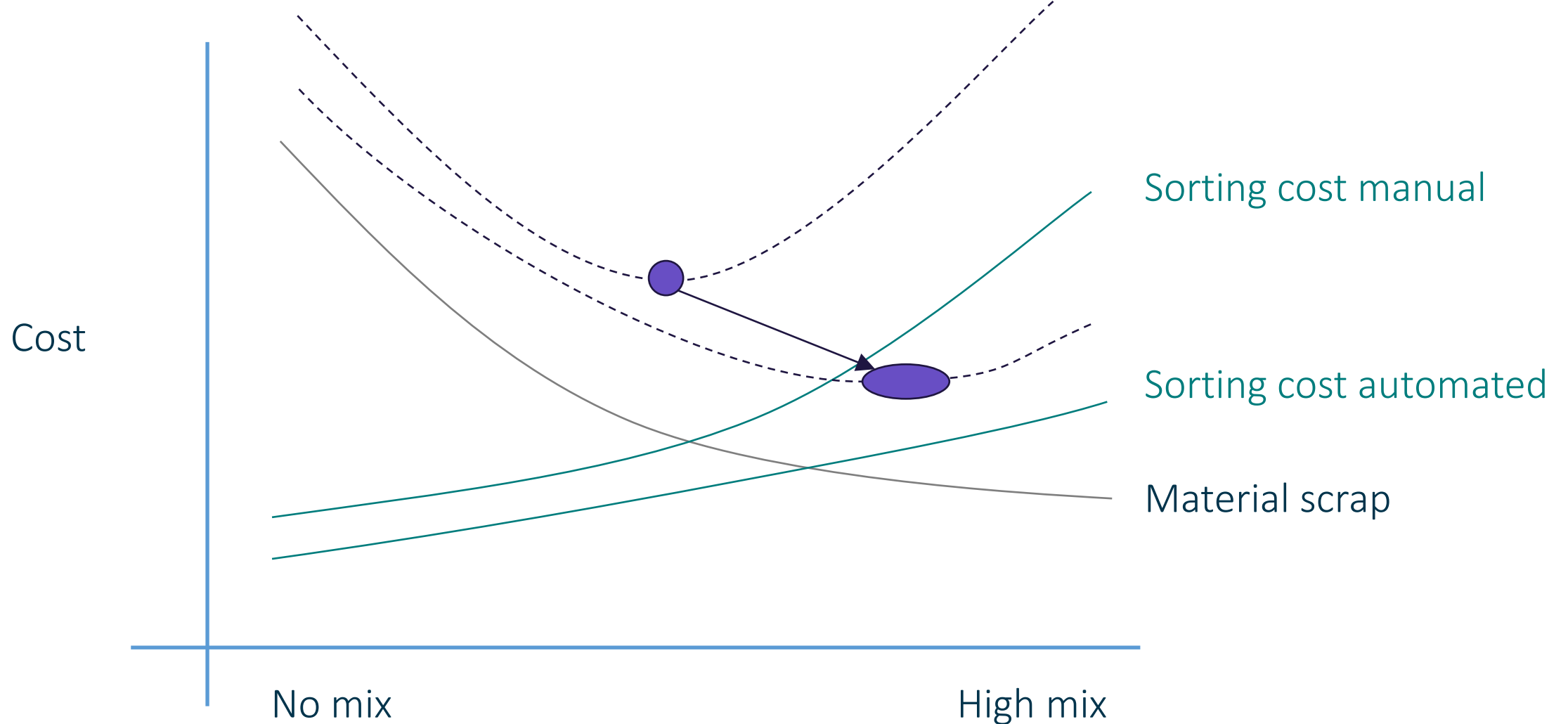


# **Cutting and Kitting of composite plies**





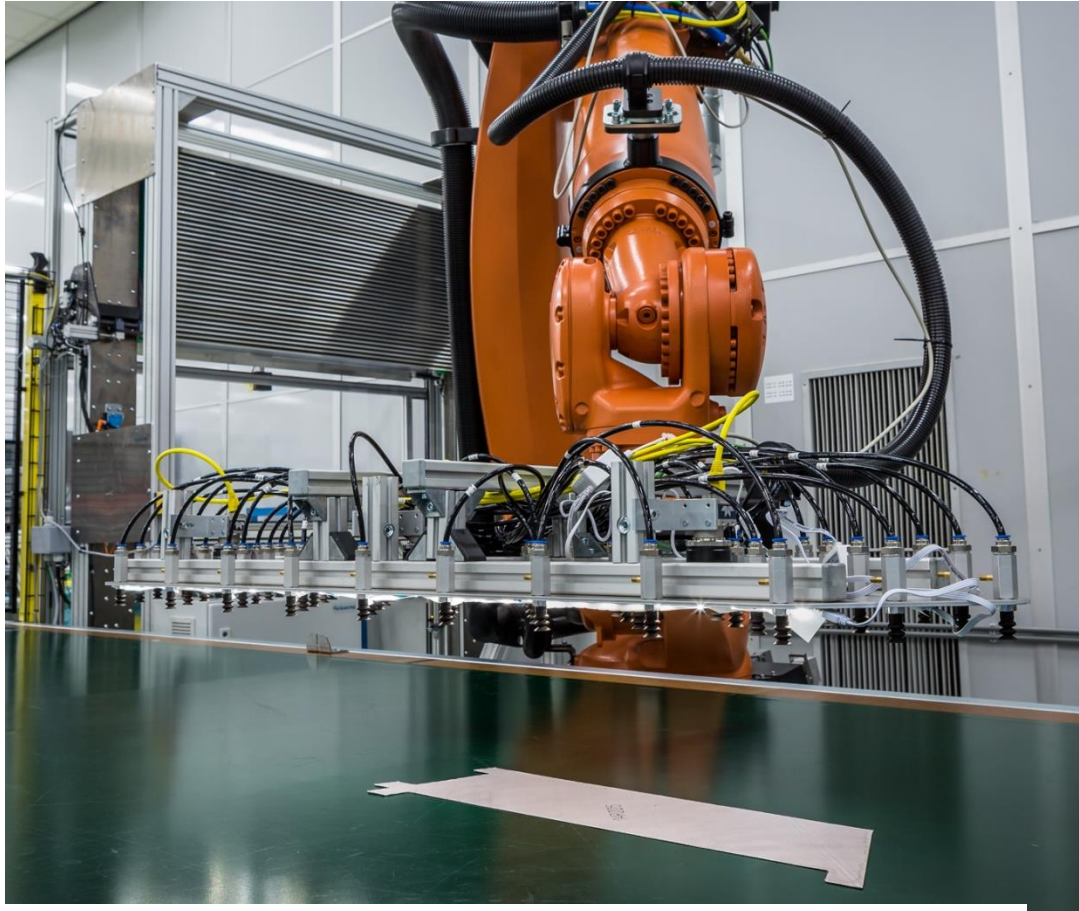
# Nesting efficiency vs sorting







# Automated Ply Kitting

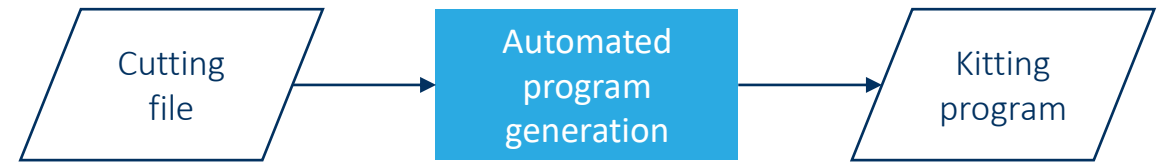
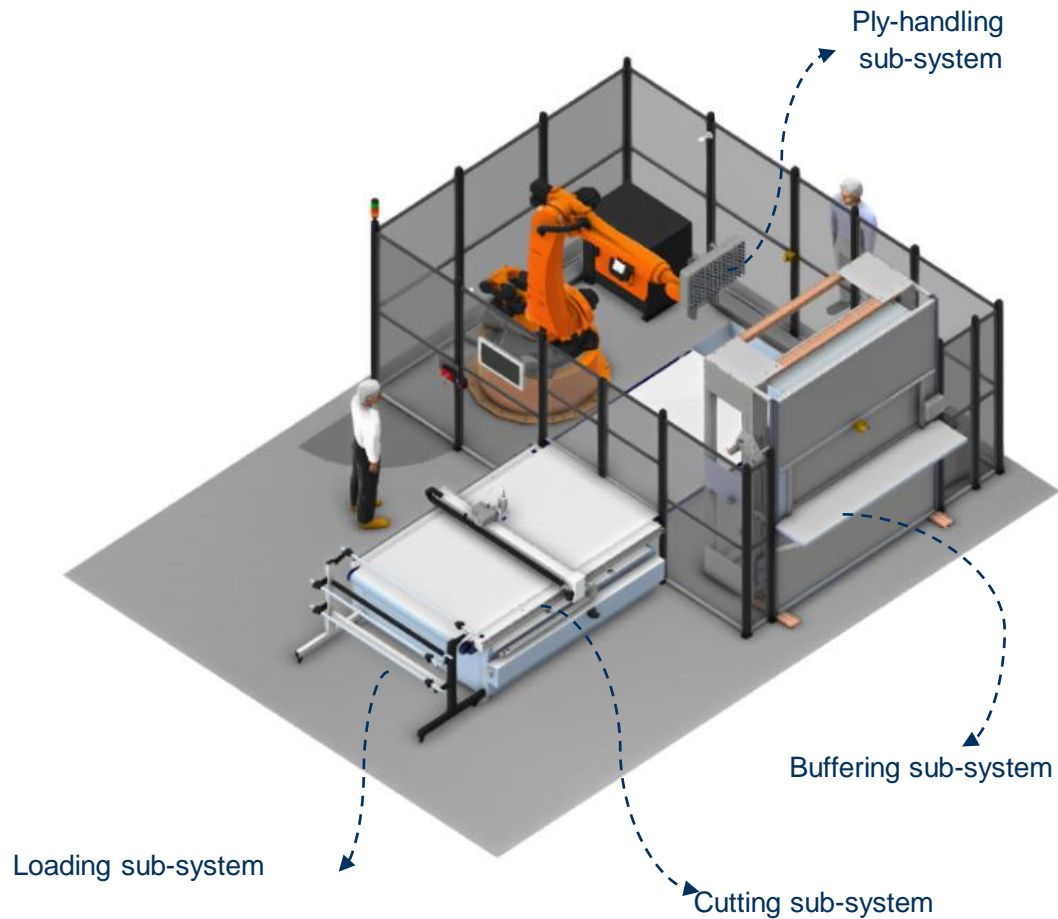


- Increased material efficiency
- Increased ply cutter capacity
- No kitting errors
- Full quality traceability
- Increased operational flexibility



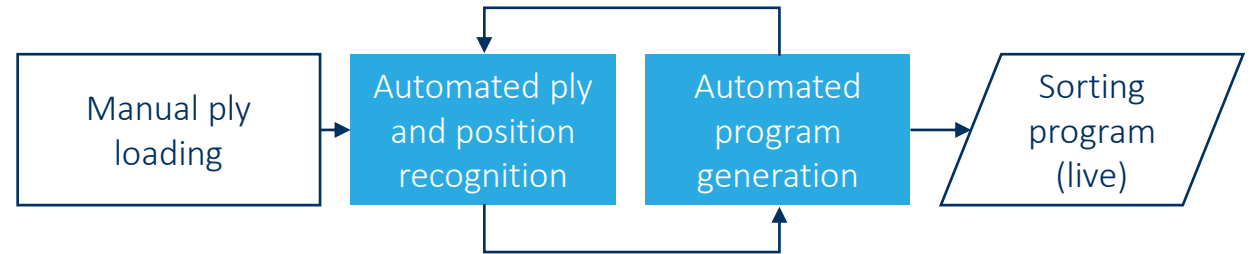
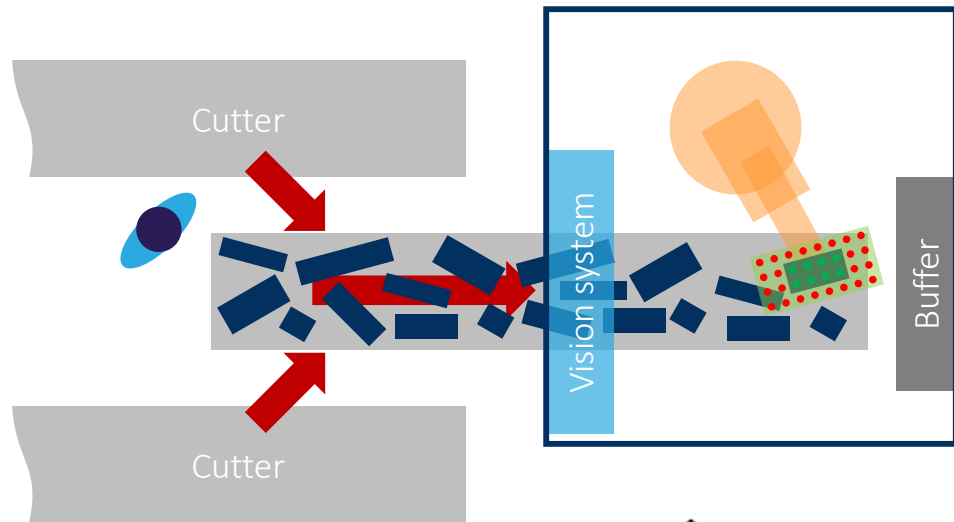
[https://www.youtube.com/watch?v=9KcElH\\_yUE8](https://www.youtube.com/watch?v=9KcElH_yUE8)

# Automated programming

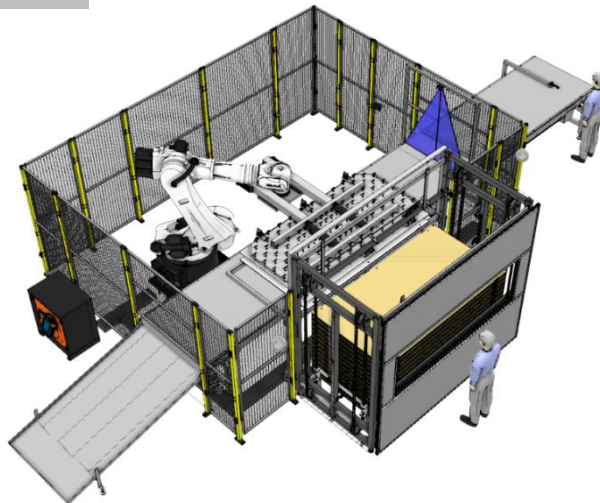
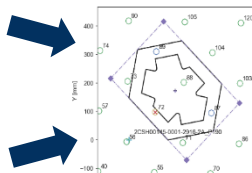


- Cutting file interpreted by Airborne's software
- Material specific process parameters retrieved from database
- Robot code and end effector control automatically determined, on-the-fly

# Adaptive processing



- Plies manually loaded to conveyor belt
- Plies and their position identified using barcode and vision system
- Robot code (including individual suction cup activation) automatically determined
- Provides opportunity for Adaptive nesting and cutting

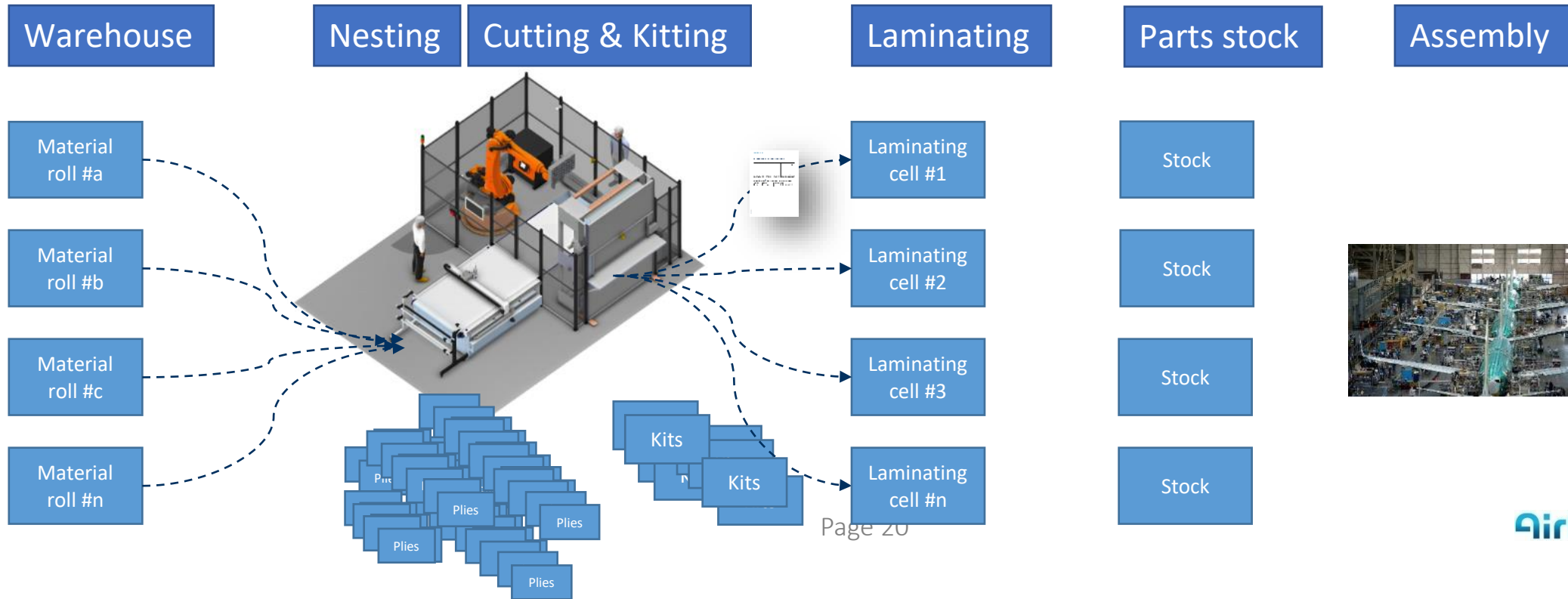




# Unlocking the digital factory

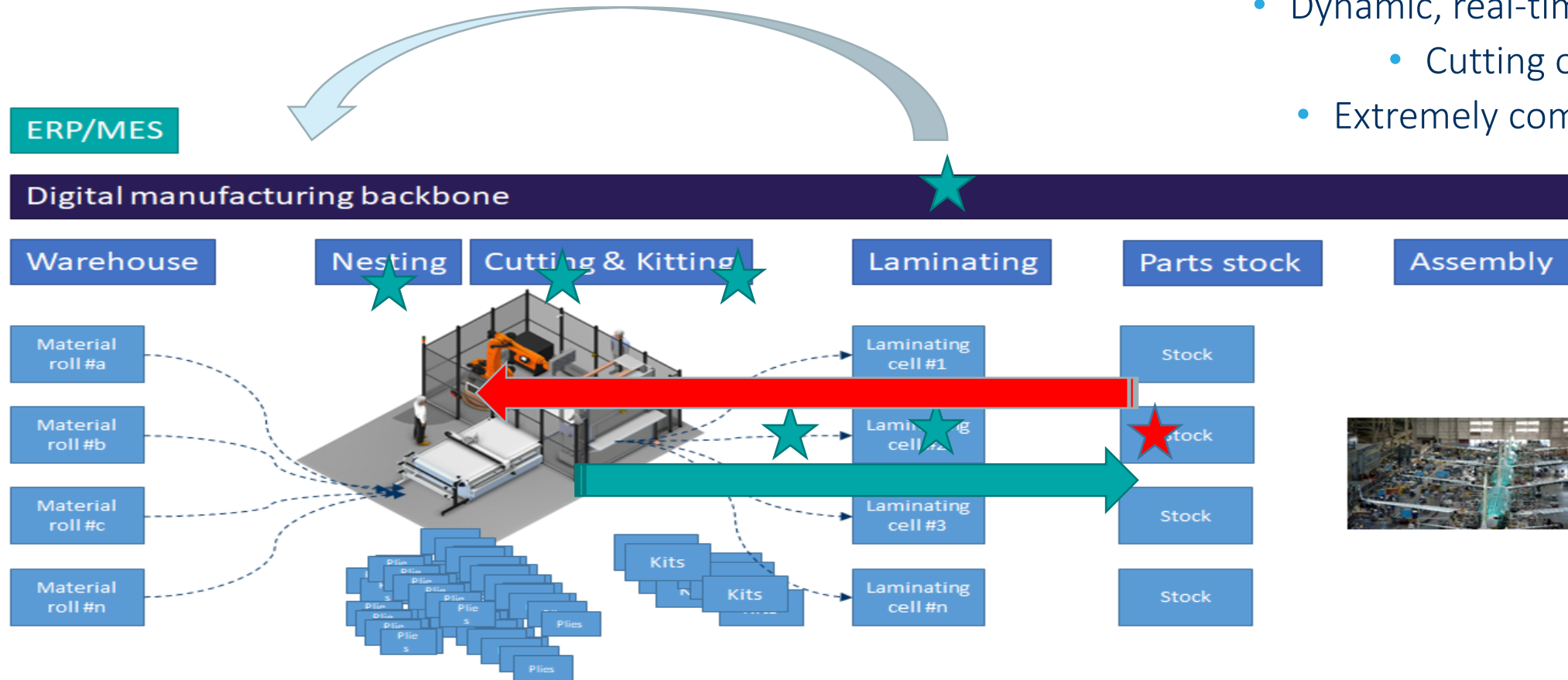
ERP/MES

Digital manufacturing backbone



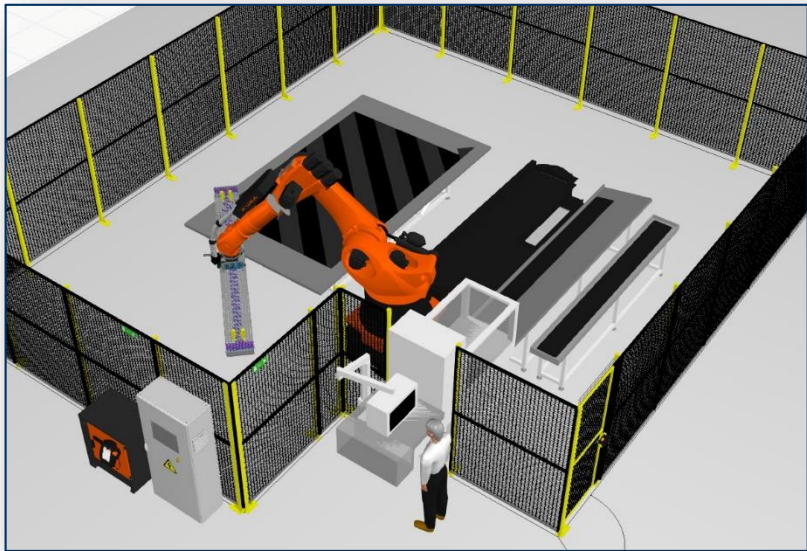
# Unlocking the digital factory

- Dynamic, real-time, nesting
  - Cutting on demand
  - Extremely complex nests

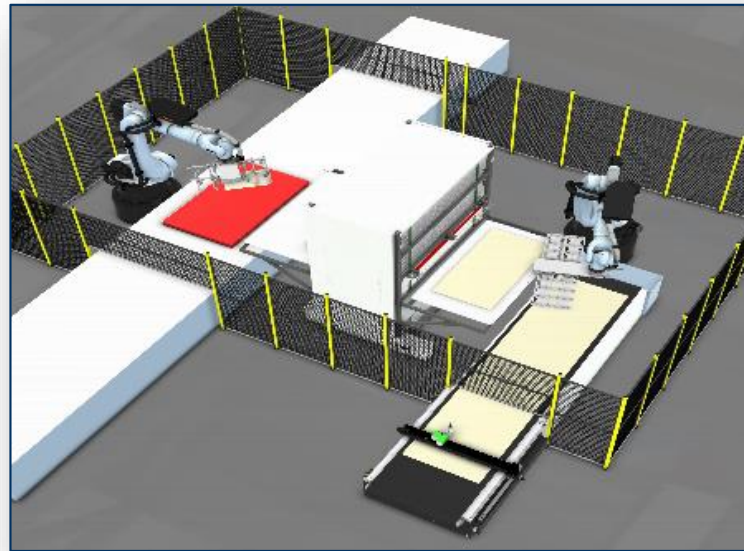


# Automated preforming: TP or dry fibre

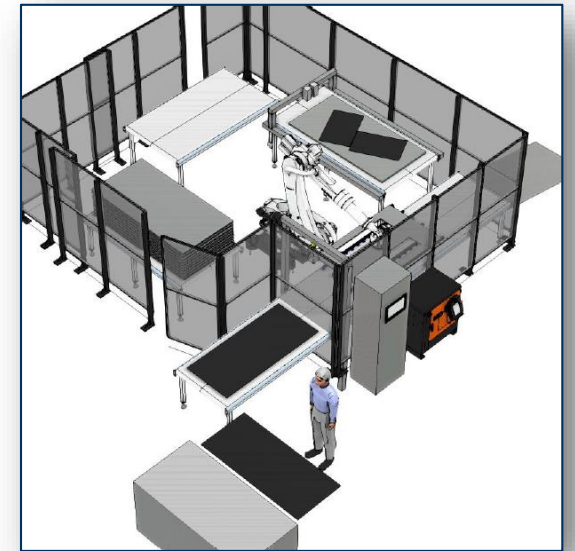
Automated preforming cell for thermoplastic blanks



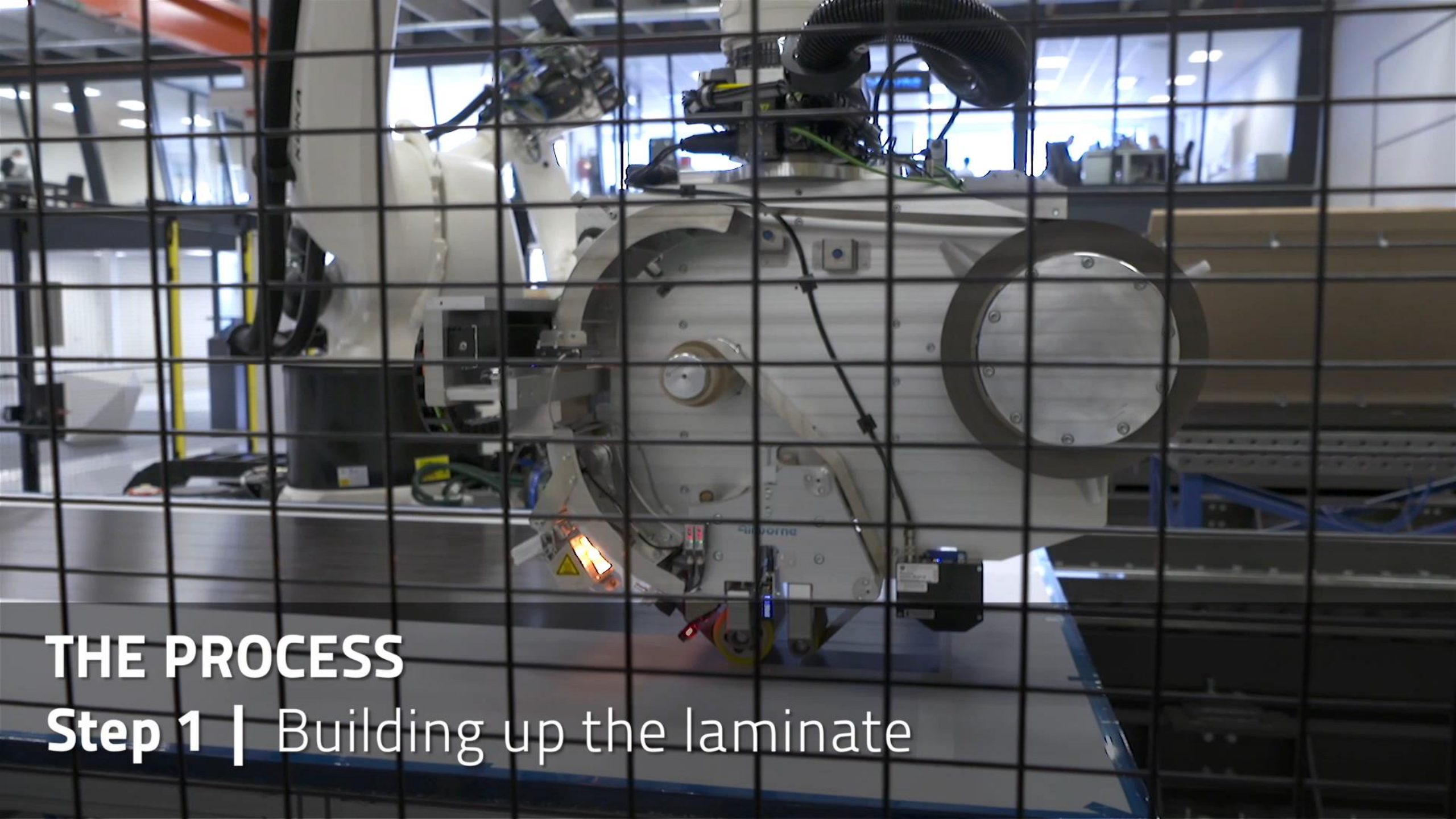
Automated preforming cell with integrated kitting system



Automated preforming for dry fibre laminates





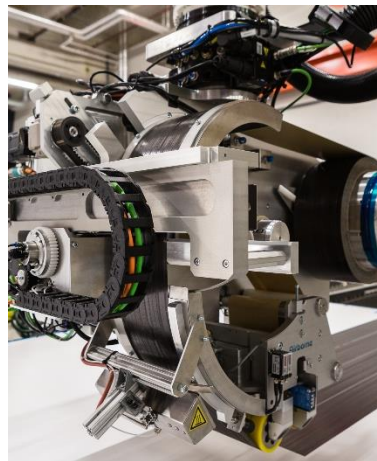
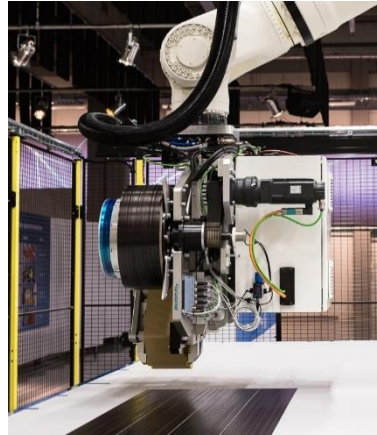
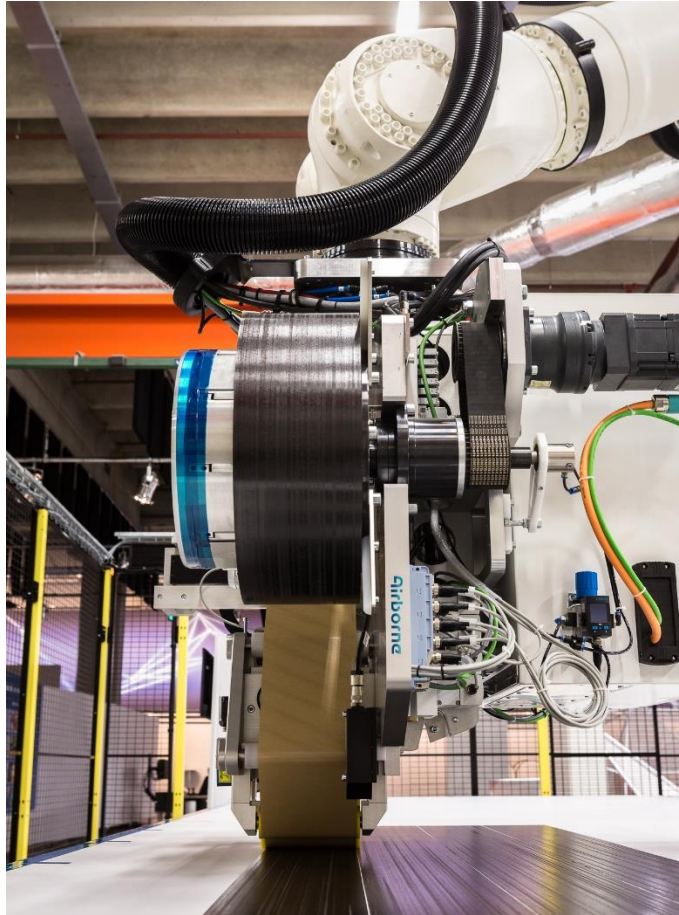


# THE PROCESS

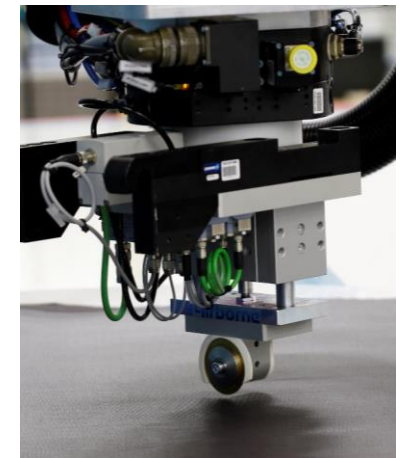
Step 1 | Building up the laminate



# Automated Lamination



- 3 functions in 1 system
- High material throughput
- Tailored preforms
- Can offload to next system



[https://www.youtube.com/watch?v=hDLrCw\\_WXBM](https://www.youtube.com/watch?v=hDLrCw_WXBM)

INTRODUCING  
**AIRBORNE CLIENT PORTAL**



[https://www.youtube.com/watch?time\\_continue=2&v=1iUPn8tZKFg](https://www.youtube.com/watch?time_continue=2&v=1iUPn8tZKFg)



# On-demand manufacturing portal

The screenshot displays the Airborne on-demand manufacturing portal interface. The top navigation bar includes the Airborne logo and a breadcrumb trail: LinkedIn blog example > Straight laminate > Editor. The browser address bar shows the URL: portal@airborne.com.

The interface is divided into several sections:

- INPUT**: Includes Material Selection, Geometry, Manual input (toggle), Length (1240 mm), and Width (920 mm).
- ORDER**: Includes Laminates, Mirror layers (toggle), and a list of plies with their orientations (0°, 45°, 90°, -45°).
- GEOMETRY**: Shows a 3D visualization of the laminate structure with three plies: Ply 1 (90°), Ply 2 (45°), and Ply 3 (-45°).
- LAMINATE BOOK**: Shows a table of parameters and delivery information.
- LAYUP LOGIC**: Shows a table of parameters and delivery information.

The table on the right side of the interface displays the following data:

Unit cost	€ 334.9
Total cost (ex works)	€ 669.7
Indicative delivery time	10 working days
Unit weight	1049 g
Thickness	0.58 mm
Longitudinal stiffness	17.8 GPa
Transverse stiffness	61.5 GPa
Material	hexply 8552/34%/ud194/as4/150 atl
Delivery Information	Marcus Kremers
First name	Marcus
Last name	Kremers
Company	Airborne
Email	m.kremers@airborne.com
Address	Laan van Ypenburg 70
Postal code	2497 GB
City	The Hague
Country	The Netherlands

<https://www.airborne.com/automation-solutions-advanced-composites/digital-client-portal/>  
[https://www.youtube.com/watch?time\\_continue=2&v=1fUPn8tZKFg](https://www.youtube.com/watch?time_continue=2&v=1fUPn8tZKFg)

# On-demand manufacturing portal

The screenshot displays the Airborne on-demand manufacturing portal interface. The top navigation bar includes the Airborne logo and a breadcrumb trail: LinkedIn blog example > Straight laminate > Editor. The browser address bar shows portal@airborne.com.

The interface is divided into several sections:

- INPUT**: Contains "Material Selection", "Geometry" (with a dropdown arrow), "Manual input" (with a toggle switch), "DXF file" (with a dropdown menu showing "AIRBORNE\_A\_rev03.dxf"), and "Laminate" (with a dropdown arrow).
- ORDER**: Contains "Mirror layers" (with a toggle switch) and a "Laminate" dropdown menu.
- GEOMETRY**: Displays three wireframe models of a curved part, labeled "Ply 1 (90°)", "Ply 2 (45°)", and "Ply 3 (-45°)".
- LAMINATE BOOK**: A section for managing the laminate layers.
- LAYUP LOGIC**: A table defining the laminate structure.
- Properties Panel**: A table on the right side listing various material and cost properties.

Property	Value
Unit cost	€ 523.6
Total cost (ex works)	€ 1047.2
Indicative delivery time	10 working days
Unit weight	1078 g
Thickness	0.58 mm
Longitudinal stiffness	17.8 GPa
Transverse stiffness	61.5 GPa
Material	hexply 8552/34%/ud194/as4/150 atl
Delivery Information	Marcus Kremers

The "LAYUP LOGIC" table is as follows:

Ply	Plies	Orient.
1	1	90°
1	1	45°
1	1	-45°

# On-demand manufacturing portal

Navigation: Airborne > Airborne 'A' > A > Editor

Tools: Back, Save, Share, Info, Refresh, portal@airborne.com

Sections: INPUT, ORDER, GEOMETRY, LAMINATE BOOK, LAYUP LOGIC

Order Form:

Place order ^

Number of laminat... Order number

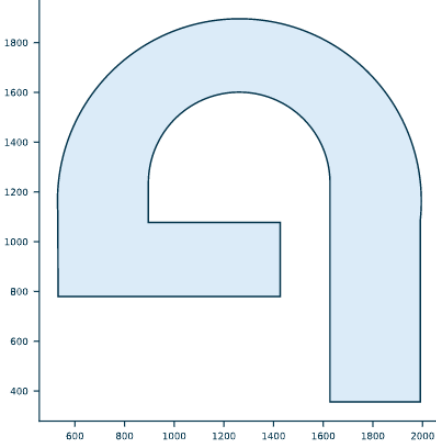
4

Accept terms and con...

**Order product**

**Download terms and conditions**

Geometry Plot:



Properties Panel:

Total cost (ex works)	€ 1918.1
Indicative delivery time	10 working days
Unit weight	1437 g
Thickness	0.78 mm
Longitudinal stiffness	48.6 GPa
Transverse stiffness	48.6 GPa
Material	hexply 8552/34%/ud194/as4/15atl
Delivery Information	Marcus Kremers

<https://www.airborne.com/automation-solutions-advanced-composites/digital-client-portal/>



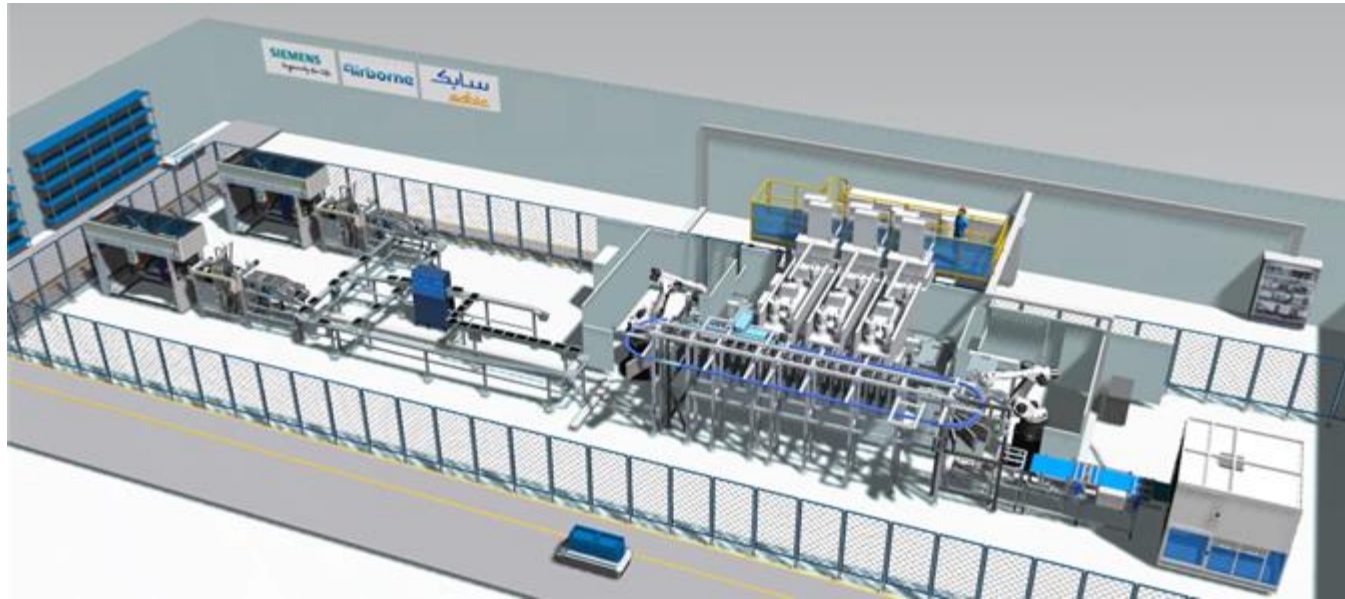
**SIEMENS**

*Ingenuity for life*

**Airborne**

سابک  
سابقہ

# High Volume Thermoplastic

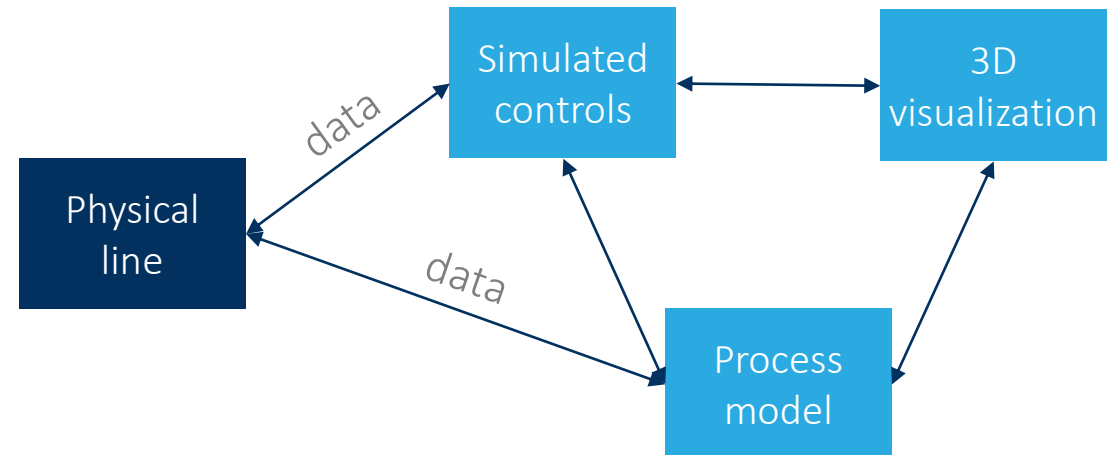


- Radical new concept for consolidating laminates
- 1.5 million parts / year, very low scrap rates
- End-to-end automation, thermoplastic, digital manufacturing
- Full quality inspection of the material and the product



# Data Insights

- Challenge
  - Full inspection of incoming tape
  - Full inspection of outgoing product
  - 500+ sensors in the line
  - 15 million plies / year
- Data Warehouse
  - 200 sensors connected
  - Data points + images
  - Ready for cloud-based data analytics





**Marcus Kremers - CTO**

**+31 6 21250007**

**m.kremers@airborne.com**

**airborne**