



# Integrated Manufacturing System - Welding solutions for Industry 4.0

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Pemamek oy

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# PEMAMEK

**Pemamek Ltd**, founded in 1970, is a Finnish family-owned company specialized in designing and manufacturing **welding and production automation solutions**.

**50**

**YEARS OF EXCELLENCE**

**260**

**EMPLOYEES**

**90%**

**EXPORT**



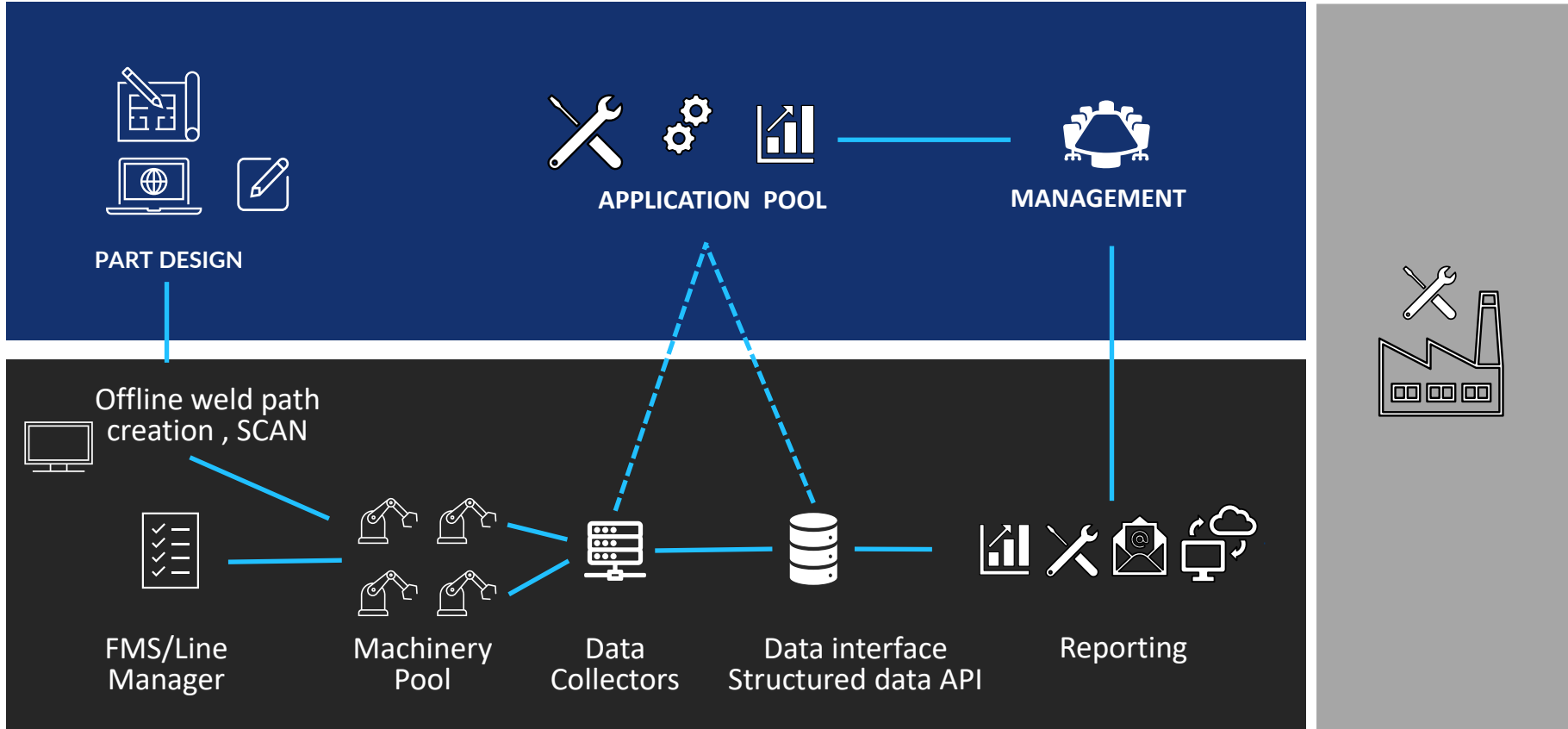
Worldwide **technology** partners:



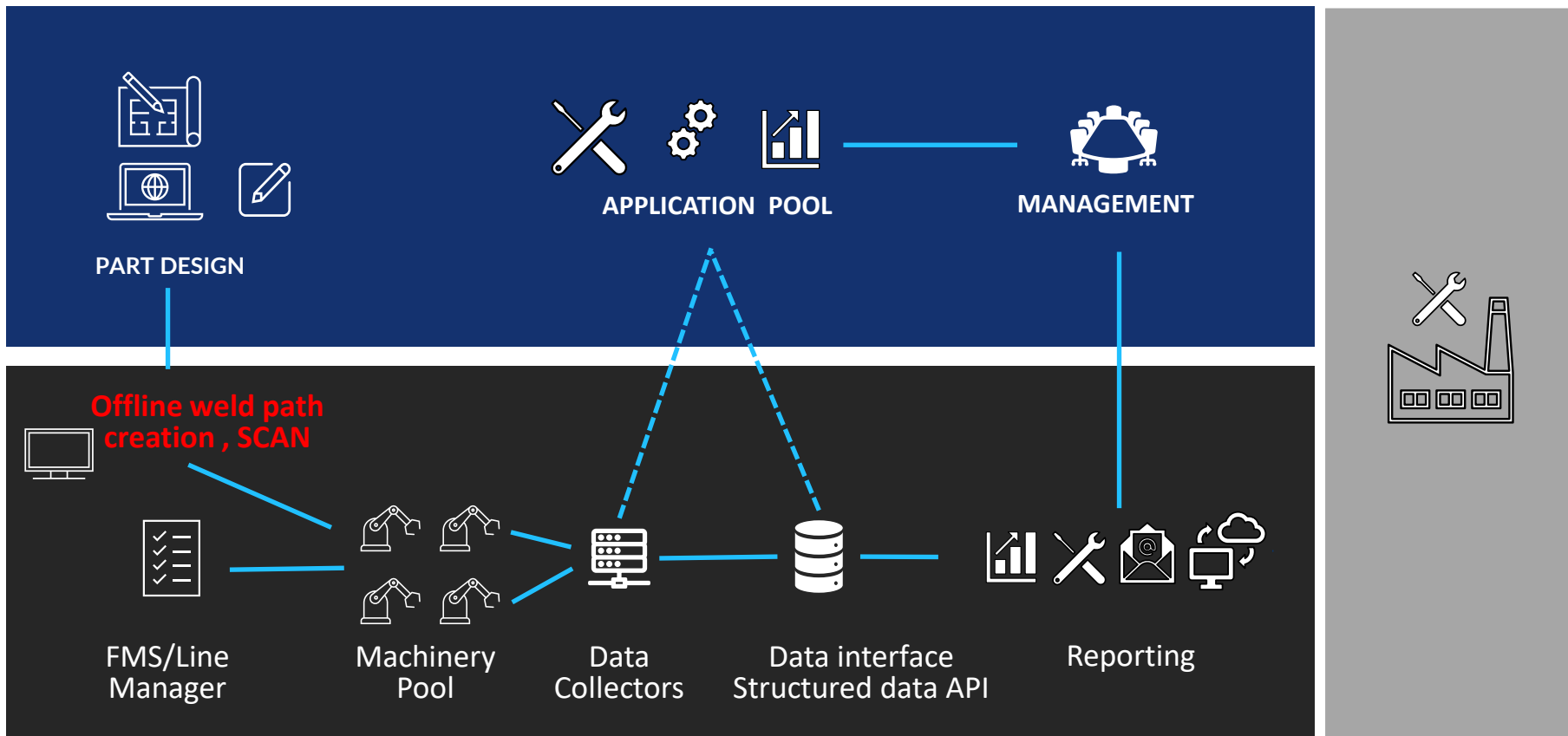
# INTEGRATED MANUFACTURING SYSTEM – INDUSTRY 4.0 IN ROBOTIC WELDING SOLUTIONS



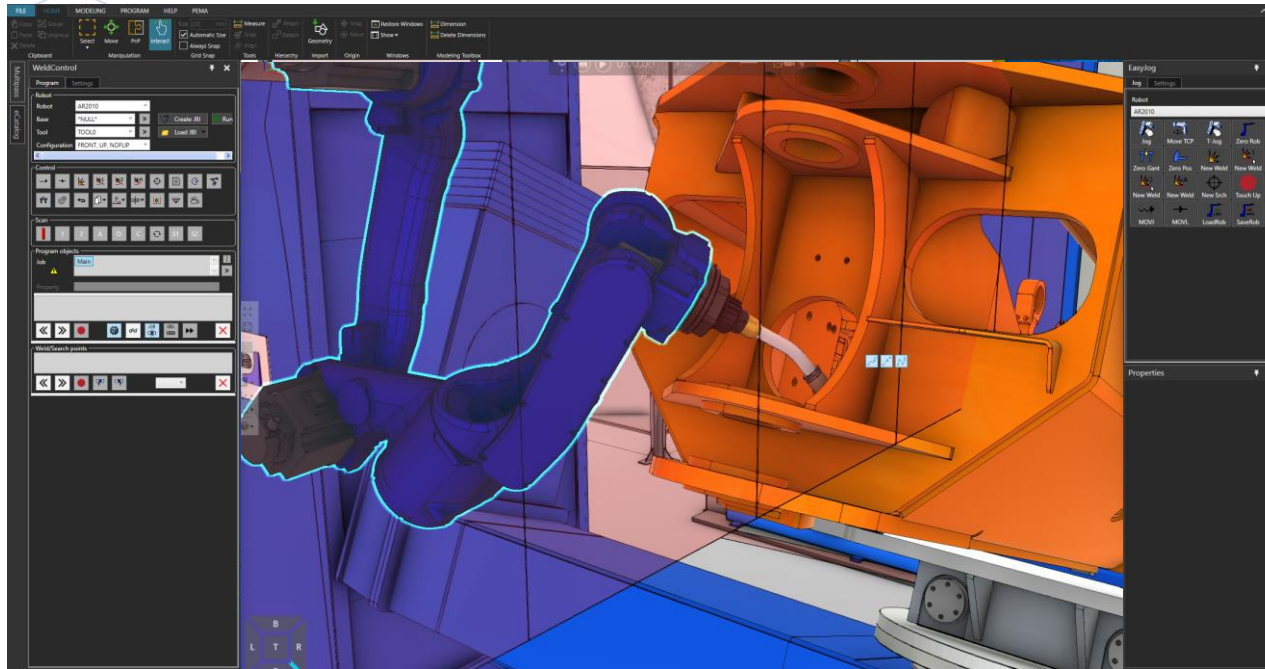
# PEMA SYSTEM ARCHITECTURE



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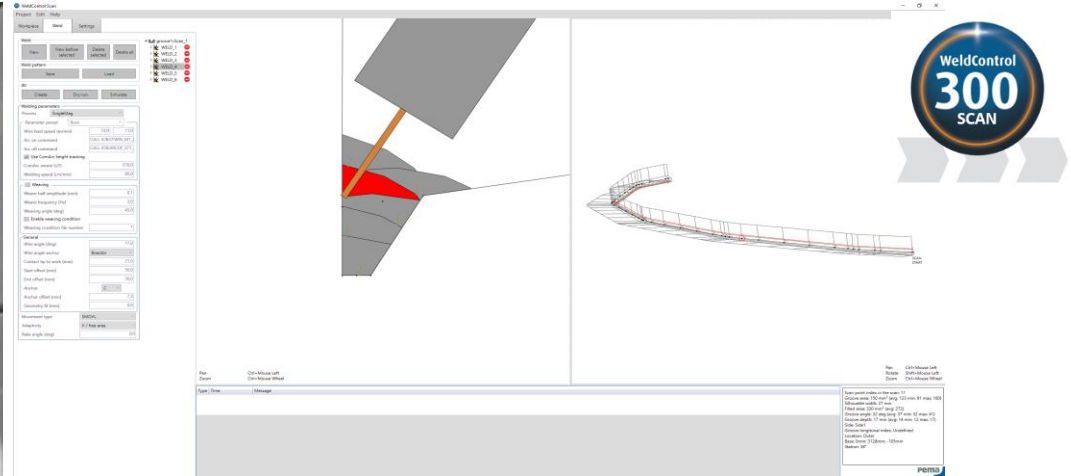
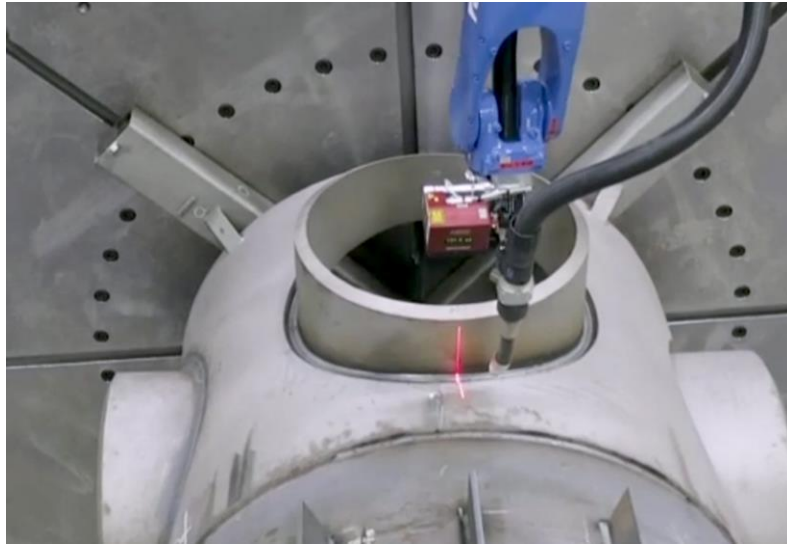


# OFFLINE WELD PATH CREATION - PEMA WELDCONTROL 300



1. 3D file imported
2. Weld paths created using
  - Copy, mirror and macro creation
  - Parametric path creation
  - Visual multi-layer weld tool
3. Simulation of the production and collision checking
4. Sending of weld path file to FMS/Line Manager

# PEMA WELDCONTROL SCAN

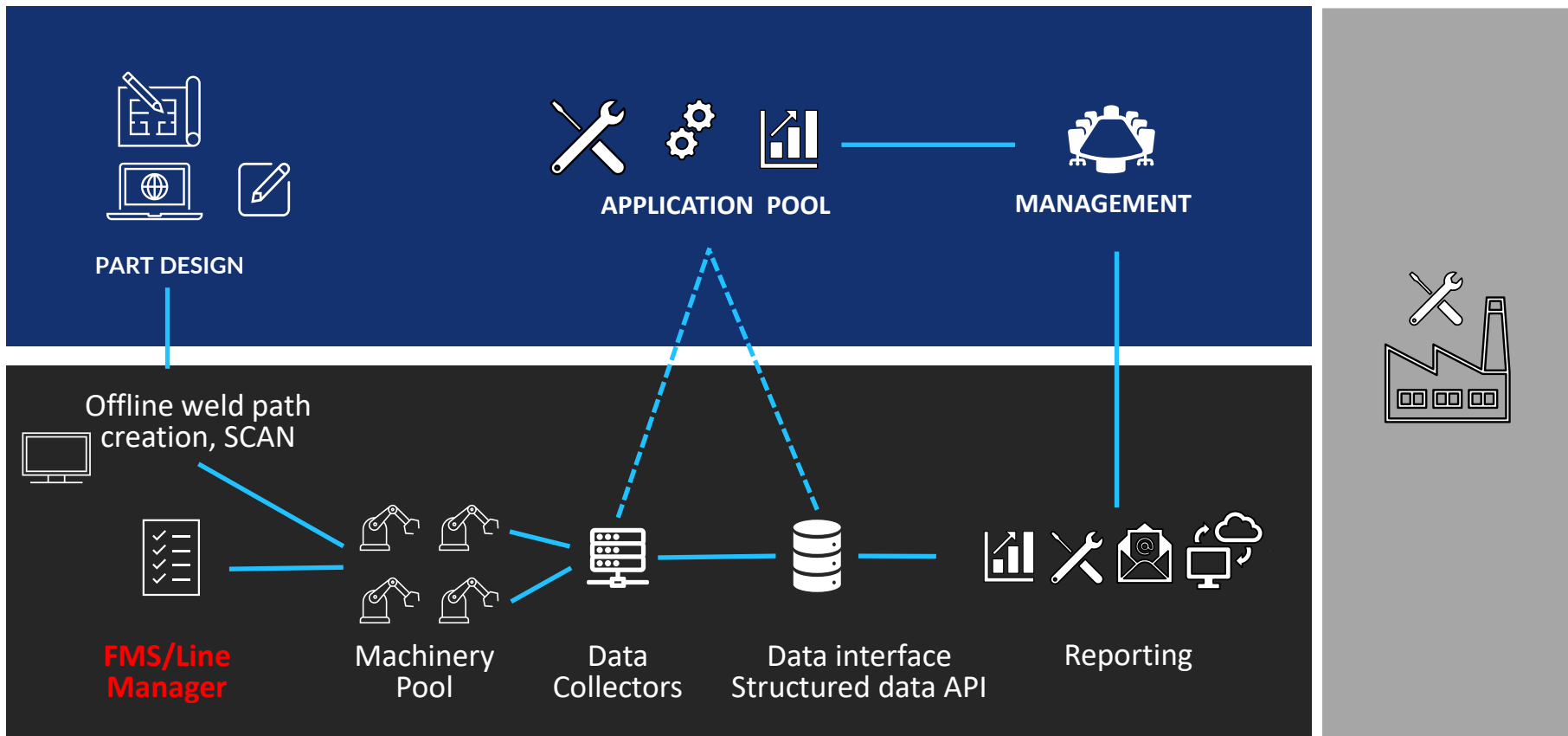


## Adaptive multi-pass welding where groove geometry and groove area varies

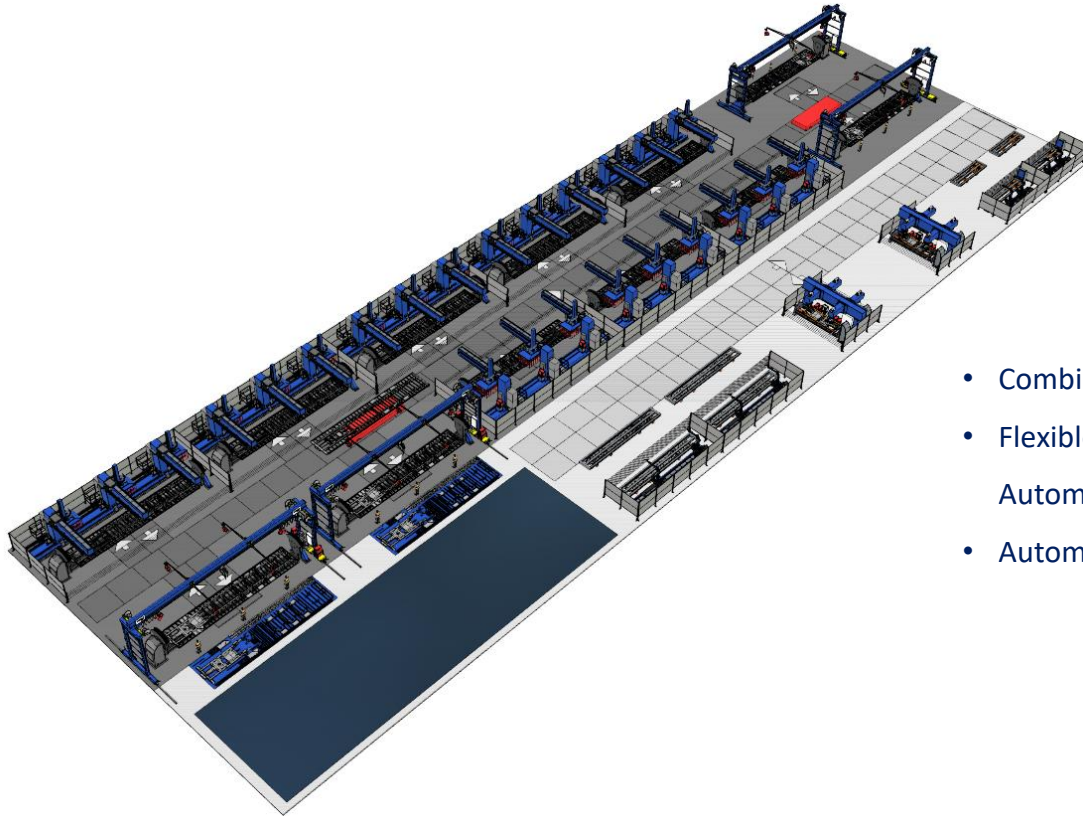
1. Scan path is programmed like creating a weld in offline weld creation
2. Groove is scanned with the laser
3. Adaptive multi-pass weld pattern is generated/fitted
4. File is sent to FMS/Line Controller



# PEMA SYSTEM ARCHITECTURE

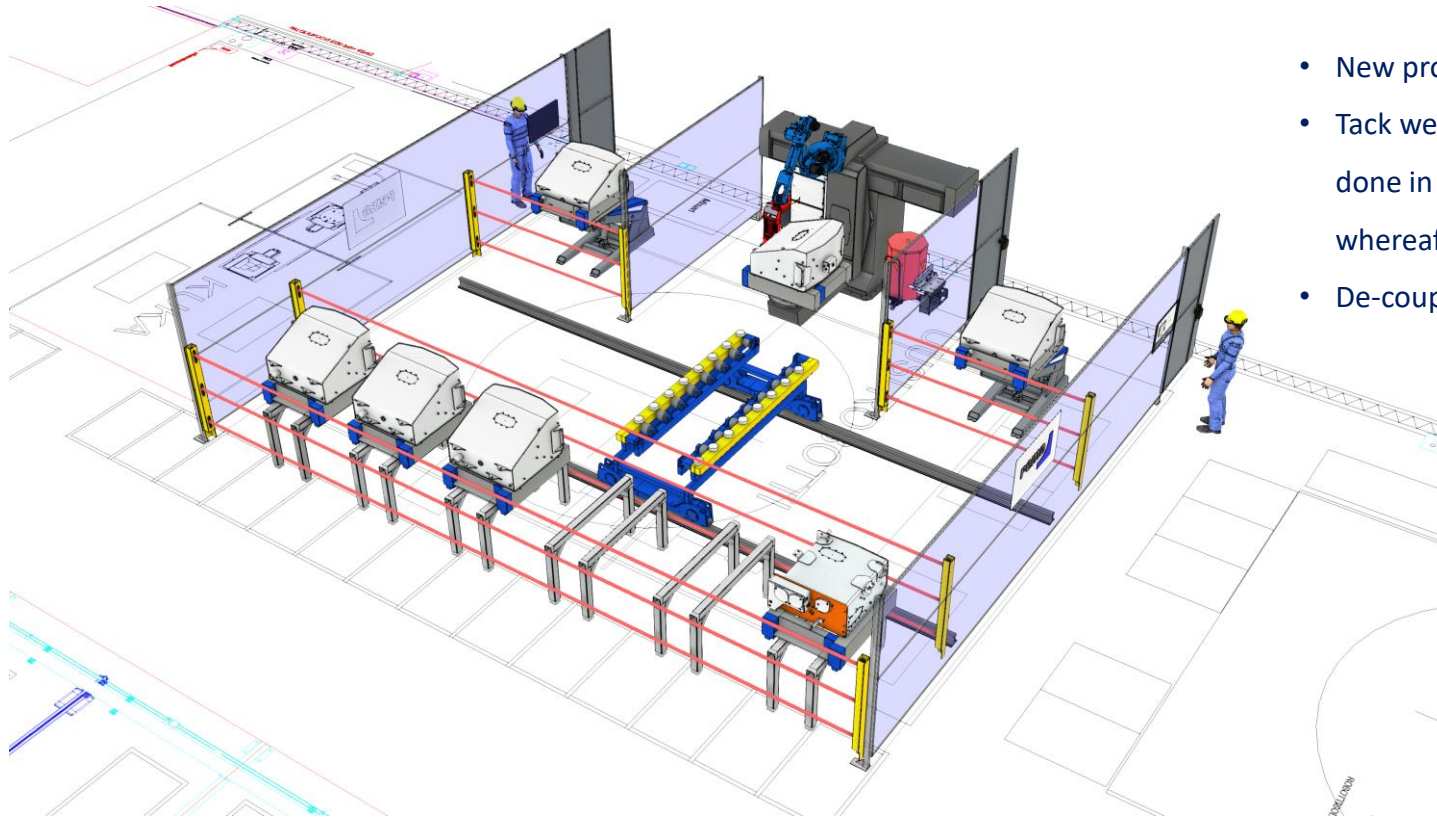


# FLEXIBLE MANUFACTURING SYSTEM - ROBOTIC WELDING OF TRAILER FRAMES



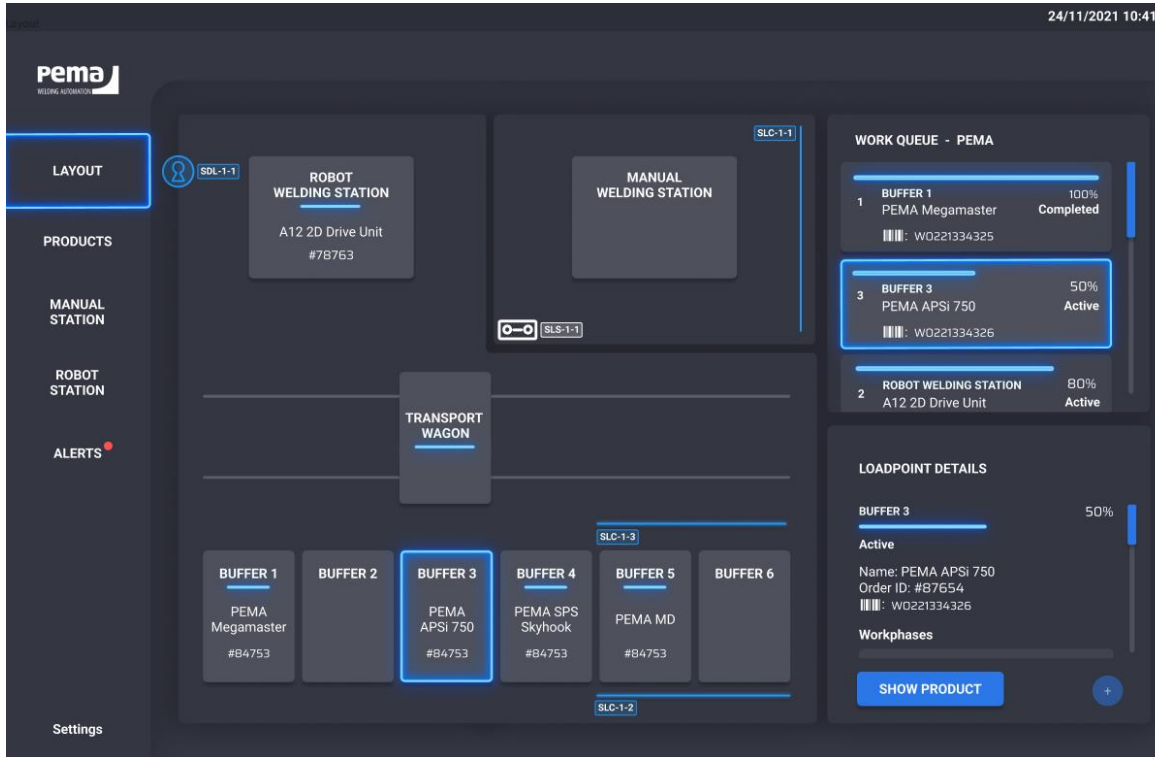
- Combination of fully automated and manual work areas
- Flexible routing of work pieces to available station with Automatically Guided Vehicle AGVs, with lifting function
- Automatic jigs at main welding stations

# FLEXIBLE MANUFACTURING SYSTEM, WITH TWO CELLS FOR MANUAL WORK STAGES



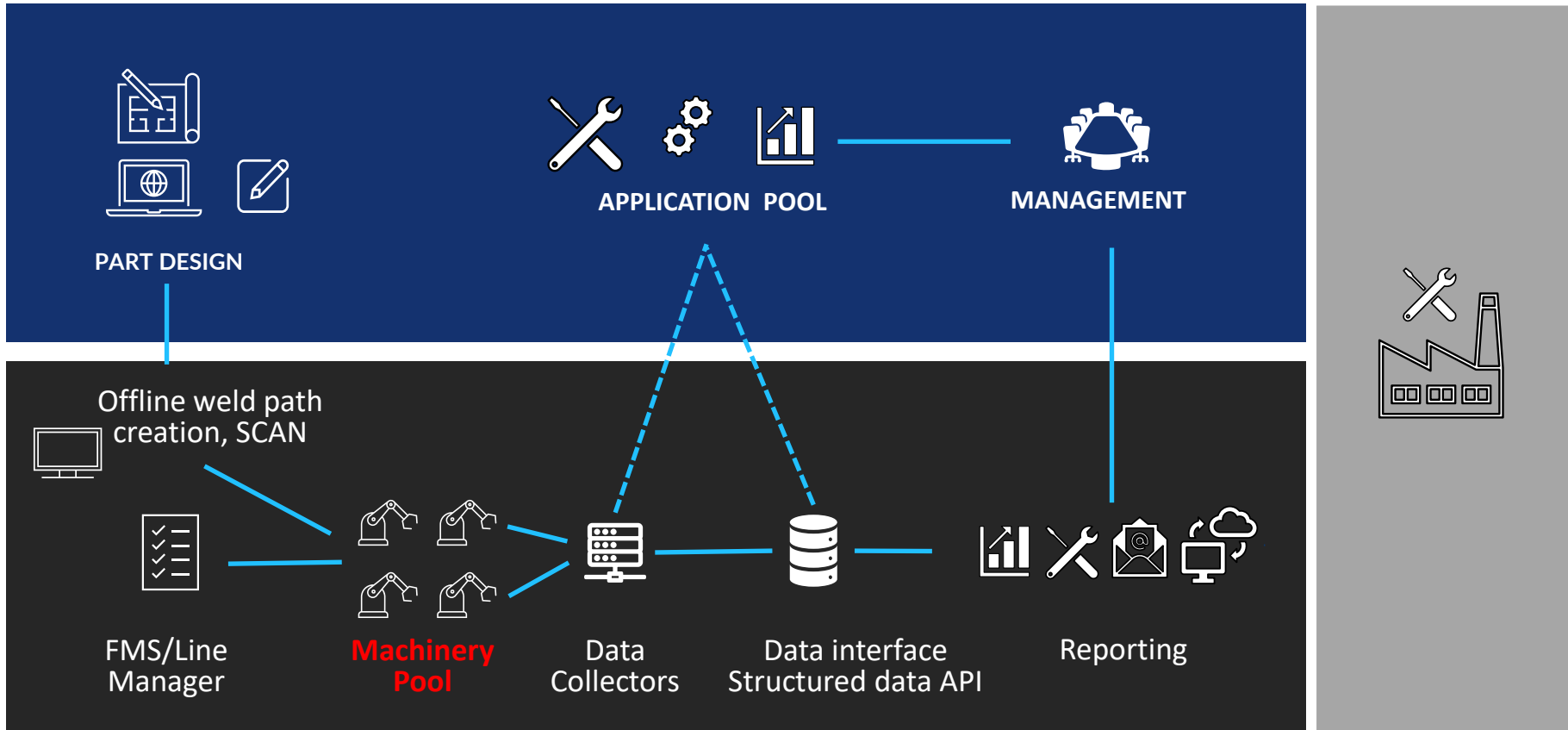
- New product to any buffer slot
- Tack welding and intermediate steps done in manual welding cells, whereafter returned to buffer
- De-coupled operation

# PEMA FLEXIBLE MANUFACTURING SYSTEM - FMS



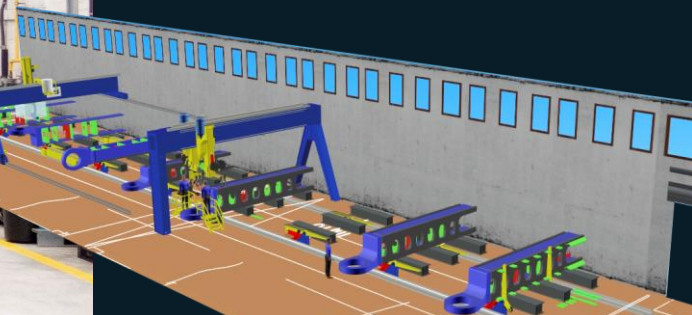
1. Each workpiece introduced to the line gets is identifier read by RFID, QR-code or similar
2. SW provides data to transport system that delivers workpiece to correct stations for processing as per product definition
3. FMS tracks all work phases and provides info of the states of items on the line
4. From layout view, operator can see overview of line and check items from single stations / buffer positions

# PEMA SYSTEM ARCHITECTURE

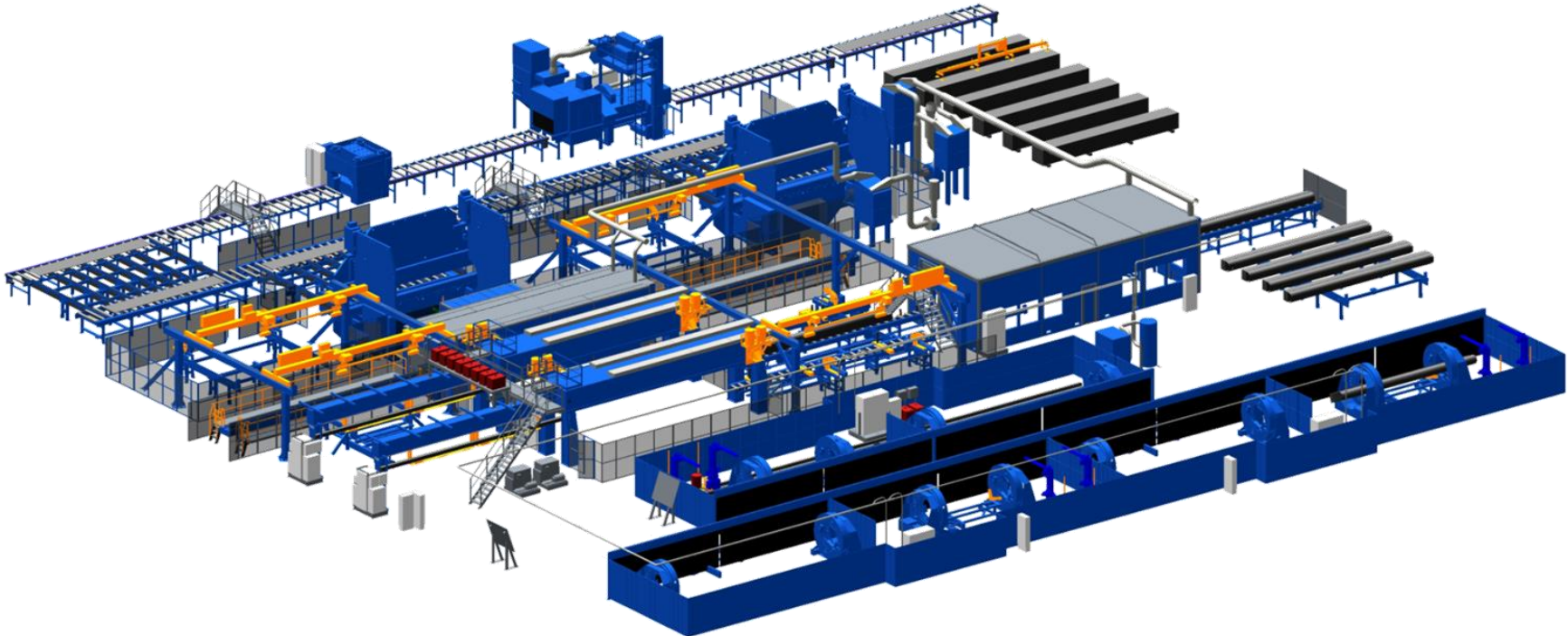


Production line for excavator  
track frame.

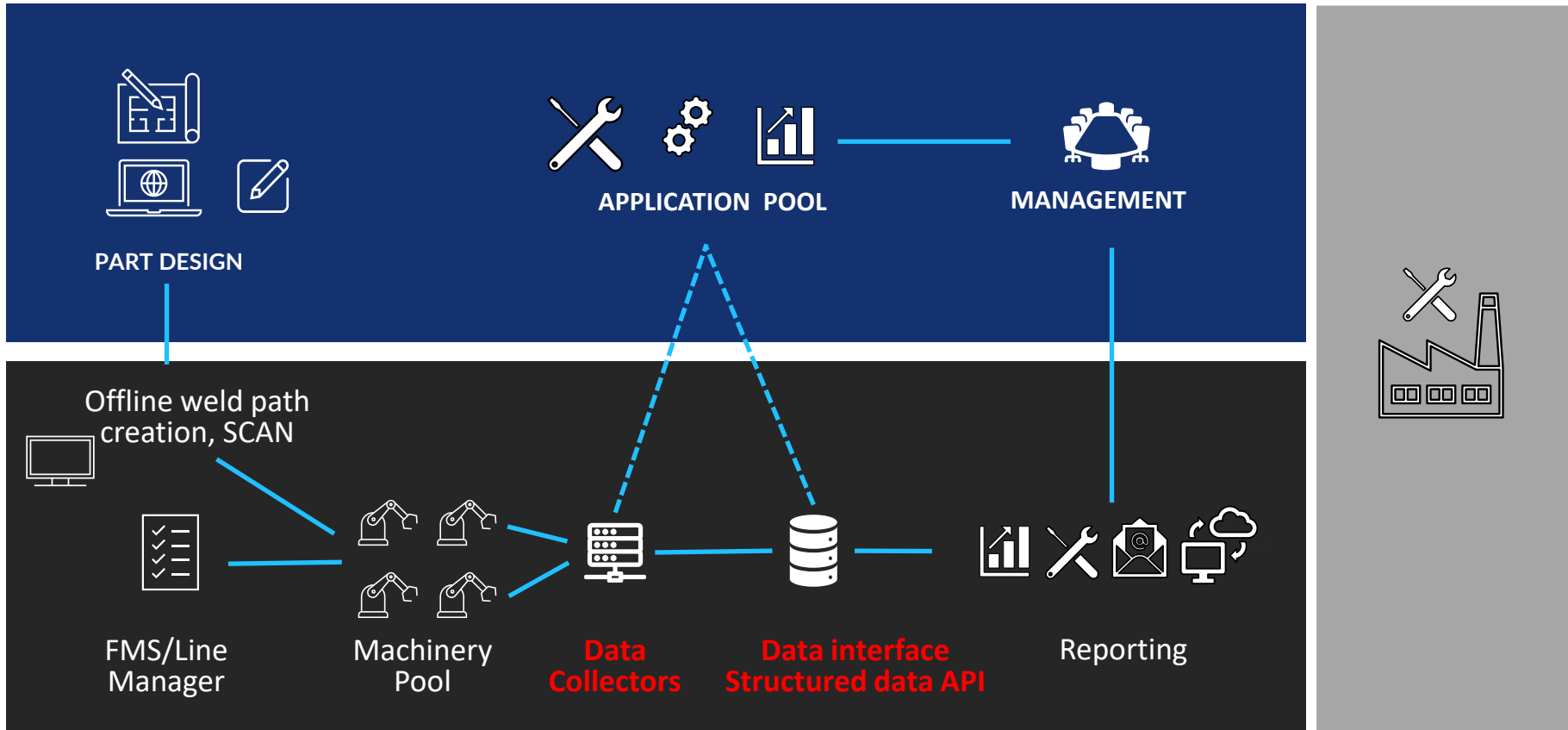
*Caterpillar Global Mining HMS GmbH,  
Germany*



# BOOM WELDING LINE

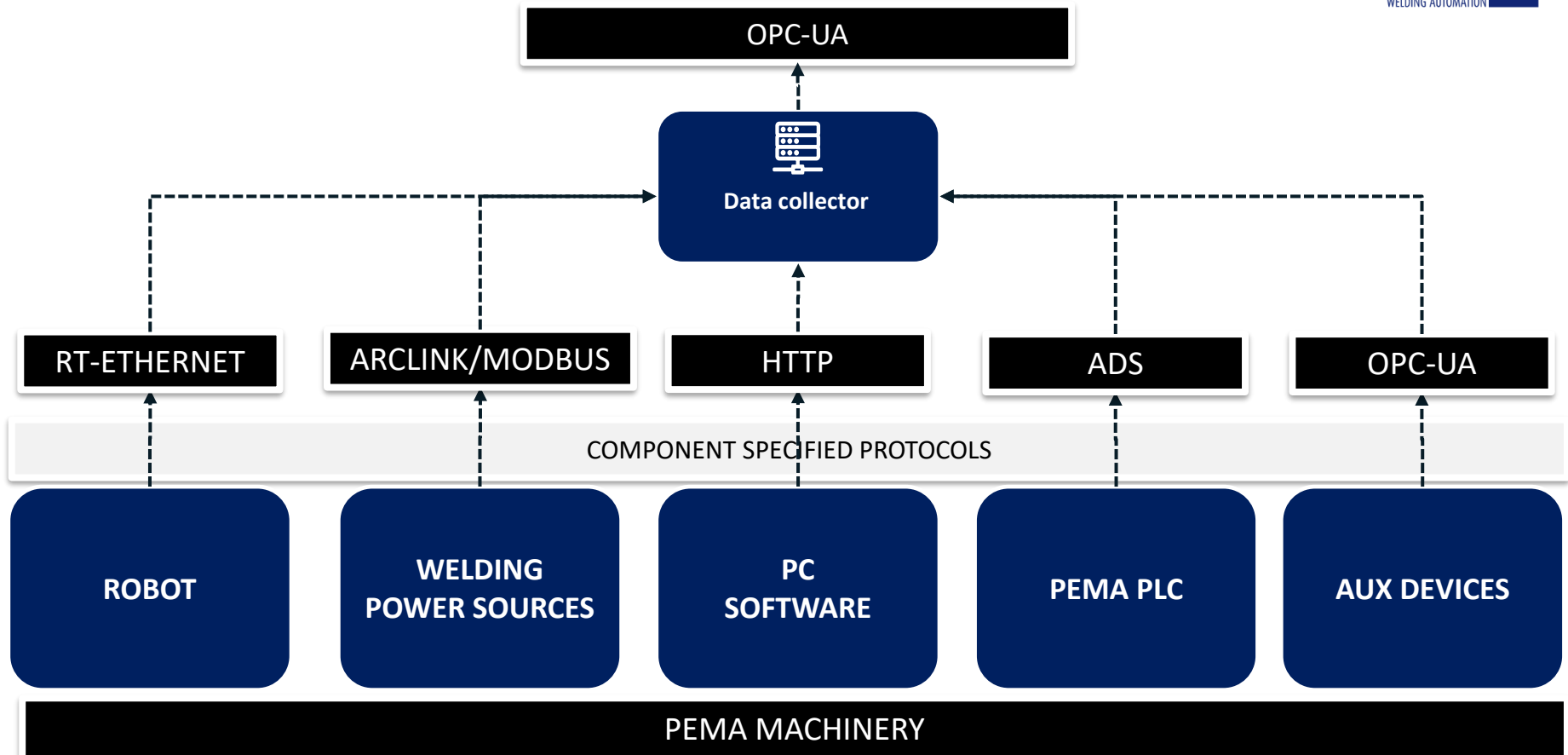


# PEMA SYSTEM ARCHITECTURE

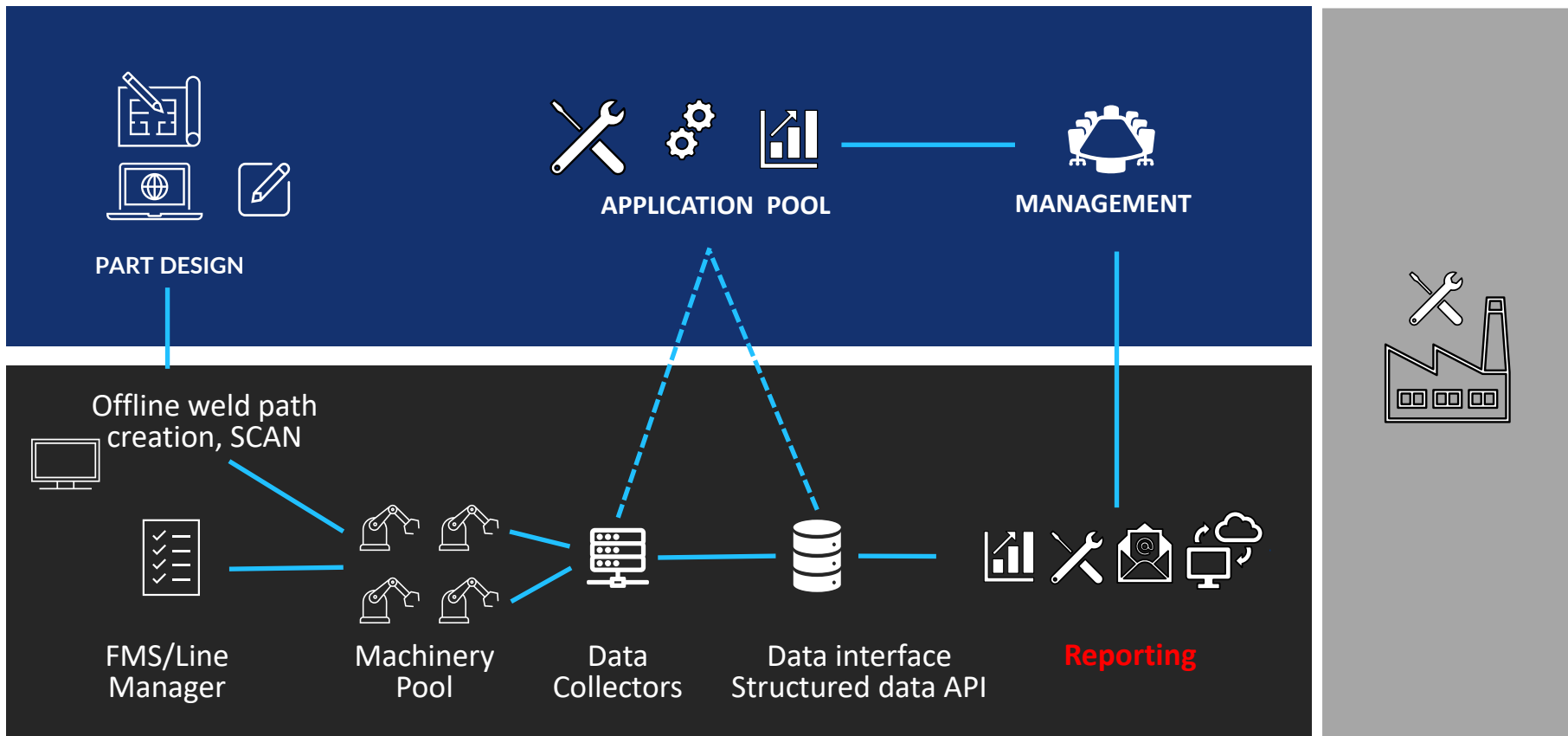




# PEMA DATA COLLECTOR



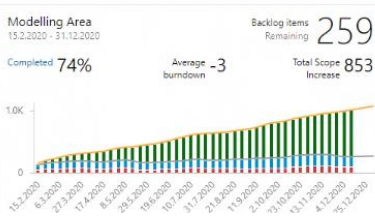
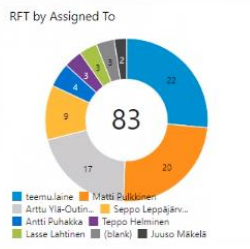
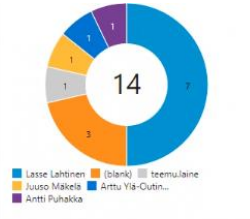
# PEMA SYSTEM ARCHITECTURE



# REPORTING – CUSTOMIZED DASHBOARDS

- Overview
- Summary
- Dashboards**
- Wiki
- Boards
- Repos
- Pipelines

ID	Title	Assigned To	State
1631	Rotating portal vertical welds need refining in short (<150mm) weld departure	teemu.laine	Ready For Testing
3007	Meyer: Alternative 4P search for insert outer welds		Approved
3266	Localization integration		New
3628	Vertical welds rake angle fix	teemu.laine	Ready For Testing
3632	Fine-tune gantry collision-free area for horizontal cutoff welds	teemu.laine	Ready For Testing
3983	RakeAngle in top corner collides if parametric boxing is turned on for bottom cor...	teemu.laine	Approved



- Productivity and efficiency monitoring
- Welding data
- Production and product tracking Traceability
- Utilization monitoring
- Maintenance
- Error diagnostics

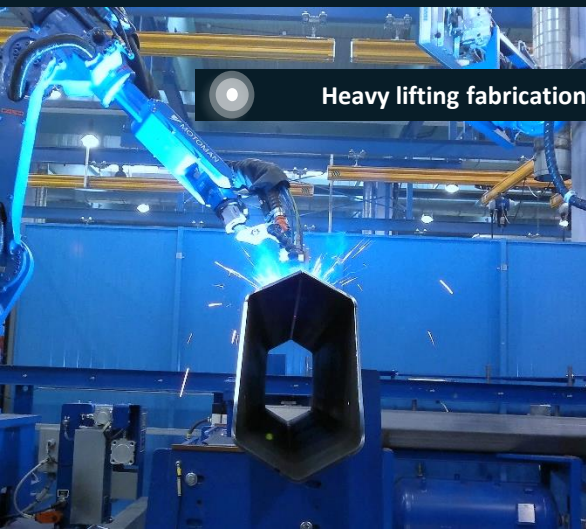
# REPORTING - WELDING DATA

<b>Time</b>	2012-02-06 16:00:20					
<b>WPS nro</b>	2	<b>Duration</b>	13s			
<b>WPS name</b>	antti	<b>Length</b>	344mm			
<b>PW</b>	<b>Procedure</b>	CC Square Wave				
1	<b>Setpoints</b>	<b>CURRENT</b>	<b>VOLTAGE</b>	<b>DC_OFFSET</b>	<b>BALANCE</b>	<b>FREQUENCY</b>
		900.0	29.0	0.0	50.0	40.0
	<b>Measurement</b>	<b>Current</b>	<b>Voltage</b>	<b>WFS</b>	<b>Heat Input</b>	<b>Deposition Rate</b>
		745.2 A	31.7 V	2.4 m/min	0.9 kJ/mm	14.1 kg/h
	<b>Monitoring</b>	<b>Tolerance</b>	<b>Out Of Range Lo</b>	<b>Out Of Range Hi</b>	<b>Peak Lo</b>	<b>Peak Hi</b>
		<b>CURRENT</b>	5.0%	0.0s	0.0s	884.7
	<b>VOLTAGE</b>	5.0%	0.0s	0.0s	28.5	29.3
<b>PW</b>	<b>Procedure</b>	CC Square Wave Twin				
2	<b>Setpoints</b>	<b>CURRENT</b>	<b>VOLTAGE</b>	<b>DC_OFFSET</b>	<b>EMPTY</b>	<b>EMPTY</b>
		850.0	33.5	0.0	0.0	0.0
	<b>Measurement</b>	<b>Current</b>	<b>Voltage</b>	<b>WFS</b>	<b>Heat Input</b>	<b>Deposition Rate</b>
		741.6 A	32.5 V	2.3 m/min	1.0 kJ/mm	4.9 kg/h
	<b>Monitoring</b>	<b>Tolerance</b>	<b>Out Of Range Lo</b>	<b>Out Of Range Hi</b>	<b>Peak Lo</b>	<b>Peak Hi</b>
		<b>CURRENT</b>	10.0%	0.0s	0.0s	842.4
	<b>VOLTAGE</b>	10.0%	0.0s	0.0s	31.7	33.9

Recognize potential product defects based on realized process parameters allowing areas for improvement to be identified and appropriate measures to be taken.

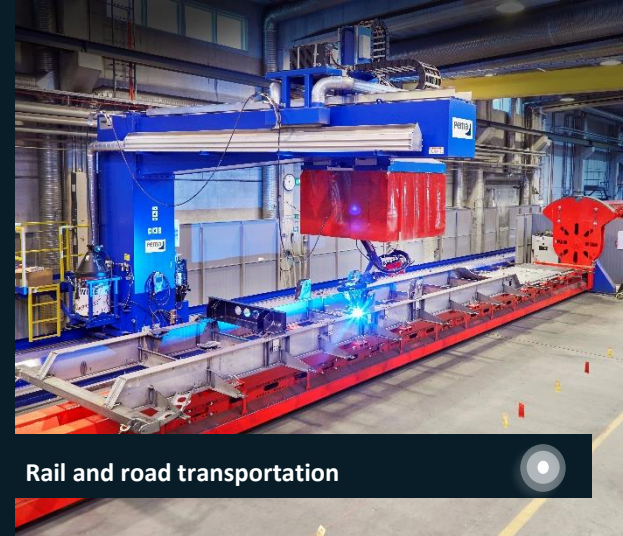


Truck trailer production

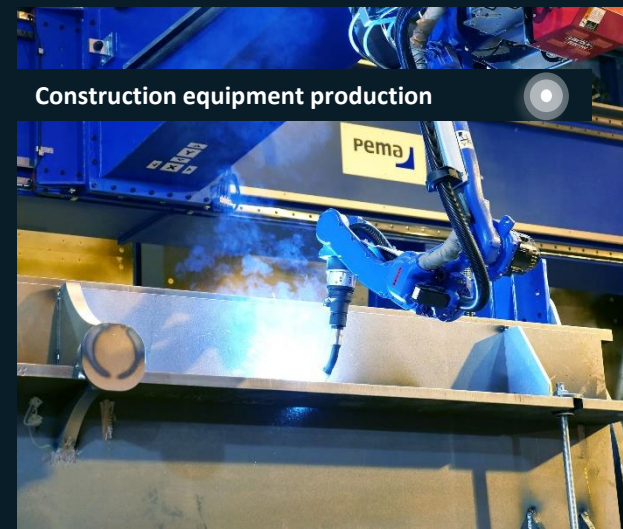


Heavy lifting fabrication

## - Industry 4.0 - Connecting people and machines in stand alone manufacturing cells



Rail and road transportation



Construction equipment production

# CONNECTING PEOPLE AND MACHINES

**Pema**  
WELDING AUTOMATION

Industry 4.0 - what it means for stand alone manufacturing cells



Full digital control over the entire automation



Numerous functions, One operator

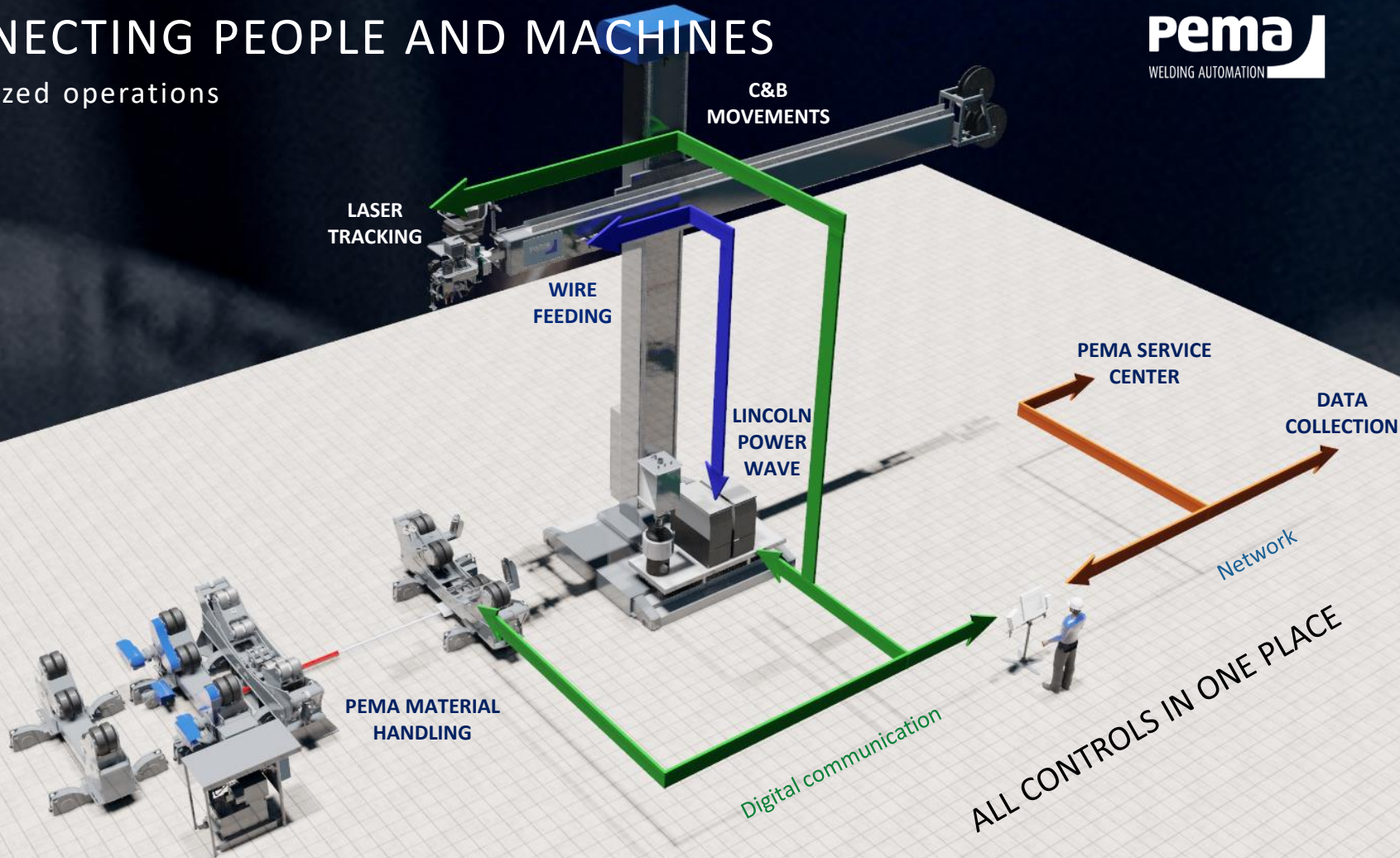


Data monitoring, diagnostics & tracking

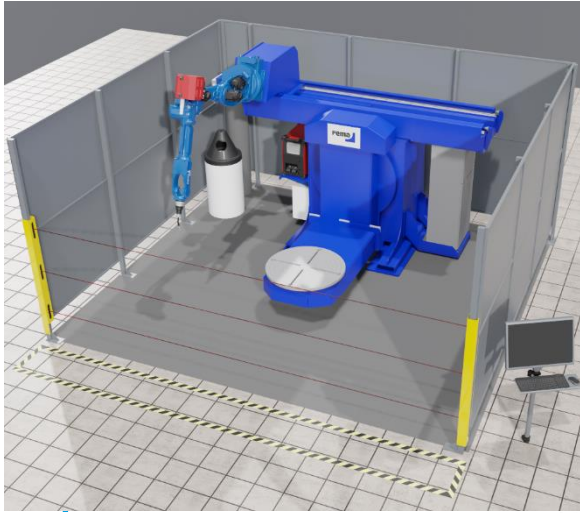


# CONNECTING PEOPLE AND MACHINES

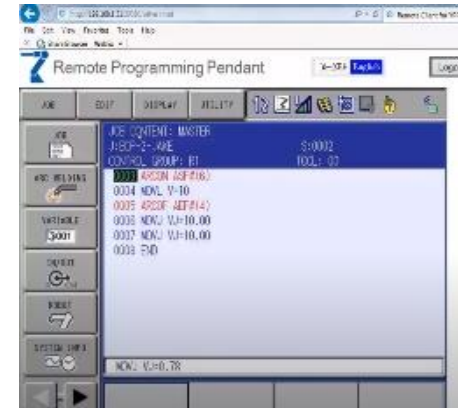
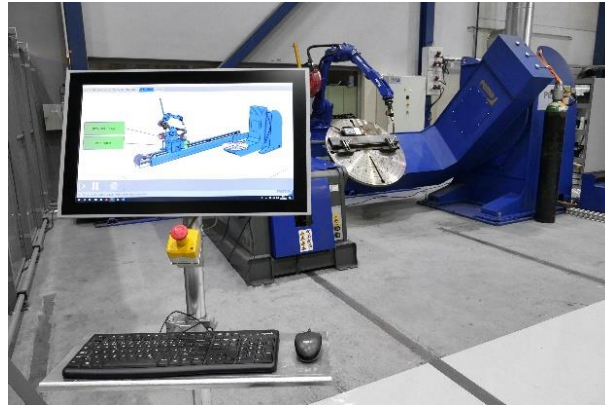
Centralized operations



# CONNECTING PEOPLE AND MACHINES - ROBOTIC CELL(S)



- Control panel integrates all functions of robotic cell(s) to one interface
- Remote connection to cell control through VPN  
→ enabling effective robotic help desk support
- Run robot programs from touchscreen interface
- Job lists and job order for robot(s)
- Production data monitoring, faults, error codes and status, SMS-messages
- Back-up of robot co-ordinate info
- Yaskawa Remote Pendant –interface
- Web access to welding power source





# Make More.

@PEMAWELDING



THE WELDING AUTOMATION COMPANY.

