# Salzgitter Mannesmann Renewables GmbH

## Nodes and Components for the Offshore Wind Jacket Industry

SALZGITTER MANNESMANN RENEWABLES

A Member of the Salzgitter Group

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# Central Business

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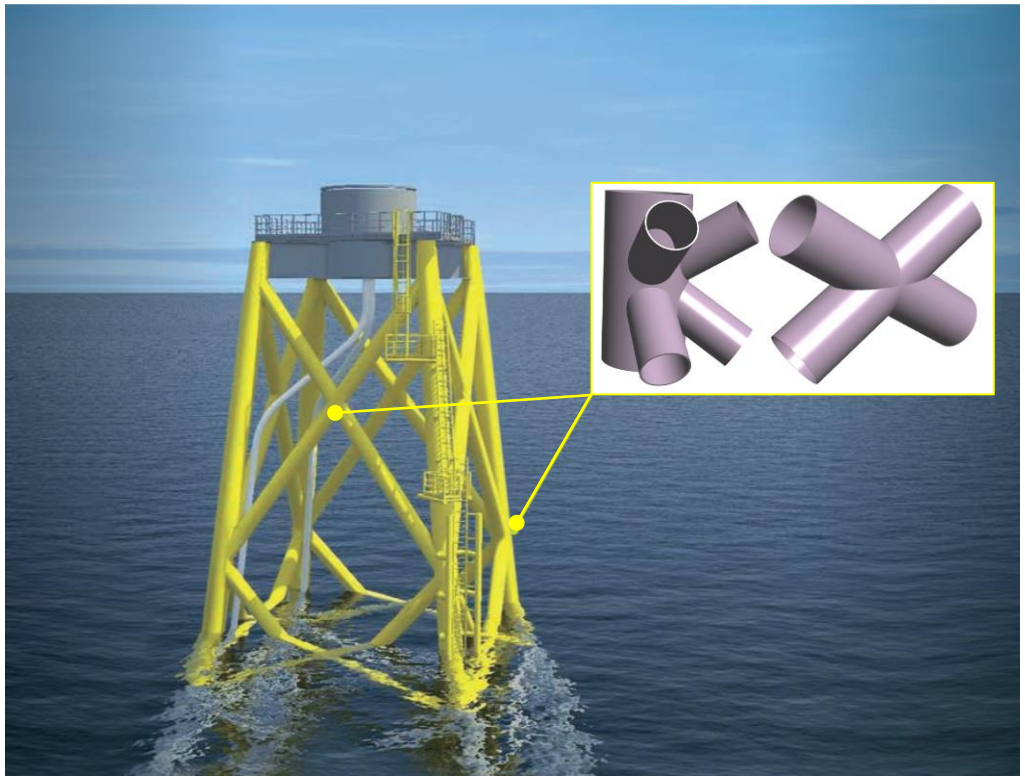
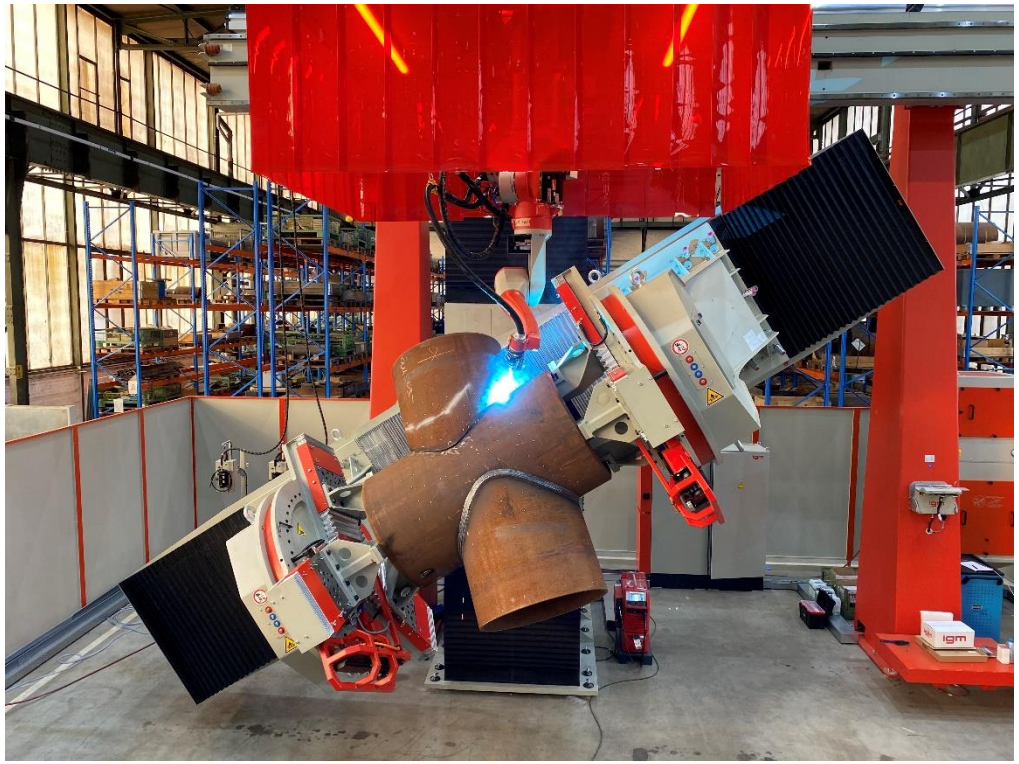
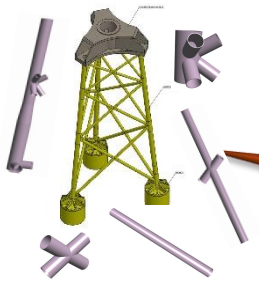
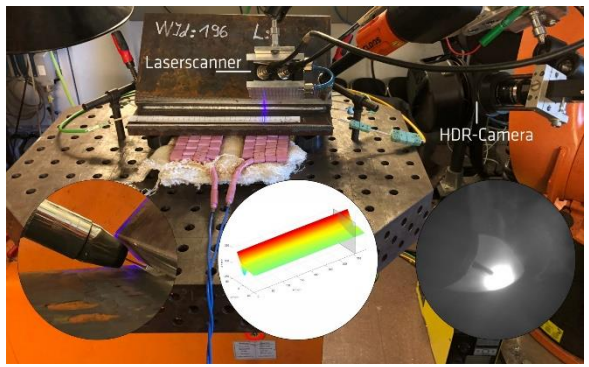




**Salzgitter Mannesmann Renewables - Developer of a Technology for Robotized Node Production for OW Jackets**
**Supplier of Robotic Welded Steel Nodes for Offshore Jackets and Consultant towards Robotic Node Welding**

# History + Outlook






**2016**
- development of Salzgitter supply chain concept incl. robotized node welding
- start technical / commercial validation procedure

**2019**
- investment decision towards robot welding cell for node production

**2020**
- Installation of robot welding in Duisburg, D
- Continuation of technical development, coop. with Salzgitter Mannesmann Forschung

**2021**
- Start of public funded SmartWeld project
- fabrication of 15 nodes till 2023

**Q4/2022**
- JACO Project: semi-commercial fabrication of 3 full scale nodes

**2024**
- first commercial fabrication of nodes for jackets

***Commercial Fabrication of Nodes for on/offshore Jackets + Consulting of Jacket fab. towards node fabrication***

# Salzgitter Supply Chain Concept

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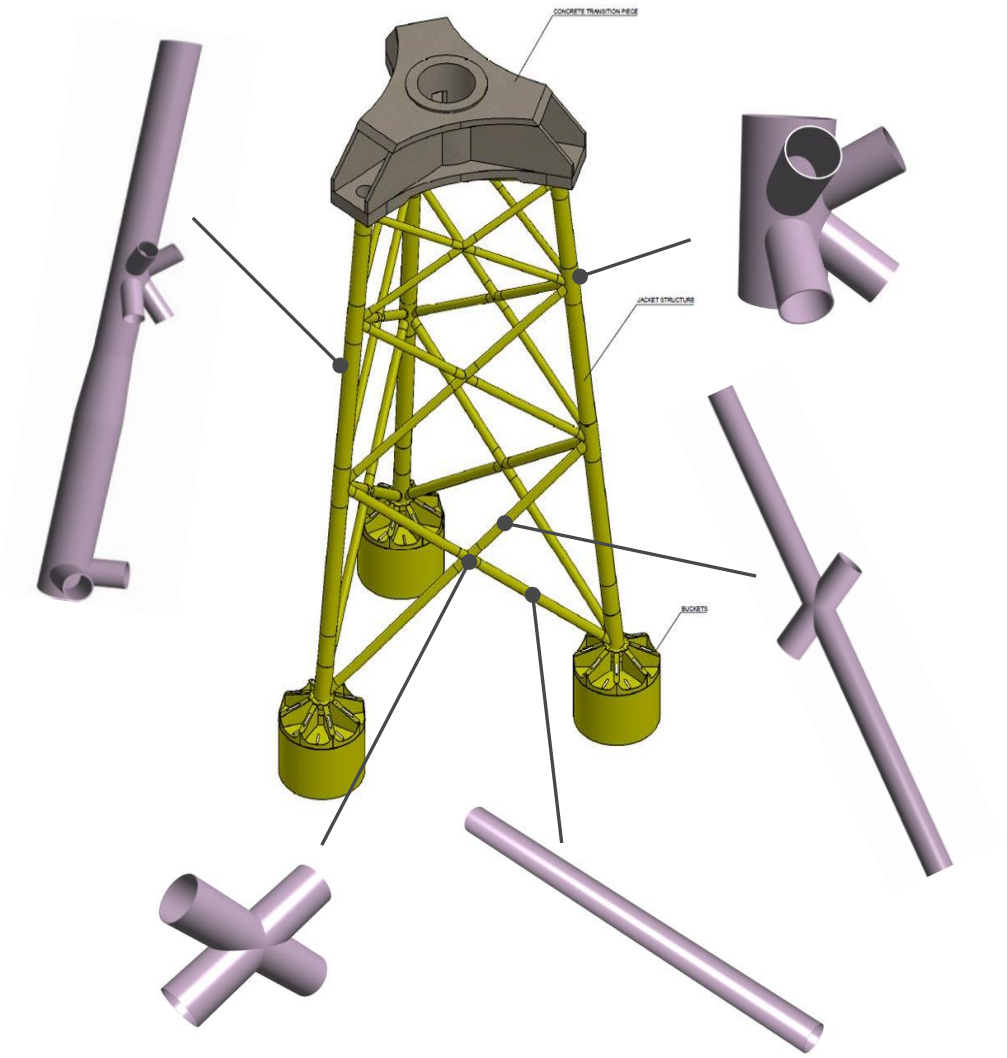
**Supply of component kid composed of**

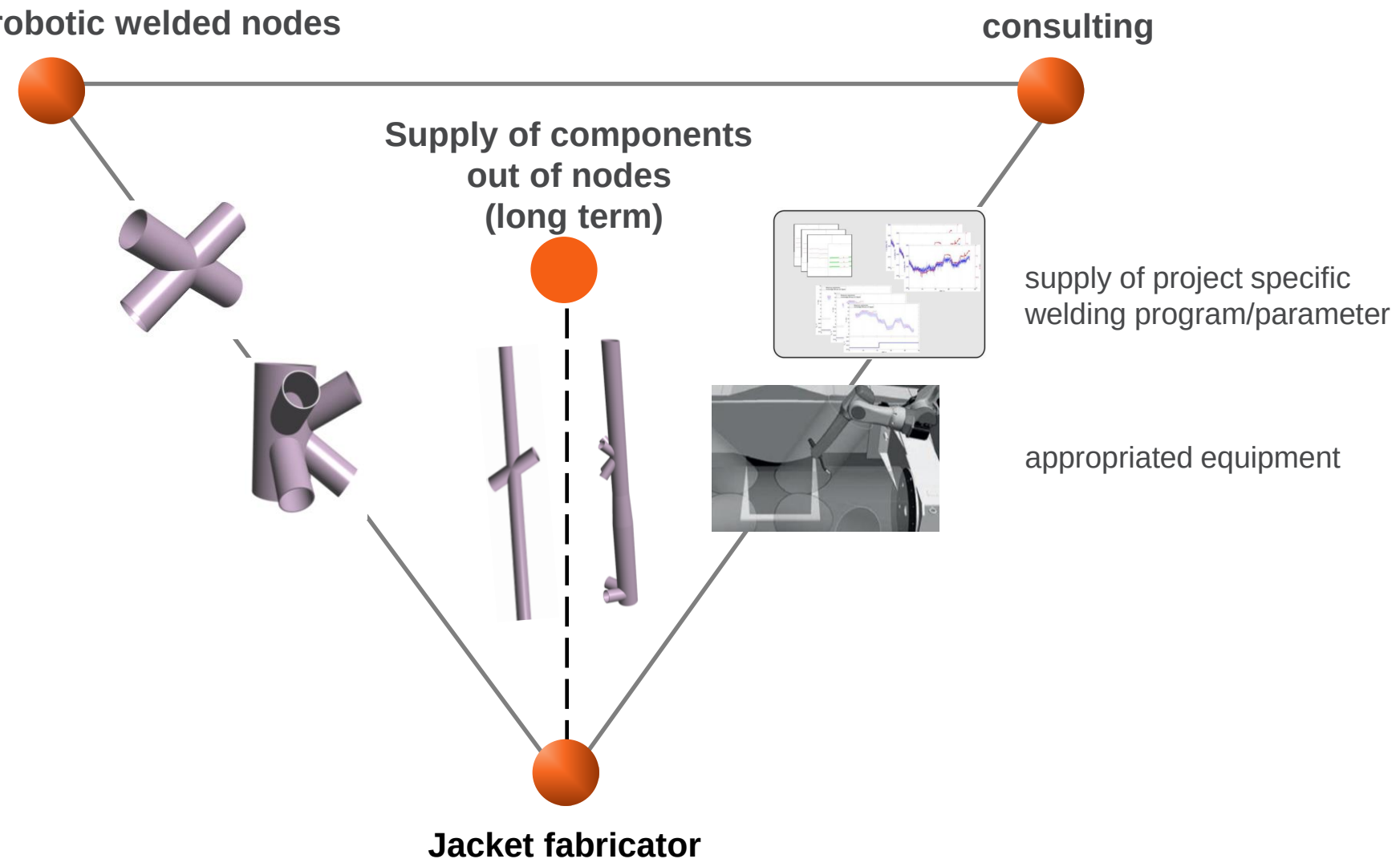
- Standardized, mass-produced tubes (based on pipeline application)
- K, Y, X - nodes prefabricated with robots
- Components out of nodes

**Benefits**

- Reduction in material cost for tubes
- Increasing automation within jacket fabrication
- reduction of complex welding work → only circumferential welds
- components out of nodes reduces assembly time at Jacket fabricator yard



# Busines model



# Equipment

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- Node fabrication cell consists of manipulator, 6-axis robot and safety equipment

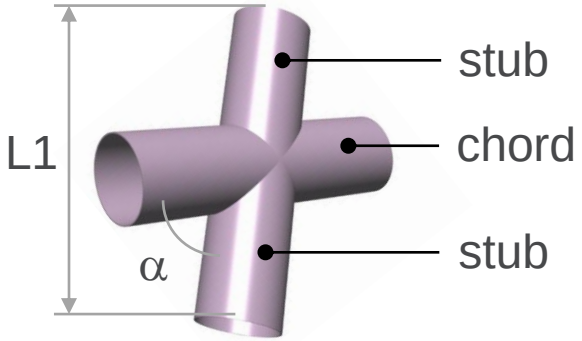
- Manipulator designed for nodes
  - to be welded always in PA/1G
  - up to 6.5 t
  - Cord OD 550 mm – 1200mm

  - Robot designed for
    - Inside welding for stubs from OD 600mm to 1200 mm
    - single arc welding

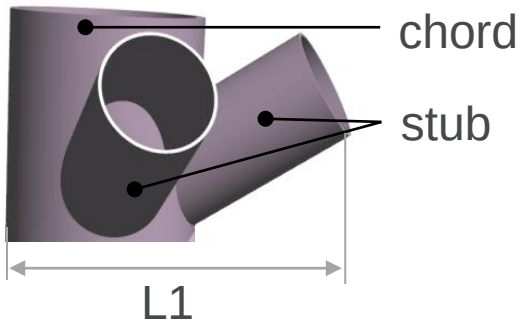
# Production range

– Equipment suitable for X and Y node fabrication

X Nodes




Y Nodes




– Node weight: up to 6.5 t
– Chord OD 550mm – 1300 mm
– Cord length: 1000mm – 3100 mm
– L1: 3100 mm
– α (stub to chord angle): 45° to 90°

# Robotic vs manual welding

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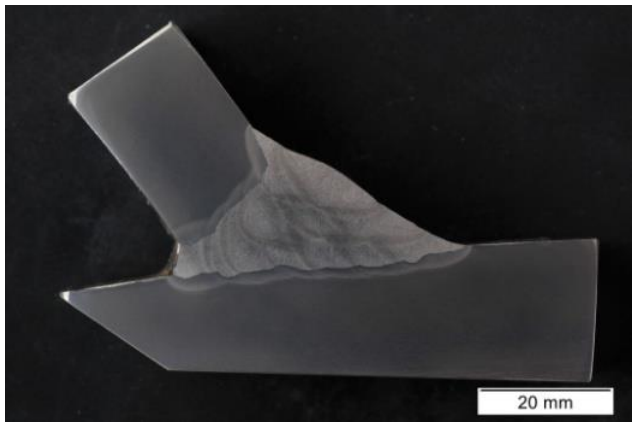
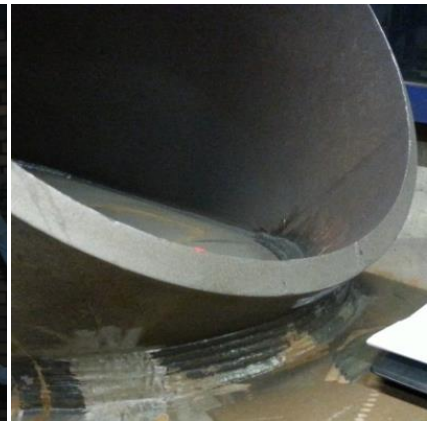
## Robotic welding

- Cord 1219 brace 610x20mm
- Heat input 1.2-1,8 kJ/mm, weaving bead
- Solid wire 1.2 mm
- Deposition rate at duty cycl. 0.6 → >3.0 kg/h
- Production time per stub after fitting: **90 min**

## Manual welding

- Cord 1219 brace 610x20mm
- Heat input 1.0 kJ/mm / Stringer beads
- Solid wire 1.2 mm
- Deposition rate at duty cycl. 0.6 < 1.0 kg/h
- Production time per stub after fitting: **400 min**

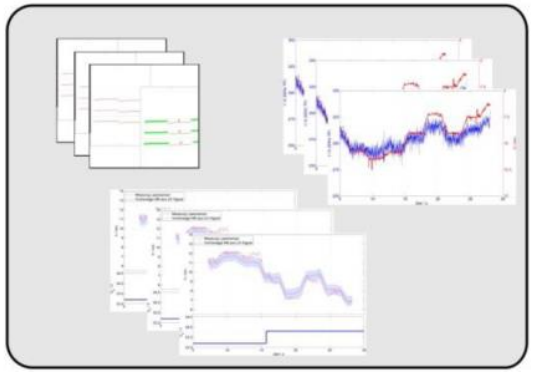


**Reduction in welding time by > 70% is archievable**

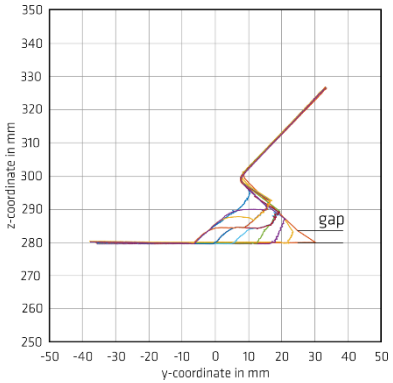
# Developments - fully mechanised welding

Measurement of seam preparation with laser scanner



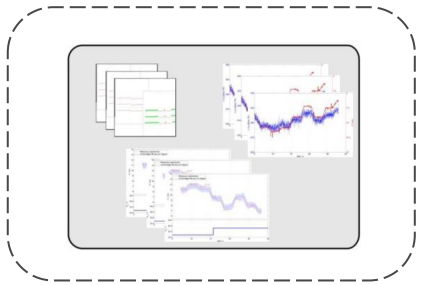
computing of weld parameter

welding of filling passes



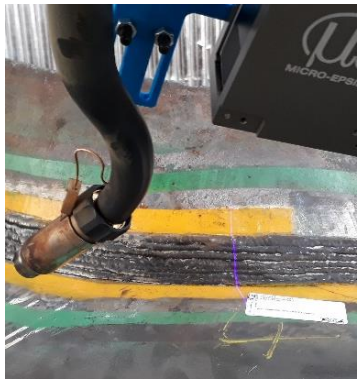

laser measurement of remaining filling volume

**target-actual comparison of filling volume**

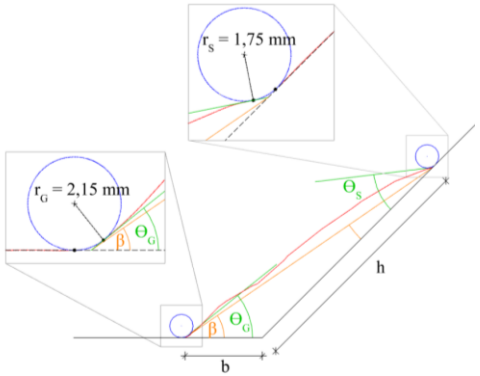


adaption of welding parameter (if necessary)

welding of filling/cap passes



measurement of weld geometry + node geometry tolerances




computing of notch radii

# Fabrication example