Simplifying AHSS Roll Forming

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Dr. Cornelia Tepper

Head of Innovation & Business Development

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What is Roll Forming?

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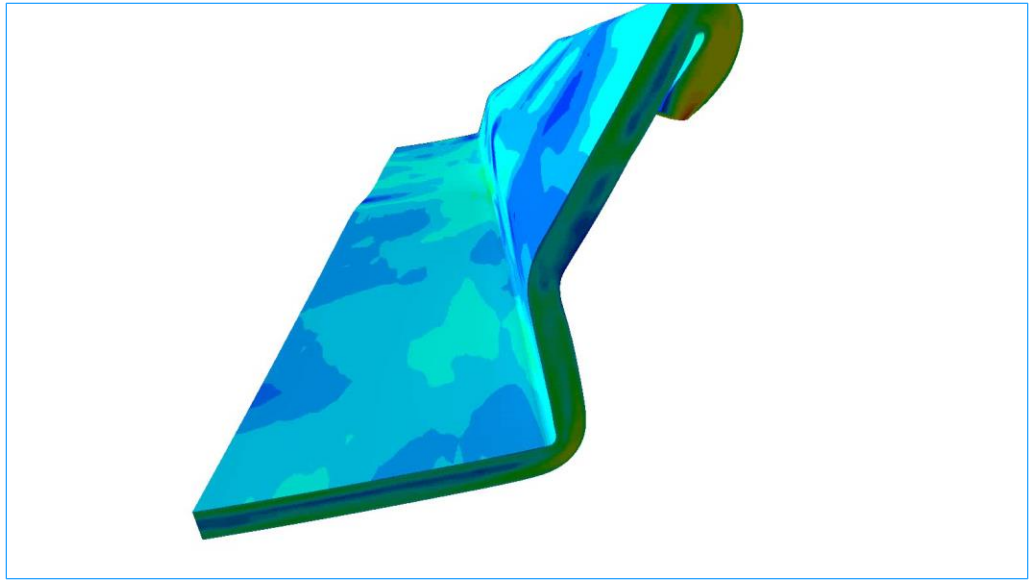

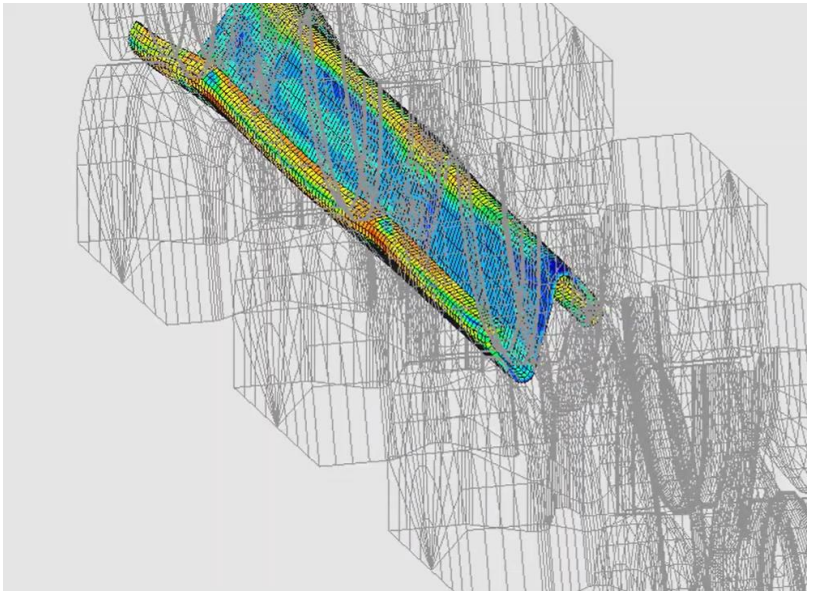

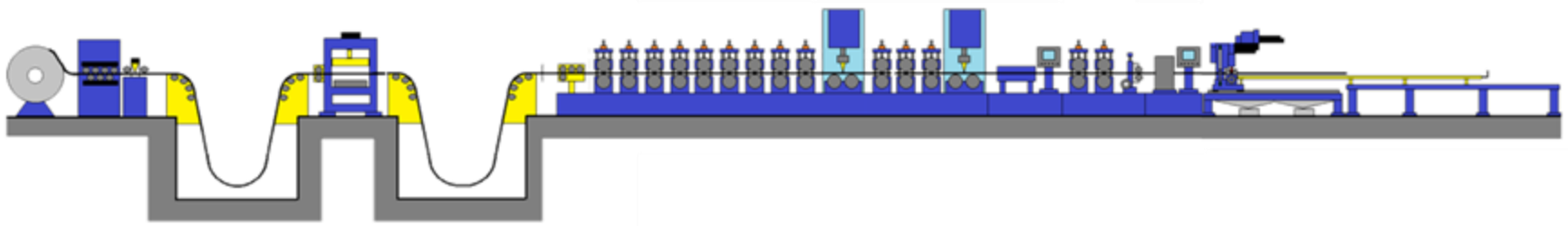

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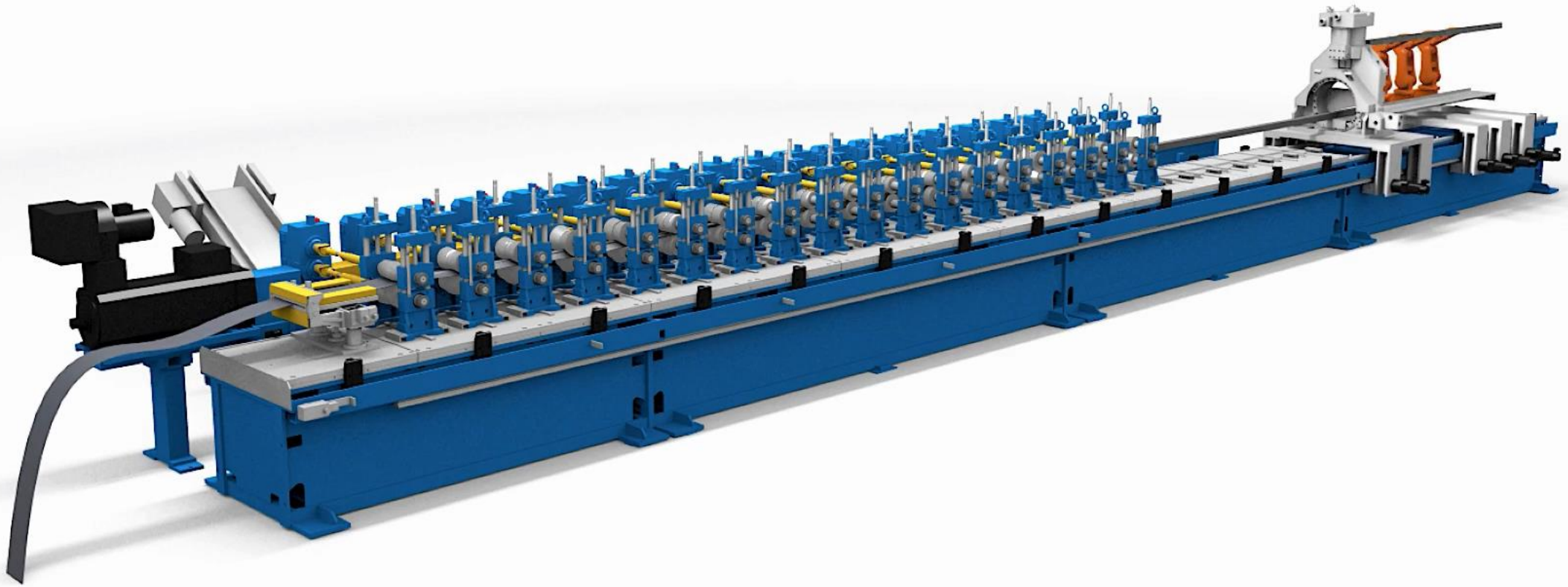

Advantages of Roll Forming

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Material efficiency

High material utilization, low energy input

- Cold forming at ambient temperature
- No heating or cooling required
- Scrap only from punching and cutting processes

Low Part Cost

Low part cost for high volume output

- High output rate
- Cost efficient Process
- Cost per piece only marginally higher than price for raw material

Process flexibility

Easy Process Adjustment to adjust for variation of forming properties

- Value adding through integration of:
  - Punching
  - Embossing
  - Welding
  - Foam filling
  - Bonding.

Roll Forming UHSS/AHSS

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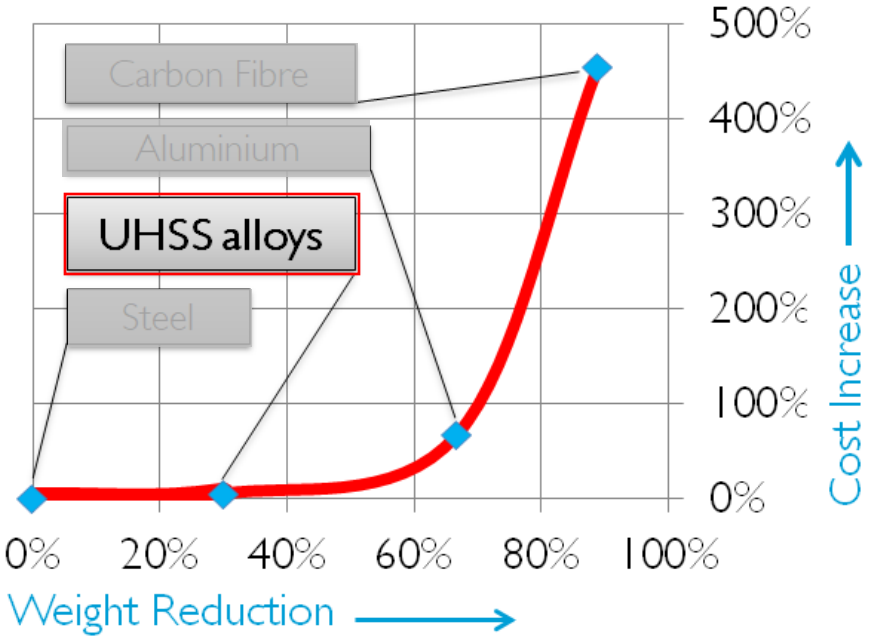
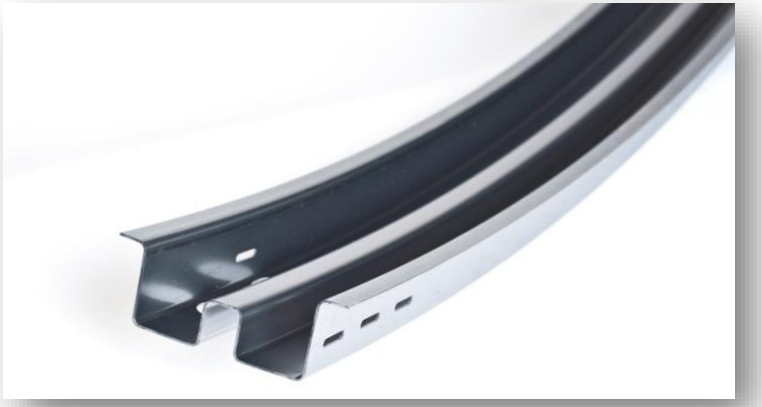


Source: Prof. R. Singer, Institute of Material Science and Technology, University Erlangen-Nürnberg

- UHSS/AHSS allows for weight and cost reduction
- UHSS alloys provide tensile strength up to 1750 MPa compared to standard steel grades with tensile ranging 270 – 400 Mpa
- Roll forming reveals its advantages especially for UHSS/AHSS with low material waste, cold forming, and high output.



Challenges forming UHSS/AHSS grade steels

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- Residual internal stresses from manufacturing process of UHSS/AHSS flat material
- Leveling coils only partially remedies internal stresses
- High variation of forming properties from coil to coil or even within one coil
- Camber resulting from internal stresses
- Flatness/waviness of material, especially for larger areas with higher flatness requirements
- Maintaining GD&T requirement with variation in forming properties

Bananas to Footballs

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Plethora of steel options offers application-specific material grade selection but adds complexity to processes

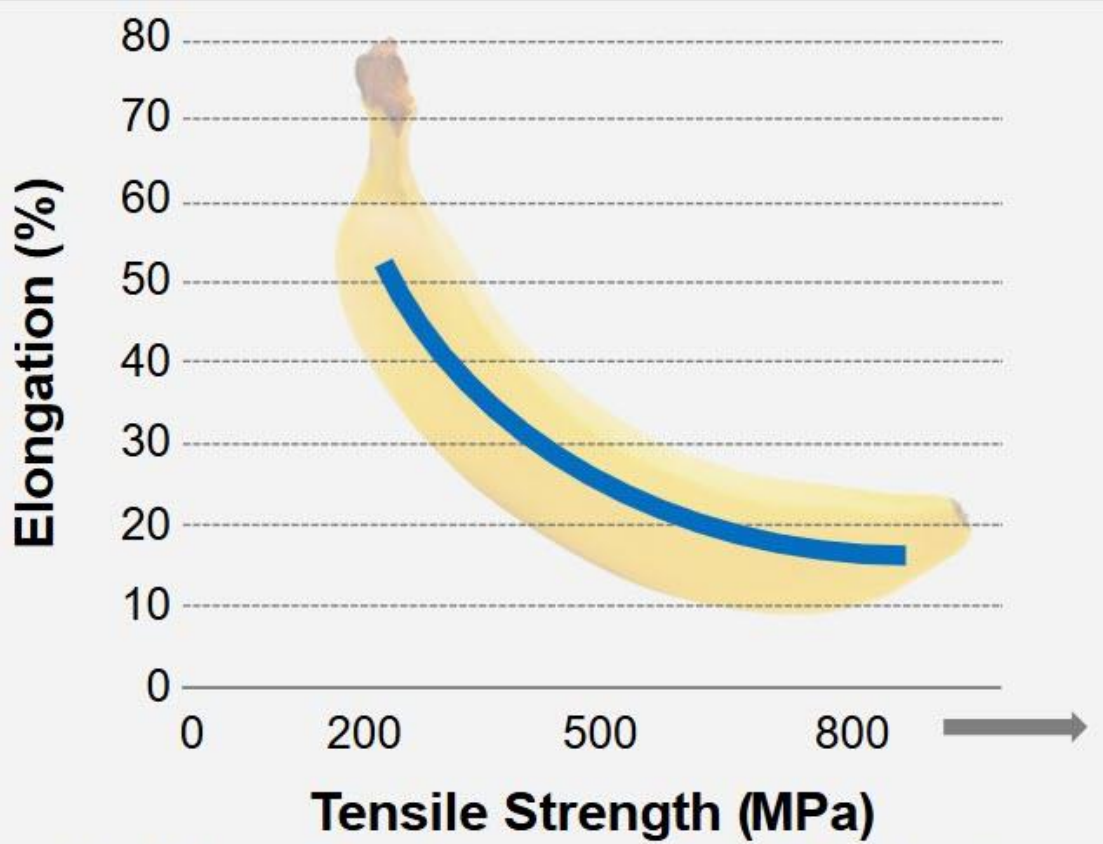

Figure 1: A generic "banana" diagram comparing strength and elongation.

Source: ahhsinsights.org

Material Complexity Simplified

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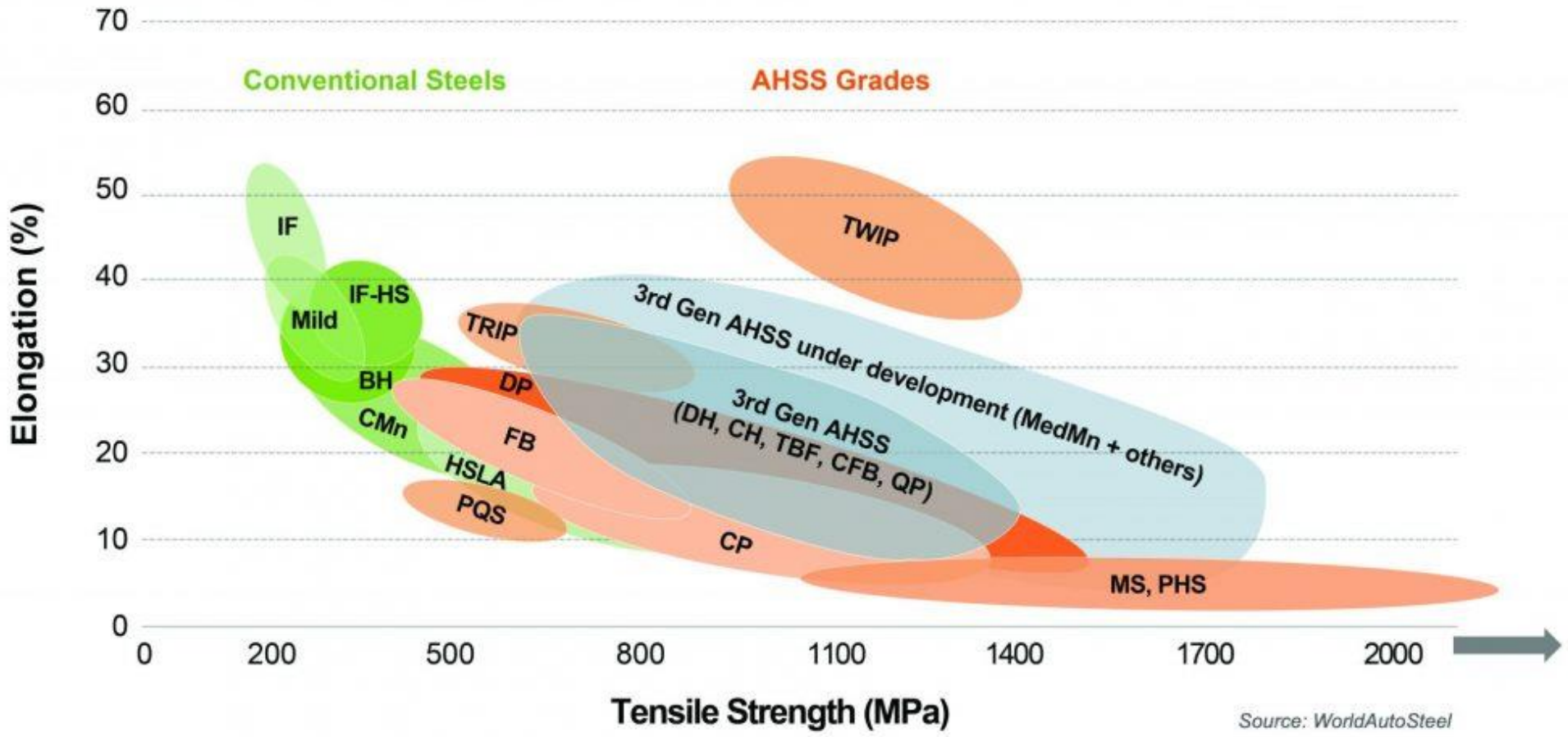

Roll Formed Products

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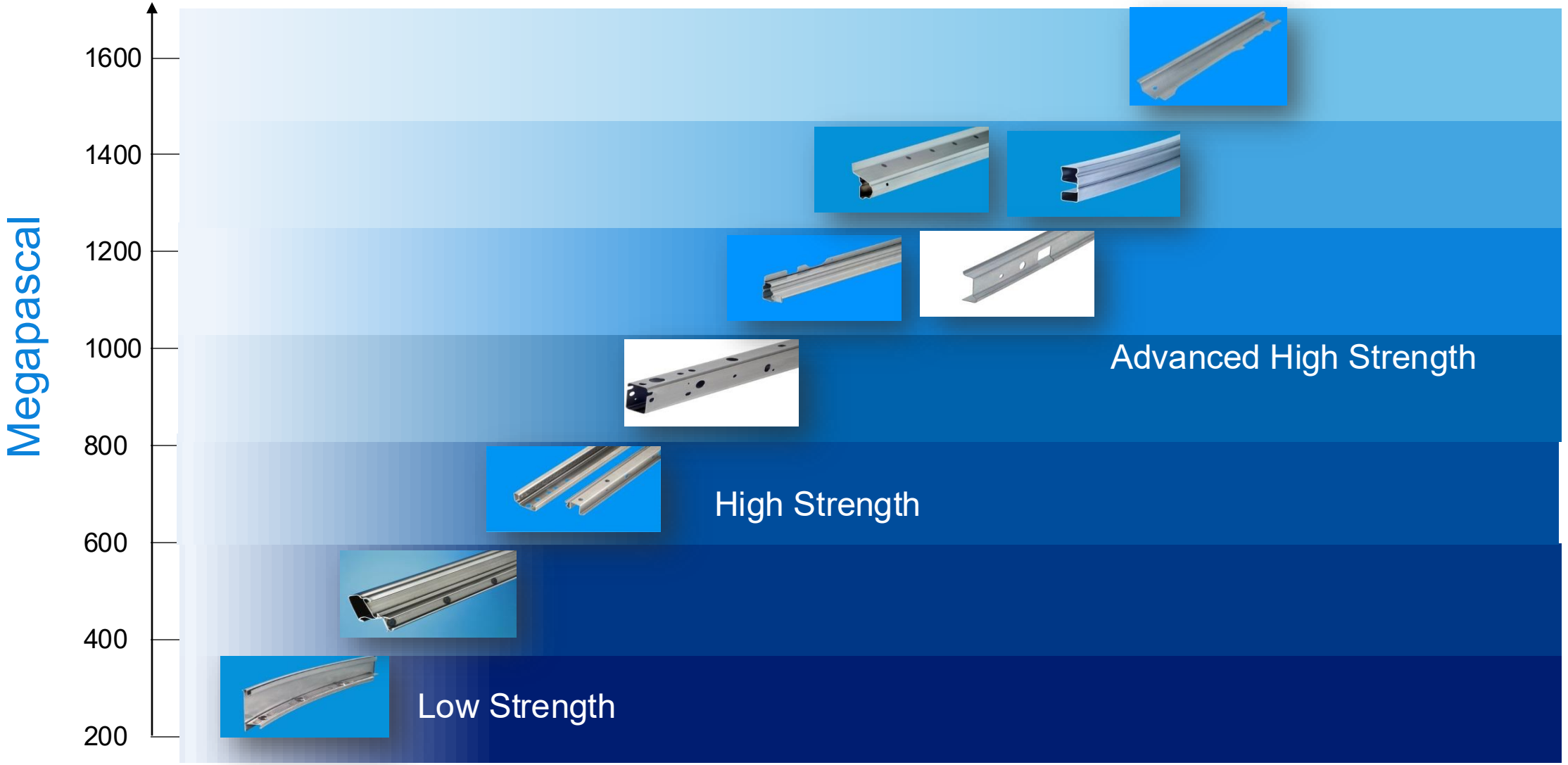

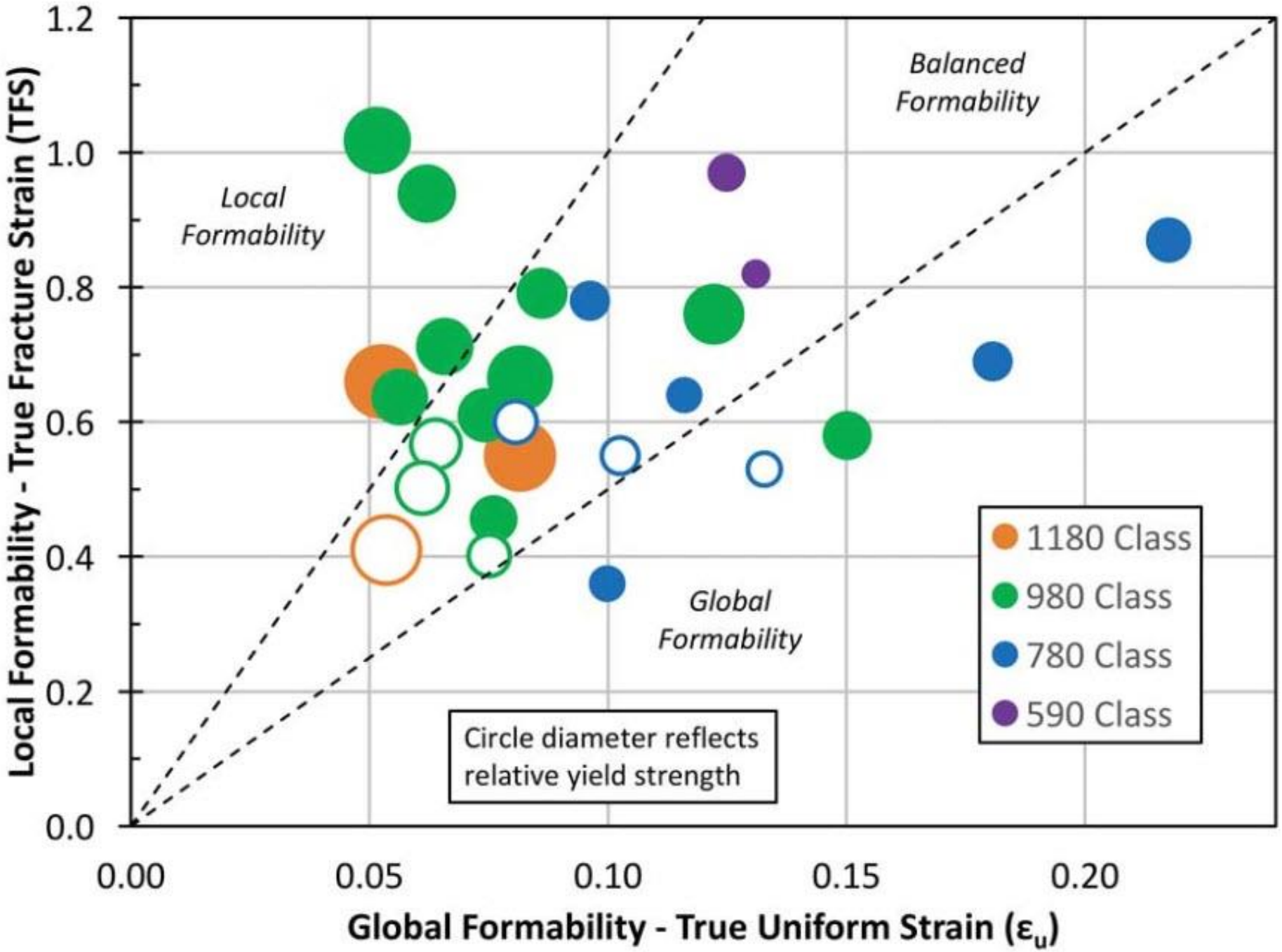
Local Formability - True Fracture Strain (TFS)
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0.00
0.05
0.10
0.15
0.20
Global Formability - True Uniform Strain (ε_u)
Local Formability
Balanced Formability
Global Formability
Circle diameter reflects relative yield strength
1180 Class
980 Class
780 Class
590 Class

Product Example 01
Multi-Chamber profile welded from UHSS

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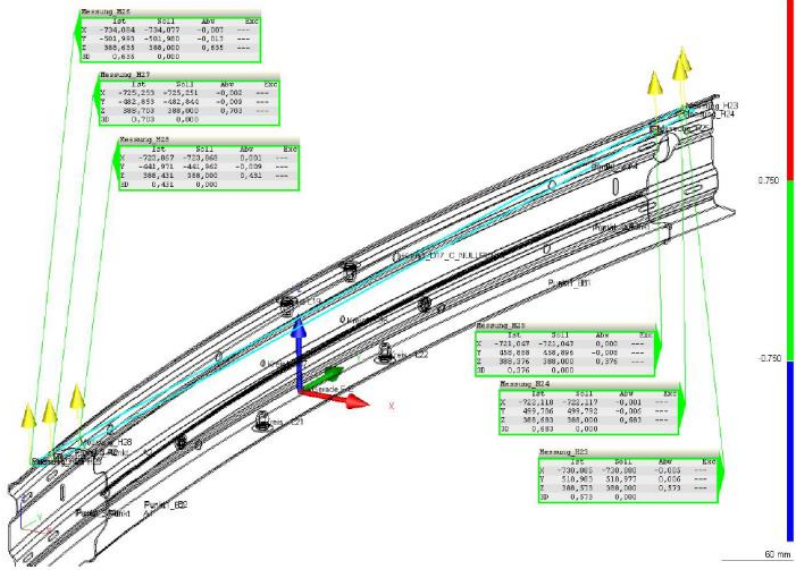
Requirement:

- Multi-Chamber cross section
- UHSS Grade MS1200

Objective:
producing a complex profile cross section with multiple welds including 100% traceability for all relevant safety requirements



Solution(s) Approach to Process Challenges:

- Engineer and design forming and welding processes that can respond to changes resulting from variations in UHSS forming properties
- Integrate and ensure 2 x inline welds needed to complete profile
- Adapt to high forming forces (up 1800 MPa)
- Respond to constant variation of tensile, spring back, thickness and flatness, ie. “waviness”

Product Example 02:
Rocker Panel - UHSS - tensile up to 1750

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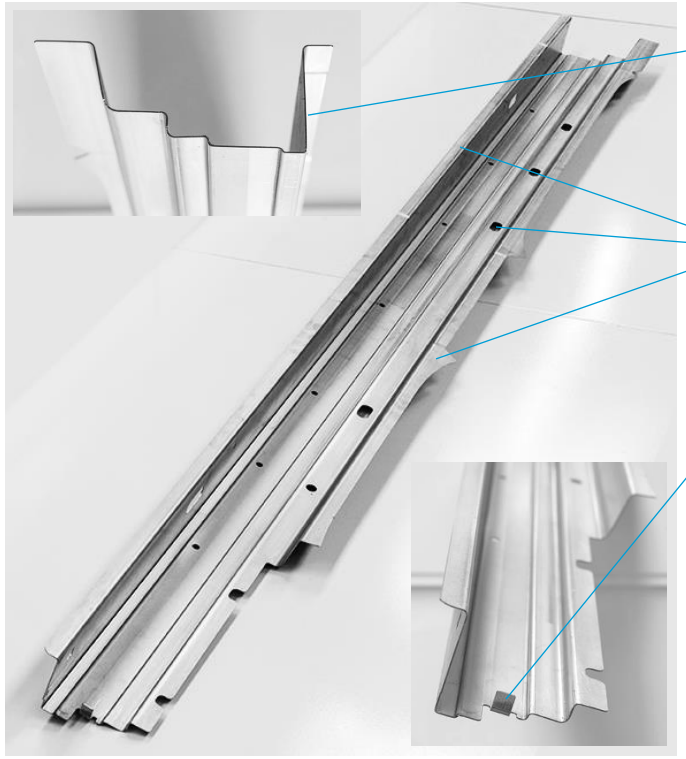

- Section roll formed within required tolerances
- Pierced, Notched and Embossed in line
- Form cut-off
- 90° tab bending at part end

Process Challenges – Coil Material:

- Changing material and forming properties
- Varying spring back, which leads to varying bending angles
- Poor flatness and straightness

Solutions Approach for AHSS challenges?

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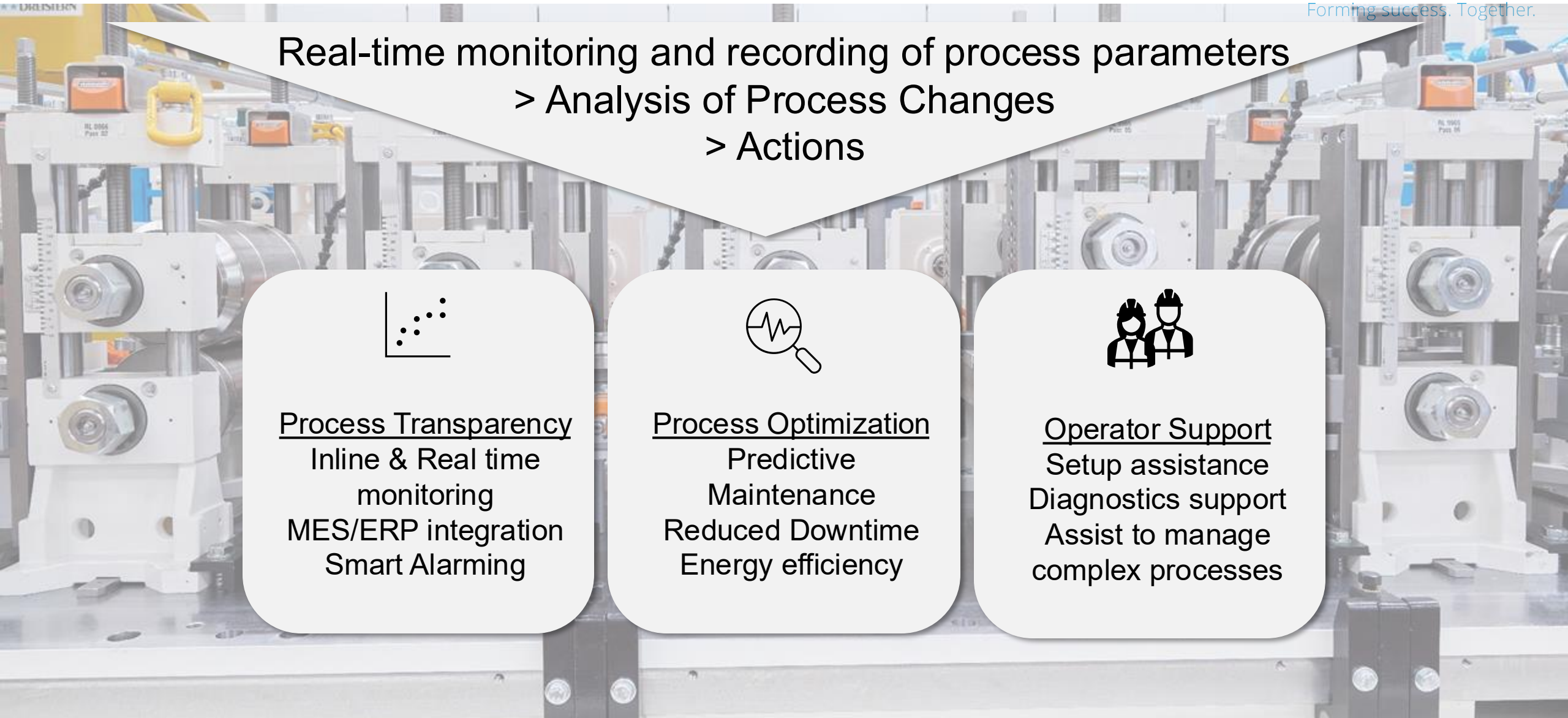

Real-time monitoring and recording of process parameters
> Analysis of Process Changes
> Actions

<u>Process Transparency</u>
Inline & Real time monitoring
MES/ERP integration
Smart Alarming

<u>Process Optimization</u>
Predictive Maintenance
Reduced Downtime
Energy efficiency

<u>Operator Support</u>
Setup assistance
Diagnostics support
Assist to manage complex processes

Designing and building a “GPS System” for the Roll Forming Process

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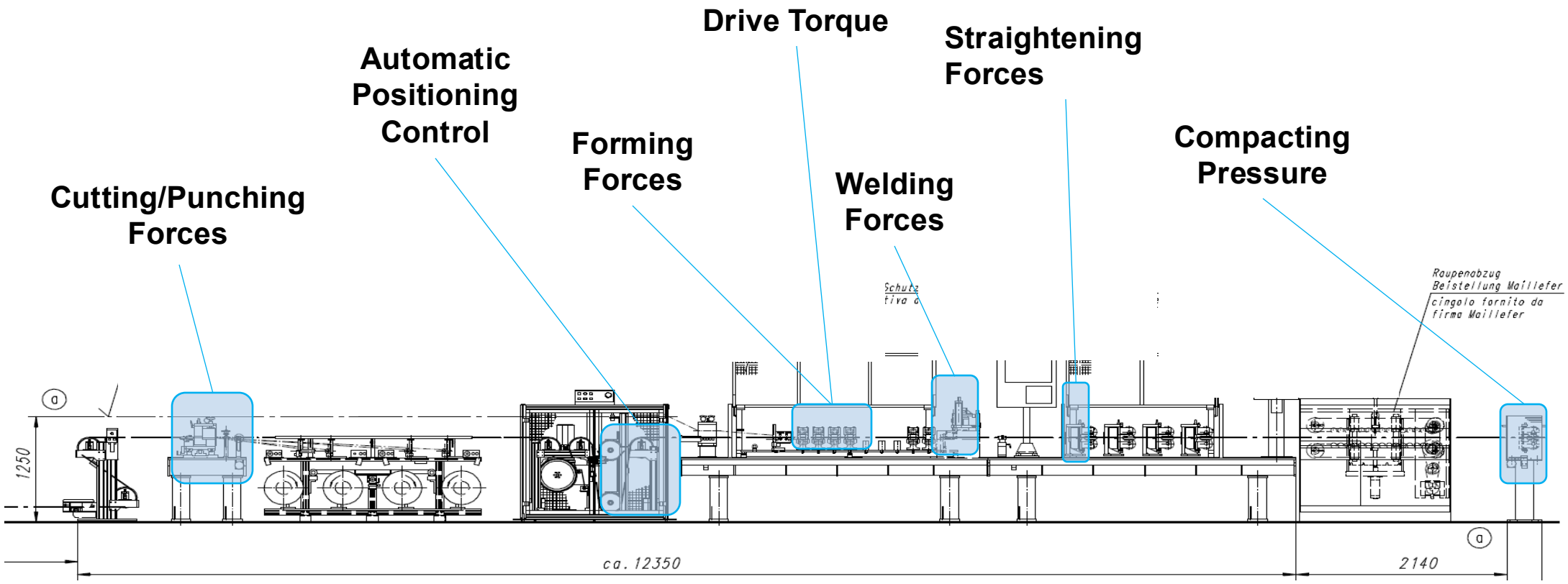

“GPS Sensor”
Forming Force Monitoring

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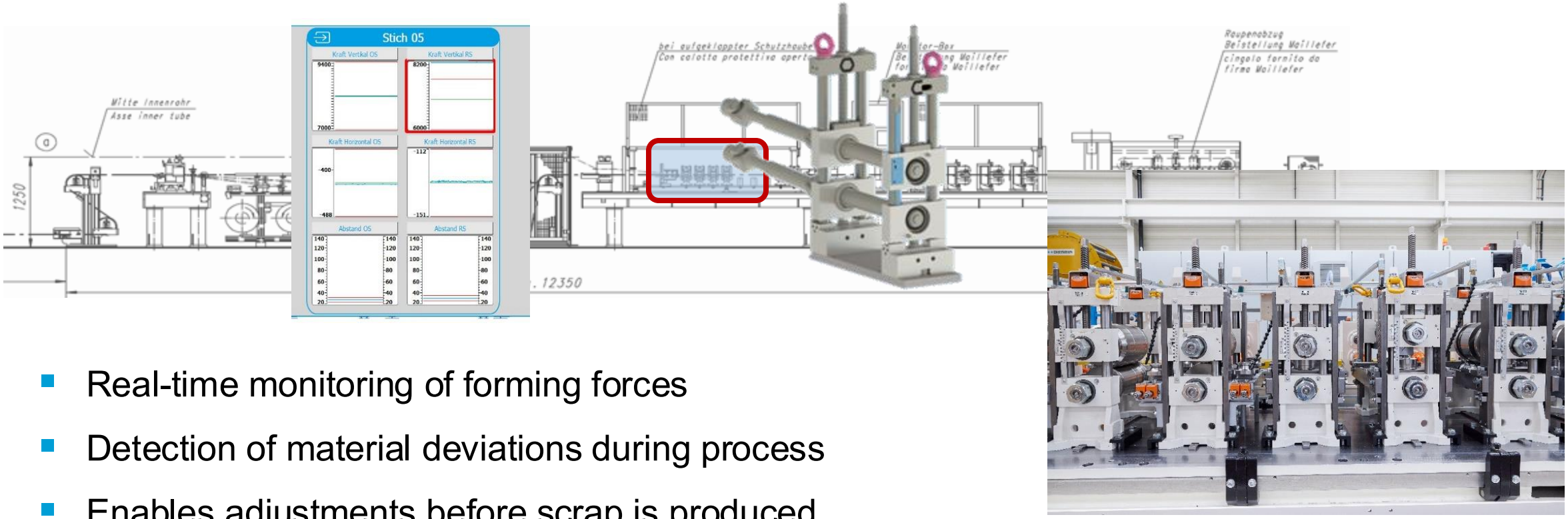

- Real-time monitoring of forming forces
- Detection of material deviations during process
- Enables adjustments before scrap is produced

“GPS Sensor”
Profile Straightening Force Monitoring

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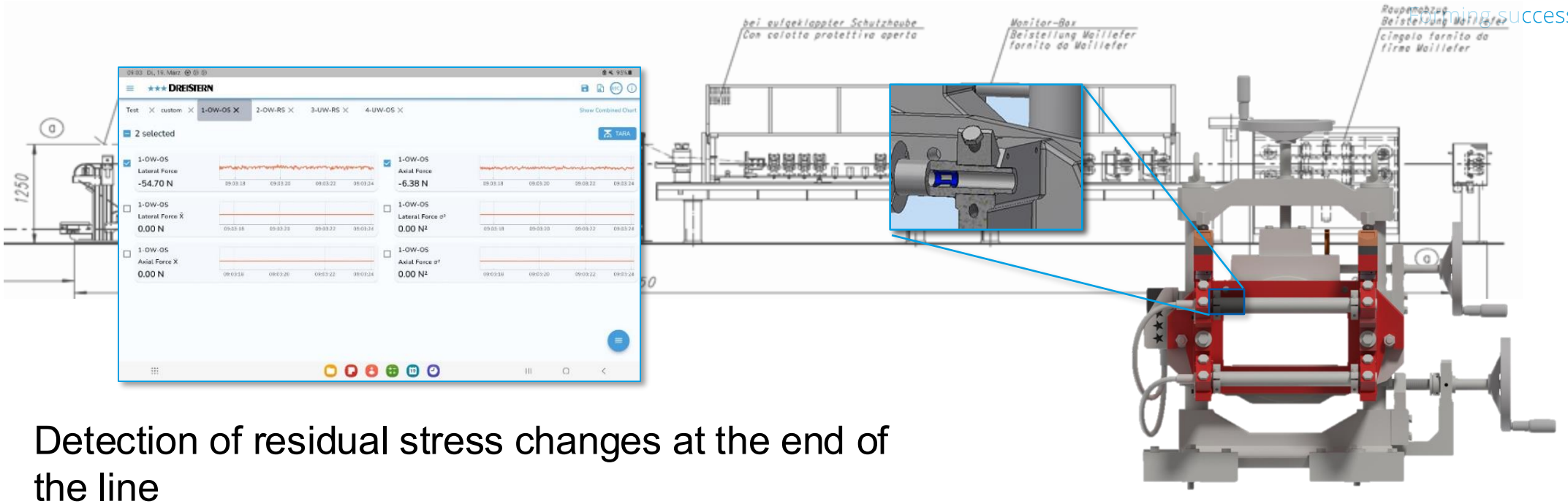
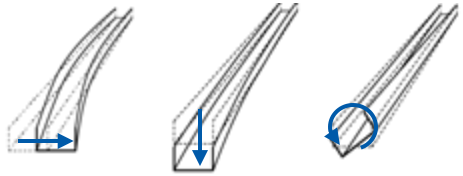


- Detection of residual stress changes at the end of the line
- Alerts for process deviation that impact product quality
- Enables operator intervention when defects occur
- Prevents extended scrap production



“GPS Sensor”
Weld and Weld Force Monitoring

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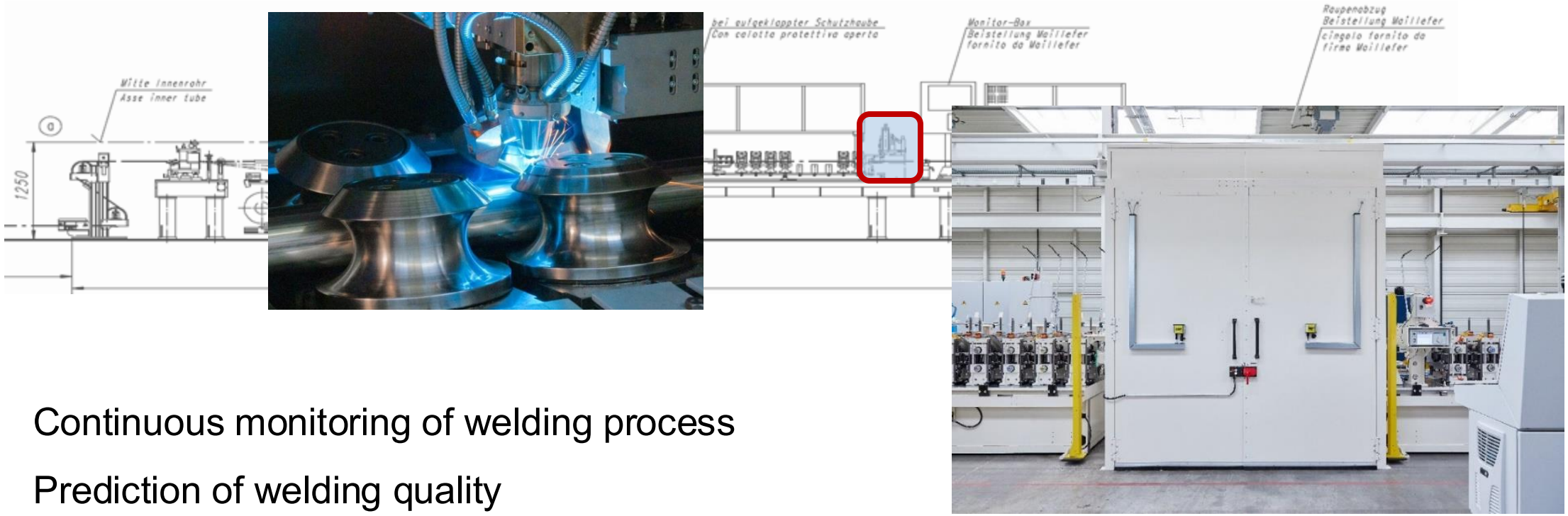

- Continuous monitoring of welding process
- Prediction of welding quality
- Variable parameter adjustment for quality assurance

“GPS Sensor”
Torque Monitoring

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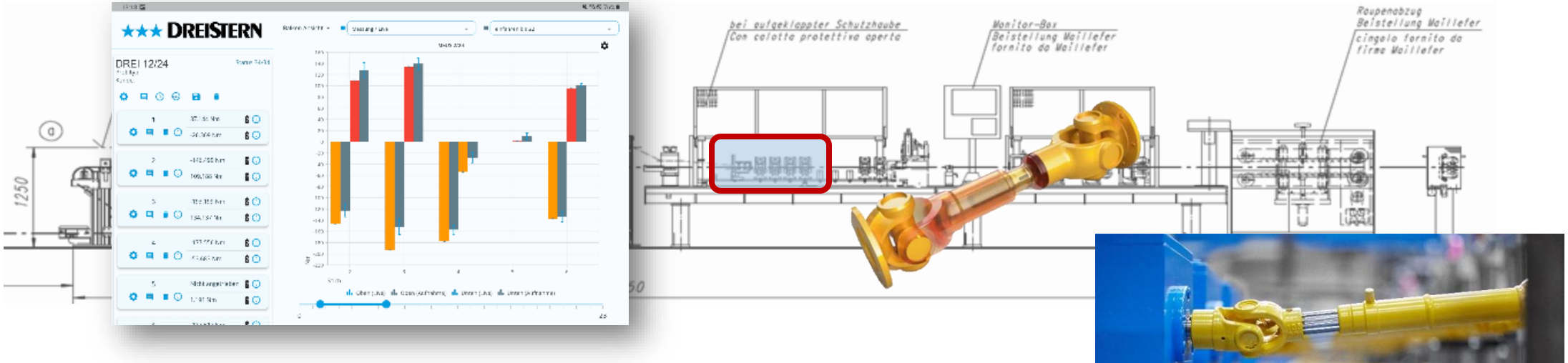

- Monitoring of drive torques
- Detection of overload or braking torques
- Early identification of machine or process issues to prevent damage
- Optimization of process to increase energy efficiency

Results and Insights for Roll Forming

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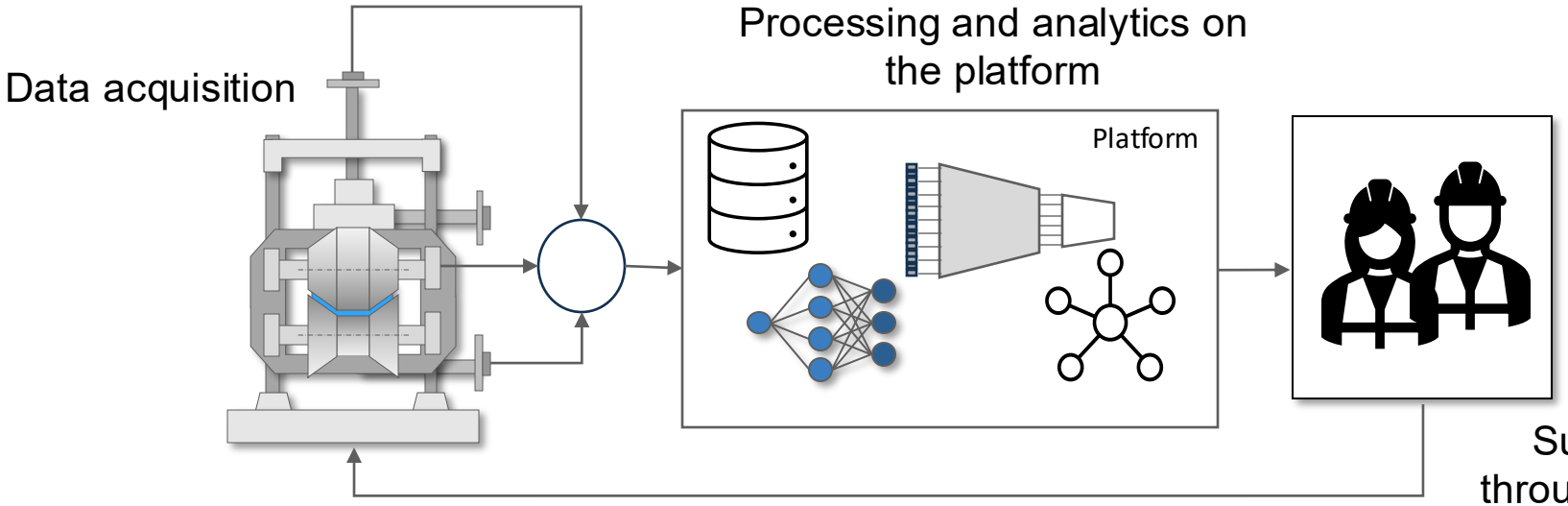
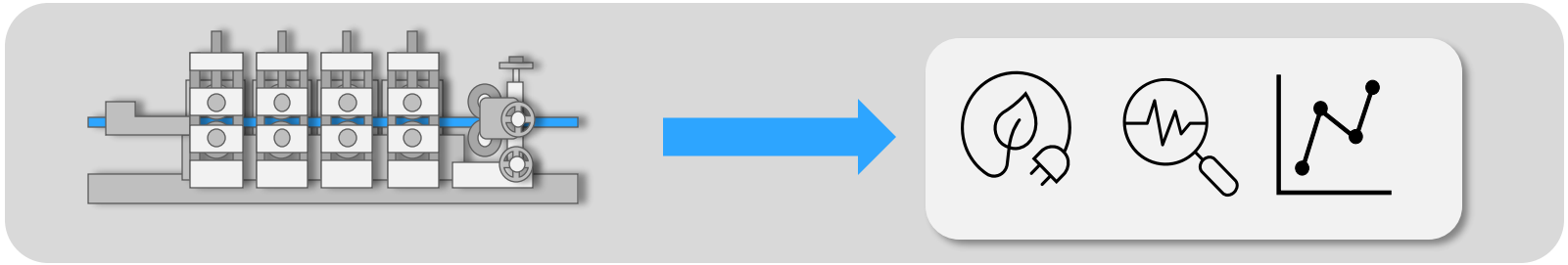


Faster root-cause analysis und reaction by users



Benefits for Roll Forming

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Roll Forming “GPS”

<u>Process Transparency</u>
Inline & real-time monitoring
MES/ERP integration
Smart Alarming

<u>Process optimization</u>
Predictive Maintenance
Reduced Downtime
Energy efficiency

<u>Worker Support</u>
Setup assistance
Diagnostics support
Assist to manage complex processes

Faster Reaction when process changes occur

Reduction of scrap and machine downtime

Higher overall efficiency

Conclusion

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- The evolution of today's industry presents new challenges—but also promotes adoption of specialized processes like roll forming
- New approaches and solutions ensure transparent and manageable processes
  - Simplified automation
  - Improved Process Control
- Implementation of new and advanced processes enable us to take control of new challenges implemented

We are simplifying Roll Forming

DREISTERN®

Get started to Roll Forming with Dreistern

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Location	Schopfheim, Germany
	Telford, USA
Employees	185
Turnover	45 Mio. Euro
Foundation	1949
Projects p. a.	25 - 30
Systems i. t. f.	More than 2.000
Profile tools	More than 10.000

By the way, battery cells can also be roll formed…

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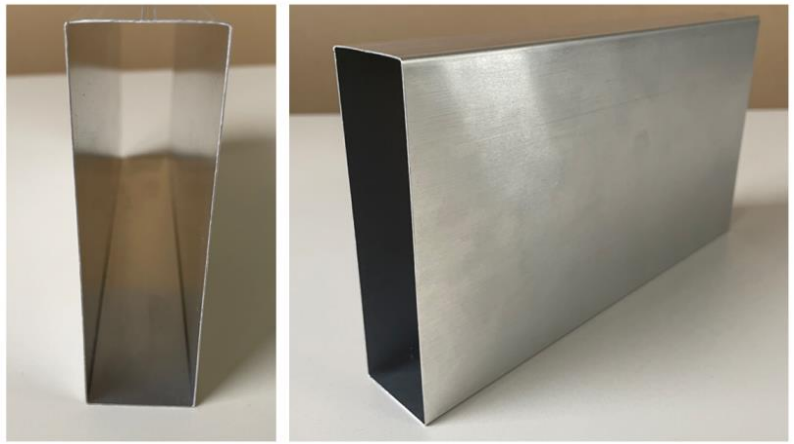

Current processes: Deep drawing or extrusion

- Limitation in length, depth and material thickness
- Output volume low
- Limitation of usage of recycled material
- Material waste due to cut off of caps
- Tide defined part tolerances and welding geometries

With rollforming:

→ High output with a target speed of 30-40 m/min
→ Higher length, depth and lower material thickness possible
→ High Material efficiency with 96-97 %
→ Achievement of tide part tolerances and welding geometries

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Thank you for your attention!

Contact

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