NDT 4.0: Robotics and Process Automation

Digitization and Industry 4.0 – Chance or Disruption?
About VisiConsult

• Manufacturer of customized X-ray systems
• Design, manufacturing, software and applications
• Over 90 employees worldwide
• Located in Northern Germany: Stockelsdorf
• ISO9001 certified processes
• US subsidiary based in Atlanta
• Germanys 4th fastest growing company (in EU 600)
The future?
Quick overview …

Will robotics, automation and AI will change our industry?
Quick overview ...

Who is already using robotics, automation or AI in NDT?
### 2018 Survey Results - Technology with Potential to Disrupt or Create Competitive Advantage

<table>
<thead>
<tr>
<th>Technology</th>
<th>Potential to disrupt or create competitive advantage</th>
<th>Support ongoing improvements</th>
<th>Little to No impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Robotics and Automation</td>
<td>65%</td>
<td>21%</td>
<td>13.9%</td>
</tr>
<tr>
<td>Predictive Analytics</td>
<td>62%</td>
<td>29%</td>
<td>9.8%</td>
</tr>
<tr>
<td>Internet-of-Things (IoT)</td>
<td>59%</td>
<td>29%</td>
<td>12.6%</td>
</tr>
<tr>
<td>Sensors and Automatic Identification</td>
<td>56%</td>
<td>34%</td>
<td>9.7%</td>
</tr>
<tr>
<td>Inventory and Network Optimization Tools</td>
<td>53%</td>
<td>37%</td>
<td>9.1%</td>
</tr>
<tr>
<td>Artificial Intelligence</td>
<td>53%</td>
<td>24%</td>
<td>22.5%</td>
</tr>
<tr>
<td>Driverless Vehicles and Drones</td>
<td>52%</td>
<td>22%</td>
<td>25.1%</td>
</tr>
<tr>
<td>Wearable and Mobile Technology</td>
<td>45%</td>
<td>35%</td>
<td>20.5%</td>
</tr>
<tr>
<td>Cloud Computing and Storage</td>
<td>40%</td>
<td>45%</td>
<td>15.5%</td>
</tr>
<tr>
<td>Blockchain and Distributed Ledger Technologies</td>
<td>35%</td>
<td>35%</td>
<td>29.6%</td>
</tr>
<tr>
<td>3D Printing (Additive Manufacturing)</td>
<td>35%</td>
<td>27%</td>
<td>37.8%</td>
</tr>
</tbody>
</table>
Top 12 Industry 4.0 (I4.0) use cases

- Advanced Digital Product Development
- Data-driven Quality Control
- Remote Service
- Virtual Training
- Remote Asset Testing/Inspection/Certification
- Everything-as-a-Service Business Models
- Predictive Maintenance
- Human Robot Collaboration
- Additive Production
- Data-driven Inventory Optimization
- Augmented Operations

2023 Market Size ($B)

CAGR (2018-2023)
The Industry 4.0 cycle

- Big Data
- Augmented Reality
- Additive Manufacturing
- Cloud Computing
- Cybersecurity
- Internet of Things
- Simulation
- Autonomous Robots

System Integration
What is Industry 4.0?

**Industry 1.0**
- Mechanization
- Steam power
- Weaving loom

1784

**Industry 2.0**
- Mass production
- Assembly line
- Electrical energy

1870

**Industry 3.0**
- Automation
- Computers and electronics

1969

**Industry 4.0**
- Cyber Physical Systems
- Internet of things
- Networks

Today
Real-time feedback loop

1. Establish a digital record
   Capture information from the physical world to create a digital record of the physical operation and supply network.

2. Analyze and visualize
   Machines talk to each other to share information, allowing for advanced analytics and visualizations of real-time data from multiple sources.

3. Generate movement
   Apply algorithms and automation to translate decisions and actions from the digital world into movements in the physical world.

Source: Center for Integrated Research.

Deloitte Insights | deloitte.com/insights
Real-time feedback loop

Casting system  X-ray system  ERP/MES system
Data segmentation

Potential causes:

• Humidity
• Temperature
• Casting parameters
• Operator induced
• Raw material

Causality or correlation?
Internet of things
Cloud inspection
Asset performance management
Predictive maintenance

![Graph showing costs versus number of failures]

- Preventive Maintenance (PM)
- Predictive Maintenance (PdM)
- Corrective/Reactive Maintenance (CM)

**Optimum**

**COSTS**

**NUMBER OF FAILURES**

- Total Cost
- Prevention Cost
- Repair Cost
Additive manufacturing
AM Process Chain

- Data processing CAD/CAM
- Additive manufacturing Process
- Post processing
- Quality Assurance
- Acceptance test
AM factory of the future
AM factory of the future

VisiConsult – Innovative X-ray solutions
Artificial intelligence
ADR results
ADR configuration - ROIs
ADR configuration - ROIs
Using AI for welds
Classification process
Probability of detection
Computed Tomography ADR

Aluminum Casting

Reconstructed slice

Porosity Analysis
Simulation of inspection
Simulation of inspection
Augmented Reality

Industry 4.0

- Autonomous Robots
- Simulation
- System Integration
- Internet of Things
- Cloud Computing
- Cybersecurity
- Additive Manufacturing
- Big Data
- Augmented Reality

VisiConsult
X-ray Systems & Solutions
Augmented Reality - Service
Supervised inspection
Supervised inspection
Robotics and automation
Automation example
The future - XRHRobotBelt

VisiConsult patented technology!
System justification

Costs per part vs. Production Volume diagram showing different investment options:
- No invest
- Invest to ADR
- Invest to DR
- Inspection by film (RT)
- Digital X-ray system (DR)
- Automatic evaluation (ADR)
System justification

[Chart showing costs through productivity losses and capital investments against degree of automation.]

- White = Costs through productivity losses
- Gray = Costs through capital investments
Thanks for your attention

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