Industry 4.0: Overview, Drivers and Implications

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Drivers of Future Manufacturing

From Capacity to Capability

- Manufacturing Flexibility
- Respond to variable market demand and achieve high levels of customer fulfillment
- Moving Production Tasks closer to the Innovation (Re-Shoring)

New production models

- Moving away from mass production
- From make-to-stock (MTS) to make-to-order (MTO), configure-to-order (CTO) and engineer-to-order (ETO) production
- Becoming more demand driven
- Mass Customization
- Lot Size 1 Manufacturing

Profitable proximity sourcing and production

- Modular products based on common platforms and configurable options
- Adopt hybrid production and sourcing strategies
- Produce modular platforms centrally, while leveraging suppliers, distributors, or retailers to tailor final products locally to better serve local customer demands

Workforce engagement

- People will remain at the center of the factory of the future
- People will provide the degree of flexibility and decision-making capabilities required to deal with increasing operational complexity
- Higher levels of collaboration

“Strategic Value Networks for Industry 4.0”, IoT Week, Aarhus, Denmark, June 19th, 2019
Fourth Industrial Revolution (Industrie 4.0) – Role of IoT & Cyber-Physical Systems (CPS)

Source: Recommendations for implementing the strategic initiative INDUSTRIE 4.0 by The Industry-Science Research Alliance & Sponsored by the German Federal Ministry of Education and Research

"Strategic Value Networks for Industry 4.0", IoT Week, Aarhus, Denmark, June 19th, 2019
The Vision: Connected & Informed Plants

Source: Cognizant.com
Industry 4.0 & Industrial Internet-of-Things (IIoT)

- **IIoT Market Momentum**
  - The lion’s share of IoT’s business value & market potential

- **Application Sectors**
  - **Manufacturing**
  - Energy
  - Oil & Gas
  - Mining
  - Supply Chain Management

- **Main Use Cases**
  - Flexible Automation
  - Predictive Maintenance
  - Quality Management
  - Zero Defect Production
  - Simulation & Digital Twins
  - Worker Safety

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Main IIoT Use Cases in Manufacturing

Flexibility in Automation
- Flexibly Configurable Production Lines
- Configuration at IT rather than OT (Operational Technology) timescales

Predictive Maintenance
- Schedule Maintenance at the best point in time – Optimal Overall Equipment Efficiency (OEE)
- Reduce Unplanned Downtime – Optimize OEE & Worker Safety

Zero Defect Manufacturing
- Collect data from the line and proactively mitigate any sources of defects
- Holistic approach to Zero Defects combining knowledge about the process, maintenance, supply chain management

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Main IIoT Use Cases in Manufacturing

Digital Simulation & Digital Twins
- Simulate industrial process in terms of what-if scenarios using their digital (twin) model
- Optimize operations & decisions – Test without disrupting the production

Supply Chain Optimization
- Created Interconnected and Informed Plants
- Rapidly exchange timely & accurate information across all stakeholders

Worker Safety
- Interact with cyber-representations instead of with harsh environments
- Track workers’ status with wearables and boost their collaboration

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Industry 4.0: Digital Enablers

- Big Data
- Blockchains
- AR/VR
- 5G
- Smart Objects
- Artificial Intelligence
- CPS
- BigData
- Cybersecurity

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Prerequisites & Preparatory Steps

Cyber-Physical Systems
- Enabling Machinery for I4.0
- Especially for legacy Machines

Digital Skills
- Strong digital team required
- Workers, but also technical and R&D partners

Testing Facilities
- Lab or Pilot Line
- Simulation & Testing Infrastructure

Strategy & Roadmap
- Specification of Business goals
- Use Cases to be implemented
## Implementation Steps

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process Reengineering</td>
<td>• As-is → To-Be</td>
</tr>
<tr>
<td>Solution Architecture</td>
<td>• RAMI4.0, Industrial Internet Consortium RA, OpenFog RA</td>
</tr>
<tr>
<td>Digital Modeling</td>
<td>• AutomationML, COLLADA, B2MML..</td>
</tr>
<tr>
<td>Field Connectivity</td>
<td>• OPC-UA, MQTT, DDS..</td>
</tr>
<tr>
<td>Data Analytics</td>
<td>• Data Mining &amp; Machine Learning, Deep Neural Networks &amp; Deep Learning</td>
</tr>
<tr>
<td>Cybersecurity</td>
<td>• Industrial Internet Security Framework, IT &amp; OT Security Convergence</td>
</tr>
<tr>
<td>Pilot Testing &amp; Deployment</td>
<td>• Pilot Lines, Testbeds, Simulation...</td>
</tr>
</tbody>
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12-18 Months
## Industry 4.0 Activities in Europe

<table>
<thead>
<tr>
<th>Launch date</th>
<th>Target audience</th>
<th>Budget</th>
<th>Funding approach</th>
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</thead>
<tbody>
<tr>
<td>2015</td>
<td>Industry &amp; production base, SMEs &amp; mid-caps</td>
<td>Approx. €10 billion</td>
<td>Mixed</td>
</tr>
<tr>
<td>2011</td>
<td>Manufacturers / producers, SMEs &amp; policy-makers</td>
<td>€200 million</td>
<td>Mixed</td>
</tr>
<tr>
<td>2012</td>
<td>Large companies, SMEs, universities, research centres</td>
<td>€45 million</td>
<td>Public</td>
</tr>
<tr>
<td>2014</td>
<td>General business community</td>
<td>€25 million</td>
<td>Mixed</td>
</tr>
<tr>
<td>2016</td>
<td>Industry, above all SMEs &amp; micro-enterprises</td>
<td>€97.5 million</td>
<td>Public</td>
</tr>
<tr>
<td>2013</td>
<td>Research, academia &amp; Industrial &amp; service SMEs</td>
<td>€50 million</td>
<td>Mixed</td>
</tr>
<tr>
<td>2012</td>
<td>Business, industry &amp; research organisations</td>
<td>€164 million</td>
<td>Mixed</td>
</tr>
<tr>
<td>2016</td>
<td>Industry &amp; service sector companies, trade unions</td>
<td>Not yet defined</td>
<td>Public</td>
</tr>
</tbody>
</table>

Source: European Commission, Key lessons from national industry 4.0 policy initiatives in Europe

"Strategic Value Networks for Industry 4.0", IoT Week, Aarhus, Denmark, June 19th, 2019
The Digital Shopfloor: Industrial Automation in the Industry 4.0 Era

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