Creating value by AI and Big Data: Industrial Applications, Challenges and Outlooks

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Oscar Lazaro (Innovalia) – olazaro@innovalia.org
Industry 4.0 Big Data & AI Transformation
AI for Factories 4.0 – G20

- AI is a key enabler for the next generation of smart manufacturing.

- It can lead to a disruption in:
  - traditional workflows,
  - supply chains,
  - value creation, and
  - business models in manufacturing and works towards empowering and expanding workforce expertise.

- AI for internet services to manufacturing will pave the way to the synergietic collaboration between humans and robots in urban autonomous factories for mass customization.
Project No: 780732

Duration: 36 months

Start date: January 1st 2018

Partnership: 50 partners, 16 countries

Strategic Objective: ICT-15-2016-2017 (Big Data Lighthouse)

Total Eligible Cost: 18,925,990.00 €

EC Contribution: 14,983,566.26 €

Project Web Site: www.boost40.eu
BOOST 4.0 Big Data & AI Industrial Applications
European Industrial Data Space

Data the AI fuel
FACTORIES 4.0

10 Lighthouse
- Automotive (6)
- Machine Tool (2)
- White Goods & Appliances (2)

3 Replication
- Textile
- Ceramics
- Elevation / AERO

- Lighthouse Factory 4.0
- Replication Factory 4.0
AI for Factories 4.0 – G20 Industrial Applications

What is AI intended for in Factories 4.0?

1. Hybrid Teams of Human Workers and Collaborative Robots in Smart Factories
2. Deep Learning for State-based and Predictive Maintenance of Networked Production Machines and for Understanding Human Behaviors of Shop Floor Workers
4. Human-Aware and Real-Time Production Planning & Scheduling for Multiagent Systems and Dynamic Plan Revision
5. Intelligent Industrial Assistance Systems for Human Workers: Proactive and Situation-Aware On-line Help and Training on the Shop Floor
6. Trusted Industrial Data Exchange Hubs and Machine Learning for Industrial Process Mining
7. Active Digital Product Memories and Digital Twins for Intelligent Asset Tracking and Production Cockpits
8. Security Technologies for Intelligent Intrusion Detection and Penetration Testing for Smart factories
9. Long-Term Autonomy and Self-Learning as well as Self-Healing Capabilities of Industrial Components
Big Data Factory 4.0 Competitive Advantages

1. VW zero defect factory 4.0 virtual **commissioning**
2. FILL lot-size-one **machine tool circular engineering** factory 4.0
3. VWAE real-time **self-learning virtual factory 4.0**
4. +GF+ **machine tool optimum production factory 4.0**
5. FIAT **autonomous assembly line** factory 4.0
6. Philips **mass customised consumer electronics manufacturing line**
7. Volvo truck **digital assembly factory 4.0**
8. GESTAMP automotive part **resource efficient factory 4.0**
9. Benteler **predictive factory 4.0**
10. Whirlpool whitegoods **spare part sensing customer service factory 4.0**
Big Data Factory 4.0 Processes

Smart Digital Engineering

Smart Planning

Smart Operations & Digital Workplace

Smart Connected Production

Smart Maintenance & Service
## Big Data/AI Factory 4.0 - Opportunities

### Smart Digital Engineering

<table>
<thead>
<tr>
<th>Pilot Area 1</th>
<th>Smart digital engineering</th>
<th>Volkswagen</th>
</tr>
</thead>
<tbody>
<tr>
<td>BOOST 4.0 Transformation Value</td>
<td>Networked Commissioning and Engineering</td>
<td></td>
</tr>
</tbody>
</table>

**Description:** Short time-to-market of innovative customised products is a key success factor for industrial companies. Integrating big data feedback information from operation and maintenance phases into the engineering phases will shorten the time for real plant or factory commissioning in lot-size-1 production facilities.

### Smart Planning

<table>
<thead>
<tr>
<th>Pilot Area 2</th>
<th>Smart Planning &amp; Management</th>
<th>Autoeuropa Volkswagen</th>
</tr>
</thead>
<tbody>
<tr>
<td>BOOST 4.0 Transformation Value</td>
<td>Cognitive Production Planning</td>
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</table>

**Description:** Allow system wide visibility and data flow and analysis from the shop-floor to the top floor to the global value chain will allow manufacturing companies to trade on their production capacity, manufacturing planning schedules and production costs to perform dynamic end-to-end production planning across flexible value networks.

### Smart Operations & Digital Workplace

<table>
<thead>
<tr>
<th>Pilot Area 3</th>
<th>Smart operations and digital workplace</th>
<th>Philips</th>
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</thead>
<tbody>
<tr>
<td>BOOST 4.0 Transformation Value</td>
<td>Autonomous Production Automation</td>
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</tbody>
</table>

**Description:** Multi-source high-speed production data processing in workplace-process-human-machine context evaluation is critical for shop-floor productivity and safety concerns. Machine learning based high-performance production data analysis is key for system autonomy-automation and augmented human competences.
## Big Data/AI Factory 4.0 - Opportunities

### Smart Connected Production

<table>
<thead>
<tr>
<th>Pilot Area 4</th>
<th>Smart Connected Production</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BOOST 4.0 Transformation Value</strong></td>
<td>Collaborative Manufacturing Networks.</td>
</tr>
<tr>
<td><strong>Description:</strong> Hundreds of thousands of parts, provided by multiple supplier facilities across the globe, go into large complex product such as automotive or smart home appliances. Big data connects physical production world with the digital twin. Big data transparency means continuous process coordination and enables quality control within and across the complete value chain.</td>
<td></td>
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</tbody>
</table>

### Smart Maintenance & Service

<table>
<thead>
<tr>
<th>Pilot Area 5</th>
<th>Smart maintenance &amp; service</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BOOST 4.0 Transformation Value</strong></td>
<td>Full Equipment and Product Availability.</td>
</tr>
<tr>
<td><strong>Description:</strong> Continuous product or machine data means continuous analysis, risk assessment, and process coordination resulting in better customer experience, fewer field service calls, optimum spare part distribution and prescriptive maintenance.</td>
<td></td>
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</tbody>
</table>
The Algorithm
Challenges for AI in manufacturing

Common standards and a free flow of industrial data in a secure and safe (trusted) environment in Europe are a prerequisite for AI applications in Factories 4.0.

Complexity of machine learning may reduce the justification for consequential decisions to “the algorithm made me do it”. Not acceptable in a healthy & safe Factory 4.0 (human centered).
Challenges for AI in manufacturing

- Transparency and trust of such Algorithmic Systems (data & algorithms) becoming competitiveness factors for Data-driven economy;

- Importance of remedying the information asymmetry between the producer of the digital service and its consumer, be it citizen or professional

- Dominant platforms on the market play a role of “prescriber” - rank
Challenges for AI in manufacturing

• Transparent-by-design, auditable-by-design, fairness & non-discrimination-by-design.
  • Fact checking & information flow monitoring & Viz.
  • Causal discovery & digital evidences.
  • Deep model & architecture interpretability
  • AI reproducibility
  • Data provenance & usage monitoring
Thanks!

Any questions?

👤 Prof. Dr. Oscar Lazaro (INNOVALIA)
✉️ olazaro@innovalia.org
🌐 www.boost40.eu
ᠬ.boost4_0
LinkedIn: www.linkedin.com/groups/12075988