Germany has one of the most competitive manufacturing industries in the world.

Industrie 4.0 allows individual customer requirements to be met [and] one-off items can be manufactured profitably.

Will allow Germany to increase its global competitiveness and preserve its domestic manufacturing industry.

Source: Securing the future of German manufacturing industry, Recommendations for implementing the strategic initiative INDUSTRIE 4.0, April 2013
Five Million Jobs by 2020: the Real Challenge of the Fourth Industrial Revolution

Oliver Cann, Director, Public Engagement, Tel.: +41 79 799 3405; Email: Oliver.Cann@weforum.org

- The Fourth Industrial Revolution, combined with other socio-economic and demographic changes, will transform labour markets in the next five years, leading to a net loss of over 5 million jobs in 15 major developed and emerging economies.

- Skills and jobs displacement will affect every industry and geographical region, but losses can be offset by job growth in key areas.

iPhone manufacturer Foxconn is replacing 60,000 workers with robots
the journey started
and the world was never the same again...

relative search interest on Google

Source: IoT Analytics Research, 2022, Google Trends
but what exactly is industry 4.0?

Industry 4.0 technologies:

- Big Data
- Advanced Robotics
- Simulation
- Integration
- Internet of Things
- AI
- Cybersecurity
- Additive Manufacturing
- Integration
- Augmented Reality
investment hype

funding of Industry 4.0 startups
but these technologies started long time ago...

Walter Pitts and Warren McCulloch

computer model based on the neural networks of the human brain

1943
JOSEPH HARRINGTON
Computer Integrated Manufacturing
1973
manufacturing execution systems

JONATHAN GOLOVIN
Consilium Founder
1978
so why now?
technology is like gravity, it is an accelerating force

Source: HP Mega Trends, 2020
pilots and PoC’s
Do these contribute to more than island solutions?

Use cases priority

<table>
<thead>
<tr>
<th>Ease of Implementation</th>
<th>Financial Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>High</td>
<td>High</td>
</tr>
</tbody>
</table>

**Strategically important use cases:** High impact yet harder to implement

**Quick-payoff use cases:** High impact, relatively easy to implement

**Wait and see use cases:** Low impact, harder to implement

**2nd-tier use cases:** Lower impact, yet easier to implement

**Implementation Strategy**

- Corporate level proof of concept: 29%
- Plant level pilot: 15%
- Plant level proof of concept: 14%
- Multiple plant level pilots: 14%
- Corporate level pilot: 13%
- Multiple corporate level pilots: 13%
- Single plant rollout for a single function: 11%

**Source:** A manufacturer’s guide to scaling Industrial IoT, McKinsey, 2021

**Source:** Pilot Purgatory in Industrial Transformation (IX) is Fake News, LNS Research 2021
the pilot purgatory
Very few claim to have successfully reached scale with I4.0

Source: McKinsey, 2021
the smart manufacturing challenges

**Technology**
- Cybersecurity: 44%
- Legacy Processes/Process Reengineering: 40%
- Technology or Solution Immaturity: 34%
- Integration: 32%
- Scalability: 32%

**Organization and Culture**
- Leadership Commitment: 42%
- Access to Skills: 36%
- Cultural Resistance: 35%
- Organization Complexity: 34%
- Competition for Resources: 32%

**Source:** Smart Manufacturing Challenges Every Industrial Manufacturing CIO Must Resolve, Gartner, 2022
it’s all about the strategy... or the lack of it

Strategy and Execution

- Available Budget: 43%
- Investment Justification: 42%
- Demonstrating ROI: 35%
- Managing Pilots: 27%
- Clarity on Alignment with Supply Chain: 26%

Source: Smart Manufacturing Challenges Every Industrial Manufacturing CIO Must Resolve, Gartner, 2022
SIRI – Smart Industry Readiness Index
The 16 dimensions of the assessment

<table>
<thead>
<tr>
<th>Process</th>
<th>Technology</th>
<th>Organisation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operations</td>
<td>Automation</td>
<td>Talent Readiness</td>
</tr>
<tr>
<td>Supply Chain</td>
<td>Connectivity</td>
<td>Structure &amp; Management</td>
</tr>
<tr>
<td>Product Lifecycle</td>
<td>Intelligence</td>
<td></td>
</tr>
<tr>
<td>Vertical Integration</td>
<td>Shop Floor</td>
<td>Workforce Learning &amp; Development</td>
</tr>
<tr>
<td>Horizontal Integration</td>
<td>Enterprise</td>
<td>Inter- and Intra-Company Collaboration</td>
</tr>
<tr>
<td>Integrated Product Lifecycle</td>
<td>Facility</td>
<td>Leadership Competency</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Strategy &amp; Governance</td>
</tr>
</tbody>
</table>
the SIRI results per industry

preparing for the future

“Resilience is about preparing for the unexpected. You need to react quickly to mitigate external stresses, and that is what digital transformation is designed to enable.”

Recent trends  |  Future trends

| Cost leadership and efficiency improvement | 46% | 27% |
| Resilience, flexibility and transparency | 20% | 34% |
| Sustainability leadership | 4% | 10% |
| Greater personalization and individualization | 8% | 10% |
| Greater innovation rate and faster time to market | 10% | 12% |
| Service leadership/higher customer satisfaction | 11% | 7% |

Source: PwC Digital Factory Transformation Survey, 2022
Preparing for the future
an example in aviation

In 2016, KLM and Boston Consulting Group (BCG) started a transformational project “digitizing KLM’s operational decision-making”.

KLM wasn’t looking to specific use cases, but rather systemic “win-wins” across a variety of organizational facets.

With a wide digitalization, created a single currency to find the best integral decision on the day-of operations.

Source: The Move to Integral Decision Making, Supported by Digital, Wired, 2023
digital backbone
implementation stage for selected IT solutions

“A standardized digital backbone is the key building block for successful factory transformation”

<table>
<thead>
<tr>
<th>IT Solution</th>
<th>Implemented</th>
<th>In rollout</th>
<th>Piloted</th>
<th>Unplanned</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturing Execution System (MES)</td>
<td>53%</td>
<td>32%</td>
<td>14%</td>
<td></td>
</tr>
<tr>
<td>Product Lifecycle Management (PLM)</td>
<td>46%</td>
<td>36%</td>
<td>18%</td>
<td></td>
</tr>
<tr>
<td>Industrial Internet of Things platform (IIoT)</td>
<td>31%</td>
<td>41%</td>
<td>23%</td>
<td>6%</td>
</tr>
<tr>
<td>Low code automation</td>
<td>10%</td>
<td>43%</td>
<td>40%</td>
<td>7%</td>
</tr>
</tbody>
</table>

Source: PwC Digital Factory Transformation Survey 2022
failed ERP implementations

- **REVOLON**
  - unable to fulfil orders of US$64 million
  - Got sued by its own shareholders

- **Nike**
  - spent $400 million
  - initial loss of $100 million, stock price fell 20%
  - class action lawsuits from unfulfilled orders
  - Took 7 years and + $500 million to mitigate

- **LIDL**
  - lost 7 years
  - $580 million invested
  - Project cancelled

- **Department of the Air Force**
  - lost 8 years
  - $5 billion invested
  - Project cancelled
Expectations and the customization trap

**Paper on glass**

A data recording approach similar to paper-based recording but in a digital environment. A paper on glass system’s interface includes predefined fields into which employees enter data.

**XY problem**

Is a communication problem encountered in software engineering where the user requirements show in a form of the use a particular solution (Y) rather than the root problem itself (X).

**Gold plating**

Is the phenomenon of working on a task or requirement past the point of diminishing returns.
**successful backbone implementations**

payback periods for selected IT solution implementations

<table>
<thead>
<tr>
<th>Payback time (years)</th>
<th>&lt;1 year</th>
<th>Average payback time</th>
<th>&gt;3 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industrial Internet of Things (IIoT)</td>
<td>14%</td>
<td>2.9</td>
<td>55%</td>
</tr>
<tr>
<td>Product Lifecycle Management (PLM)</td>
<td>9%</td>
<td>2.7</td>
<td>41%</td>
</tr>
<tr>
<td>Low code automation</td>
<td>4%</td>
<td>3.1</td>
<td>59%</td>
</tr>
<tr>
<td>Manufacturing Execution System (MES)</td>
<td>3%</td>
<td>3.3</td>
<td>69%</td>
</tr>
</tbody>
</table>

Source: PwC Digital Factory Transformation Survey 2022
successful backbone implementations
technologies CEO’s believe will most significantly impact their business over the next 3 years

Source: 2022 CEO Survey — The Year Perspectives Changed, Gartner, 2022
so let’s do AI
chihuahua or muffin?
so let’s do AI
chihuahua or muffin?

Source: Chihuahua or muffin? My search for the best computer vision API, Mariya Yao, 2017
Data enrichment is defined as merging third-party data from an external authoritative source with an existing database.

Examples from other industries:

- Social Media
- Customer Relationship Management
- Insurance
MES contextualized AI

Example: Perform process parameter tuning for optimal yield and performance

Predictive Model Creation & Deployment based on Historical Equipment and MES Data

Application of Predictive Model for Performance Parameter Tuning for Optimal Yield and Performance

Other examples:
Predict Lot Yield and Performance
Golden Tools / Route Selection Calculation
Automatic (and Early) Excursion Detection
the future of employment

the future of employment by WEF
projected job creation and displacement, 2023-2027

### the future of employment by WEF

Expected impact of technology adoption on jobs, 2023–2027

<table>
<thead>
<tr>
<th>Technology Category</th>
<th>Expected Impact 2023-2027</th>
</tr>
</thead>
<tbody>
<tr>
<td>Big-data analytics</td>
<td>58.0%</td>
</tr>
<tr>
<td>Climate-change mitigation technology</td>
<td>49.5%</td>
</tr>
<tr>
<td>Environmental management technologies</td>
<td>45.8%</td>
</tr>
<tr>
<td>Encryption and cybersecurity</td>
<td>43.3%</td>
</tr>
<tr>
<td>Biotechnology</td>
<td>42.9%</td>
</tr>
<tr>
<td>Agriculture technologies</td>
<td>41.3%</td>
</tr>
<tr>
<td>Digital platforms and apps</td>
<td>41.0%</td>
</tr>
<tr>
<td>Health and care technologies</td>
<td>40.3%</td>
</tr>
<tr>
<td>Education and workforce development technologies</td>
<td>39.8%</td>
</tr>
<tr>
<td>Augmented and virtual reality</td>
<td>39.6%</td>
</tr>
<tr>
<td>Power storage and generation</td>
<td>37.6%</td>
</tr>
<tr>
<td>E-commerce and digital trade</td>
<td>36.6%</td>
</tr>
<tr>
<td>Biodiversity protection technologies</td>
<td>35.0%</td>
</tr>
<tr>
<td>Cryptocurrencies</td>
<td>35.1%</td>
</tr>
<tr>
<td>Cloud computing</td>
<td>34.8%</td>
</tr>
<tr>
<td>Water-related adaptation technologies</td>
<td>33.7%</td>
</tr>
<tr>
<td>New materials</td>
<td>32.9%</td>
</tr>
<tr>
<td>Distributed ledger technology</td>
<td>30.5%</td>
</tr>
<tr>
<td>3D and 4D printing and modelling</td>
<td>28.8%</td>
</tr>
<tr>
<td>Satellite services and space flight</td>
<td>28.5%</td>
</tr>
<tr>
<td>Internet of things and connected devices</td>
<td>28.1%</td>
</tr>
<tr>
<td>Nanotechnology</td>
<td>28.0%</td>
</tr>
<tr>
<td>Artificial intelligence</td>
<td>25.6%</td>
</tr>
<tr>
<td>Quantum computing</td>
<td>23.5%</td>
</tr>
<tr>
<td>Text, image, and voice processing</td>
<td>17.6%</td>
</tr>
<tr>
<td>Electric and autonomous vehicles</td>
<td>16.5%</td>
</tr>
<tr>
<td>Robots, humanoid</td>
<td>-2.6%</td>
</tr>
<tr>
<td>Robots, non-humanoid (e.g. industrial automation, drones)</td>
<td>-8.8%</td>
</tr>
</tbody>
</table>

**Source:** World Economic Forum, Future of Jobs Survey 2023
one last topic: Industry 5.0?

"a vision of industry [...] beyond efficiency and productivity [...] and reinforces the role and the contribution of industry to society."

It places the wellbeing of the worker at the centre of the production process and uses new technologies to provide prosperity beyond jobs and growth while respecting the production limits of the planet.

“It complements "Industry 4.0" [...] by putting research and innovation at the service of the transition to a sustainable, human-centric and resilient European industry.

Source: research-and-innovation.ec.europa.eu, European Union 2023

Source: Here’s the Secret Ingredient in Economic Growth, NY Times, 2022
summing it up...

1. Industry 4.0 (and digital transformation) is a journey

2. You need a strategy... and a backbone

3. MES is a great backbone (at least some are...)

4. Mind gold plating, paper on glass, XY problem, customization trap

5. Evolve iteratively – you don’t know what the future holds
THANK YOU!

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