Industrial Policy steering the Fourth Industrial Revolution: insights from German Mittelstand 4.0 Competence Centers


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INDUSTRY 4.0: The Concept

The concept refers to the industrial application of digital technologies (IoT, Big data, sensors, augmented Reality...) and modern ICT.

Under the Industry 4.0 heading, rendering devices and sensors embedded in both inputs, outputs, equipment and machineries enable Cyber Physical Systems (CPS) within firms. (Broy 2010; BMWi, Recommendations for implementing the strategic initiative INDUSTRIE 4.0, 2013)

CPS represent a virtual representation of physical systems allowing firms to acquire and collect real-time data on production and work process.
INDUSTRY 4.0: The Value of Data

CPSs allow:

• Advanced transparency in monitoring production modules and business units;

• Optimization of process flows through the collection and cloud-based analysis of real-time feedbacks and live data;

• More informed decision making.

Image: Future of work lab – Stuttgart
‘The related changes in and between companies are much more profound and concern also work processes and the entire organizational and operational structure.’

→ Technological upgrading
→ Organizational arrangements
→ Human-machine interaction (Ergonomics)
→ Business models
→ Transformation in the structure of employment (quality and high skills)

‘Therefore, the three dimensions human, technology and organization have to be considered in a holistic way for the successful digital transformation of enterprises.’

(BMWi 2015; Müller and Hopf 2017; Butera 2017)

2nd IR

- Electricity and Heavy Machinery
- Mass production
- Production organization based on scientific management of the division of labour (Fordist-Taylorism)

3rd IR

- ICT Technologies
- Flexible Production
- WCMS / Lean Production

4th IR (in the making?)

- Digital Tech, Additive Manufacturing, but also Nanotech, Biotech
- Mass-customization, New business models, Servitization
- Work 4.0
- Reshoring – Skills and High Competences driven
Framing the Issue

WHICH ROLE DOES INDUSTRIAL POLICY PLAY IN THE FOURTH INDUSTRIAL REVOLUTION?

TRIGGERING?

STEERING AND SHAPING?

RESPONDING TO THE CHALLENGES?

...AND HOW?

CASE STUDY: German policy initiative “Mittelstand 4.0 – digital production and work processes”

METHODOLOGY: Policy and Literature Review on the topic, 25 Interviews (both on-fields and over the phone), 5 on-field visits at 2 Competence centers (Kaiserslautern, Stuttgart).
Mittelstand 4.0 – digital production and work processes

Main Strategy and Vision Documents to implement Industry 4.0

- Plattform 4.0
- Digital Agenda 2025 ➔ Mittelstand 4.0 – digital production and work processes
- RAMI 4.0
- High Tech Strategy 2020
- Occupational Safety and Health Strategy – White Paper
- "Research for greater internet security": Data protection, Cybercrime, Privacy preservation, Security of critical infrastructures
- White book "Digital platforms": Regulatory frameworks for the platform economy
- Green Paper / White Paper Work 4.0
DigitBr Index – State of the Art of digitalization of KMU in Germany

‘SMEs have little information on the potential of digitalization to strengthen their international competition ‘

(Müller and Hopf 2017; ZEW 2017; BMWi 2017)
Mittelstand 4.0 – Policy Aim, Target, Tool

• Policy Aim: Transferring Knowledge on Industry 4.0 solutions and digital technologies to MITTELSTANDEN (KMU = Kleine und Mittel Unternehmen)

NO Pre-competitive R&D / Development of new Hardware or Software

• Policy Target: Mittelstanden
KMU = Kleine und Mittel Unternehmen (SMEs, Craft Enterprises, Handycrafts)
499 employees – Turnover: 50 million €

• Policy Tool: Competence centers: a set of networks (consortia), made up of 4 / 7 institutions, organizations or associations each, tasked with documenting existing knowledge on Industry 4.0 solutions and transferring it to the Mittelstanden

NO MARKET ACTORS WITH PROVED EXPERIENCE IN T&K TRANSFER
Mittelstand 4.0 – Policy Design

10 NATIONAL COMPETENCE CENTERS
TOPIC-LED

- Cloud
- Communication
- E-Standards
- Usability
- Textile
- Construction
- IT Economy
- Handcraft
- Digital
- Handcraft
- Processes

17 REGIONAL COMPETENCE CENTERS
Mittelstand 4.0 – 1st Wave of Funding (2015-2016)

Total Funding: 18 Million €

For Instance, Competence Center KAIERSLAUTERNs is made up of:

- Technologie-Initiative SmartFactory KL e.V (leader)
- Deutsches Forschungszentrum für Künstliche Intelligenz GmbH (DFKI)
- Technische Universität Kaiserslautern
- Institut für Technologie und Arbeit e.V. (ITA)
<table>
<thead>
<tr>
<th>Regional Competence Centers 2015-2016</th>
<th>Specialization</th>
</tr>
</thead>
<tbody>
<tr>
<td>BERLIN (East)</td>
<td>Work 4.0 and Qualification Digital Marketing and Business Models Value Added Process 4.0</td>
</tr>
<tr>
<td>DARMSTADT (Center)</td>
<td>Work 4.0 and Qualification IT Security Digital Business Models Value Added Process and Energy Management</td>
</tr>
<tr>
<td>DORTMUND (West)</td>
<td>Automation of Production, Production Technology Logistics</td>
</tr>
<tr>
<td>HANNOVER (North)</td>
<td>Digitalization of Production Technologies Work 4.0 Logistics</td>
</tr>
<tr>
<td>KAIERSLAUTERN (West)</td>
<td>Industry 4.0 production plant for testing and demonstration HRM 4.0 Digital Business Models</td>
</tr>
</tbody>
</table>
Mittelstand 4.0 – 2nd Wave of Funding (2016 – 2017)

Total Funding: 29 Million €

For Instance, Competence Center AUGSBURG is made up of:

- Fraunhofer IGCV (leader)
- Technische Universität München (München)
- Cluster Mechatronik & Automation gGmbH
- VDMA Bayern (Employer Ass)
- fortiss GmbH
- Institut für Werkzeugmaschinen und Betriebswissenschaften (IWB)
- Fraunhofer IIS (Nürnberg)
## Mittelstand 4.0 – 2nd Wave of Funding

<table>
<thead>
<tr>
<th>RCCs 2016-2017</th>
<th>Specialization</th>
</tr>
</thead>
<tbody>
<tr>
<td>AUGSBURG (South)</td>
<td>Software – Solution for Automation of Production Work 4.0 Digital Business Models Logistics</td>
</tr>
<tr>
<td>CHEMNITZ (East)</td>
<td>IT Law – Data Protection, Usability Work 4.0 and Qualification Production Technologies Business Process</td>
</tr>
<tr>
<td>HAMBURG (North)</td>
<td>Logistics and Supply Chain Digital Business Models Work 4.0</td>
</tr>
<tr>
<td>ILMENAU (Center)</td>
<td>Industry 4.0 production plants for testing and demonstration, 3D – Printing Data Acquisition and Processing for Value Chain Quality Control</td>
</tr>
<tr>
<td>STUTTGART (South)</td>
<td>Digital solutions in the fields of Smart Mobility, Smart Production, Smart Building and Smart Health</td>
</tr>
</tbody>
</table>
Mittelstand 4.0 – 3rd Wave of Funding (2017 – 2018)

Total Funding: 43 Million €

For Instance, Competence Center COTTBUS is made up of:

• Brandenburgische Technische Universität Cottbus
• Technische Hochschule Wildau
• HP – Leibniz-Institut für innovative Mikroelektronik
• Industrie- und Handelskammer (IHK) Cottbus
• Hochschule für Produktionsmanagement
### Mittelstand 4.0 – 3rd Wave of Funding

<table>
<thead>
<tr>
<th>RCCs 2017-2018</th>
<th>Specialization</th>
</tr>
</thead>
<tbody>
<tr>
<td>BREMEN (North)</td>
<td>Digitalization of Maritime Economy, Automotive, Aerospace, Food and Beverage / Logistics</td>
</tr>
<tr>
<td>COTTBUS (East)</td>
<td>IT Safety and Security, Digitalization of Production Technologies, Logistics</td>
</tr>
<tr>
<td>LINGEN (West)</td>
<td>Digitalization of Maritime Economy, Agriculture, Trade Digital Business Models / Data Analysis</td>
</tr>
<tr>
<td>MAGDEBURG (Center)</td>
<td>Production Networking / Digital Business Models / Standardization, IT Safety and Security, User-Friendly implementation of technologies</td>
</tr>
<tr>
<td>ROSTOCK (North)</td>
<td>Digitalization of Tourism Sector, Health Economics and Medical Technology</td>
</tr>
<tr>
<td>SAARBRUCKEN (West)</td>
<td>Production Networking / Human-Technology Interaction Digital Business Models / Digital Services and Assembly</td>
</tr>
<tr>
<td>SIEGEN (West)</td>
<td>Work 4.0, Qualification of Employees, Human-Technology Interaction</td>
</tr>
</tbody>
</table>
Mittelstand 4.0: Services offered

WHAT

- INFORMATION
- INFORMATION DAYS (SPECIFIC TOPIC)
- ONE STOP SHOPS (i.e. CHAMBER OF COMMERCE)

HOW

- ON-LINE PRACTICAL GUIDELINES
- INFORMATION DAYS (SPECIFIC TOPIC)
- ONE STOP SHOPS (i.e. CHAMBER OF COMMERCE)

Information

- LEARNING FACTORIES
- TEST ENVIRONMENT
- SHOWCASES
- LABS
- DIGITALIZED PRODUCTION PLANTS

Demonstration

- IN HOUSE WORKSHOPS
- WORKSHOPS AT CC’s PLACE
- WEBINAR AND BLENDED LEARNING

Qualification/Training

- MICRO AND MACRO PROJECTS
- INFORMING SMEs ABOUT FUNDING (EU / Federal / State)

Implementation
Mittelstand 4.0 – Collaboration and Coordination

Forms of Collaboration and Coordination Taking off

- Since the beginning:
  
  SAP Online Platform

  Regional Conferences (to be held quarterly) for Competence Center staff only

- Spontaneous collaboration since 2017

  Joint Events / Trainings / Workshops / Drafting of Guideline on Industry 4.0 solutions addressed to SMEs

  Specific Trainings on demand

- Encouraged coordination by Federal Government (BMWi) and The Monitoring Agency

  Working Groups (regular meetings quarterly) in occasion of the Regional Conference
Mittelstand 4.0 – Collaboration and Coordination

- Collaboration among Regional Competence Centers

KAISERSLAUTERN – DARMSTADT: WORK 4.0, HRM 4.0 and QUALIFICATION

BREMEN – HANNOVER: IT SECURITY

ILMENAU – CHEMNITZ: IT SECURITY, DATA PROTECTION

ILMENAU – HANNOVER: DIGITAL PRODUCTION (Topics: Rami4.0, Retrofittable sensors, joint projects)

DORTMUND - HANNOVER: DIGITAL PRODUCTION (Demonstrations at the Smart Factory Production Plant)

AUGSBURG – STUTTGART: DIGITAL PRODUCTION (Advanced Manufacturing)
Mittelstand 4.0 – Collaboration and Coordination

Working Groups (set up since 2017)

<table>
<thead>
<tr>
<th>WG</th>
<th>Participation</th>
</tr>
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<tbody>
<tr>
<td>STRATEGY and VISION</td>
<td>Mandatory (PM from each CC)</td>
</tr>
<tr>
<td>MARKETING AND DISSEMINATION</td>
<td>Mandatory (STAFF from each CC)</td>
</tr>
<tr>
<td>INFORMATION AND DEMONSTRATION</td>
<td>A Selection of CC, according to their specialization</td>
</tr>
<tr>
<td>WORK 4.0, EMPLOYEES QUALIFICATION, HRM 4.0</td>
<td>A Selection of CC, according to their specialization</td>
</tr>
<tr>
<td>DATA PROTECTION LAW AND IT SECURITY</td>
<td>A Selection of CC, according to their specialization</td>
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Insights and Trends Observed

• Mix of "place-based" and "cross-sectoral / topic-led" approach: two-tier policy

• Multi-level Governance? Actually German Länder are not directly involved, but interactions with the local competence centers seems to be frequent

• "Intermediary institutions/organizations" seem to be leading players to trigger the entrepreneurial discovery process: is latent knowledge a constraint to EDP, then requiring intermediate actors to make it explicit/codified?

• Central Role played by Vision (feeling of Identity) and Communication Strategy by the Federal Government (Communication competence center, policy documents, Marketing and Dissemination WG)

• Policy as an "adaptive" process

• Collaboration among Competence Centers came up spontaneously before Coordination (Re-funding of the initiative will dedicate 25% of the resources to foster collaboration)
Thank you for the attention!