Industrial Innovation Policy and Clean advanced manufacturing: Policy Challenges at the Network level
OUTLINE

• Features of Smart Industry (industry 4.0)
• Example of new production processes with Key Enabling Technologies
• Problem of aligning heterogeneous preferences in business models
• A behavioural approach to explore conditions for behavioural convergence across actors
• Exploration of dynamic drivers with two actors (regulators and companies)
Paradigm shift – smart industry

Source: DFKI (2011)
Paradigm shift – Smart Industry

What is this and why now?

Smart Industries are industries that have a high degree of flexibility in production in terms of product needs, volume, timing, resource efficiency and cost. They are able to (fine-) tune to customers’ needs, and are enabled, networked and driven by ICT and the latest available proven manufacturing techniques.

Source: www.smartindustry.nl
The cyber-physical challenges for smart industry that TNO focuses on

- Strategy and Policy
- Information value analysis incl. policy
- Business value across chains
- Big data visualisation
- Security and privacy
- Context aware and adaptive services
- Real-time analytics: learning/behavioural
- Data delivery/logistics: fusion, timing, streaming
- Complex event processing,
- Distributed control (Supply/demand engines)
- Data standards: interop, semantics
- Scalable, high performance IoT architectures
- Virtualisation/software defined networking
- Industry grade access networks (LTE, wifi)
- Information centric embedded system design
Zero waste intelligent manufacturing

**Clean** advanced materials and processes

Flexible, smart and **resource efficient** manufacturing systems

**Track and Trace**
Connected digital factory

Energy efficiency
Printed Electronics - ACREO

See PDF
# Roadmap for Industry 4.0

## Smart Industry transition strategy

<table>
<thead>
<tr>
<th>Year</th>
<th>2018</th>
<th>2025</th>
<th>2035</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Horizontal integration along the entire value network (inter-sectors)</strong></td>
<td>Methods for new economic models</td>
<td>Framework and methods for new business models</td>
<td>Alignment and application protocols across value networks</td>
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<tr>
<td><strong>Systems integration product-service systems</strong></td>
<td>Integration of real and virtual worlds / interfaces for customer intimacy, manufacturing networks and frameworks for big data governance</td>
<td>Systems engineering</td>
<td></td>
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<tr>
<td><strong>Vertical integration (intra-sectors)</strong></td>
<td>Sensors data analyses infrastructures and protocols for process guidance data based</td>
<td>Intelligence, flexibility and adaptivity</td>
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<tr>
<td><strong>New social organisation of industry and work</strong></td>
<td>Design of workplace and acceptance of technology</td>
<td>Multimodal assistance systems</td>
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<tr>
<td><strong>Continuous development of Smart Industry</strong></td>
<td>Cyber-physical communication systems for smart industry</td>
<td>IoT security and safety protocols and regulations</td>
<td>Industry platform development</td>
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Agents in Basic Business Model

Great advances in business models ontologies. BUT
Knowledge and models available are descriptive/qualitative far from enabling prediction of outcomes in complex settings

Core issues:
Value Proposition and relations/interactions between agents in the system enabling/limiting convergence around an innovation.
Multi-agent Consensus Problem

- **Main idea**
  - Having a set of agents to agree upon a certain value (usually global function) using only local information exchange (local interaction)

- **Also known as:**
  - Agreement problem (economics, social networks)
  - Load balancing (Computer Science & communications)
  - Synchronization (statistical mechanics)
  - Rendezvous and flocking (robotics)

- **Old problem:** Markov Chains (60’s), Load balancing (‘70), Distributed decision making (80’s), flocking (00’s)

- **Smart Industry:** Dynamic competitive-collaborative value networks in business models
What triggers investment decisions in companies and consumers? Support from governments?

\[ B \sim W = W(A, SN, C) \]
Companies’ engagement on business innovation

- Social outcomes
- Economic outcomes
- Markets pressures
- Regulation pressures
- Communities pressures
- Technological capabilities
- Organisational capabilities
- Attitude towards innovation
- Willingness to innovate
- Innovation, change

$W(A, SP, PC)$  $B(C, W)$
Determinants of government engagement on business innovation support

Social Norms (SN)

Attitude on Innovation policy

Economic & and political outcomes

Policy Implementation

Willingness to implement Policy

Social outcomes

Market pressures

Lobbying pressures

Communities pressures

Institutional capabilities

Org. and Tech. capabilities

Policy Enforcement Power (PC)

B(C, W)

W(A, SP, PC)
Next stage: non linear behavioural dynamics

System of two actors

Policy/Regulator
behaviour

Regulatees/Firm
behaviour
Business innovation behavioural determinants

- Social outcomes
- Economic Outcomes
- Markets pressures
- Regulation pressures
- Communities pressures
- Technological capabilities
- Organisational capabilities
- Attitude toward innovation
- Social Norm
- Control over Innovation
- Willingness to innovate
- Business Innovation dynamics
- Willingness to Implement Policy
- Social Norms
- Policy Enforcement Power
- Lobbying pressures
- Communities pressures
- Institutional capabilities
- Org. and Tech. capabilities
- Social outcomes
- Economic & political outcomes
- Market pressures
- Power

Social outcomes
Economic Outcomes
Markets pressures
Regulation pressures
Communities pressures
Technological capabilities
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