Next Generation Manufacturing
Manufacturing 2030

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with contributions from ISG ManuFuture

and 80 stakeholders
MANUFACTURE next generation

From 2020 to 2030

Impact of Global Megatrends

EFFRA Road Map 2013
ICT Action T

Vision 2020
SRA Road maps

2010

Europe 2020
7th / 8th FP

2020

2030

Strategic Innovation Agenda

Future R&D
Future Markets
Sources:
- OECD
- Foresight Studies
- RB 2030
- Grand Challenges
- Megatrends

Future Technologies
Sources:
- Vision Papers of ETPs
- Key Enabling Technologies (KETs)

Impact of Global Megatrends

Sources:
- Vision Papers of ETPs
- Key Enabling Technologies (KETs)

EC strategy papers
- EU2020 strategy
- Innovation Union (autumn 2010)
- A new strategy for the single market (M. Monti, 9 May 2010)
The Paradigm and SRA fields are still relevant … but need new orientations

<table>
<thead>
<tr>
<th>From cost orientation to High Adding Value by Competitive &amp; Sustainable Development for…</th>
<th>Innovative Products</th>
</tr>
</thead>
<tbody>
<tr>
<td>… growth, jobs … competition … environment</td>
<td>New Business Models</td>
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<tr>
<td>Research for Factories of the Future</td>
<td>Manufacturing Engineering</td>
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<td>Emergent Technologies</td>
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<td>Infrastructure</td>
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<td>Education</td>
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- Consumer Goods Emerging Sectors
- European Production System
- Capital Intensive Goods Enabler Sectors
# Megatrends with Impact on Manufacturing

<table>
<thead>
<tr>
<th>Megatrend</th>
<th>Impact and Trends</th>
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<tbody>
<tr>
<td><strong>Ageing</strong></td>
<td>Future markets and products, Human work and organisation</td>
</tr>
<tr>
<td><strong>Individualism</strong></td>
<td>Individual and customised products, Relation of human being and work conditions</td>
</tr>
<tr>
<td><strong>Knowledge in the global ICT</strong></td>
<td>Knowledge driven Product-Development, Optimisation of manufacturing processes, IP and IT security</td>
</tr>
<tr>
<td><strong>Globalisation</strong></td>
<td>Global process-standards in OEMs, Products and manufacturing technologies for the global markets, Local conditions and regulations, Competition of locations</td>
</tr>
<tr>
<td><strong>Urbanisation</strong></td>
<td>Environment, Mobility, Traffic, New products for mega-cities, Work in mega-cities, Factories in urban environment</td>
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<tr>
<td><strong>Sustainability</strong></td>
<td>Priorities for economic, ecologic, social efficiency of manufacturing</td>
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<tr>
<td><strong>Finance</strong></td>
<td>Turbulences in finance of investment, R&amp;D and long term assets, Economic cycles</td>
</tr>
<tr>
<td><strong>Public debt</strong></td>
<td>Adding value - Resilience, Growth for employment, Taxes, general conditions</td>
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Topics of the Strategic Innovation Agenda

- Innovative Products & Processes
- Knowledge based Manufacturing Engineering
- Infrastructure & Education
- New Business Models in the Life Cycle of Products

Competitive & Sustainable Development

Factory as good neighbor Manufacturing in urban Environment

Volume production back to Europe

Factory and Nature Lean, Clean, Green Factories

Next Generation ICT for Factories

Innovative Technologies for Manufacturing

Lightweight Factory as good neighbor Manufacturing in urban Environment

Volume production back to Europe

Next Generation ICT for Factories

Innovative Technologies for Manufacturing

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Next Generation ICT for Factories

Innovative Technologies for Manufacturing
Research and new Business Models

Growth

Manufuture SRA + Road

EFFRA Road 2013

Manufuture Strategic Innovation Agenda

Innovative Products
Innovative Processes
Knowledge based Engineering

New Business Models

4 major topics
emergent technologies

Infrastructure
Education

Time

2008 2009 2011

FOF EFFRA
New Business Models along the life cycle of products

Development and Implementation of a European Model (Reference Model)
- Robust and resilient
- Adding Value by knowledge based management
- Innovation culture for economic, ecologic, social efficiency
- Investment policy for sustainability
- compliance

Research for methods and technologies
- Methodologies for risk- and resilience management
- Service oriented engineering tools
- Life-Cycle Managementsystems for manufacturing
- Methodologies for diagnostics and maintenance

Development of Infrastructure and Education
- Regional synergies
- efficient technology transfer
- E-Education, E-Learning at work
Creating Innovative Products

<table>
<thead>
<tr>
<th>Increasing the creativity and efficiency of products</th>
<th>... by ...</th>
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<tbody>
<tr>
<td>... for existing Markets</td>
<td>Engineering Competence</td>
</tr>
<tr>
<td>Implementation of New Materials / Nano’s Weight reduction (dematerialisation)</td>
<td>Implementation of new Process-Technologies</td>
</tr>
<tr>
<td>Embedding of sensors / electronics</td>
<td>High skill, Motivation</td>
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<tr>
<td>New functionalities / technical intelligence</td>
<td>Collaboration</td>
</tr>
<tr>
<td>E-Mobility (E-Cars, Engines, Batteries, …)</td>
<td>Cooperation</td>
</tr>
<tr>
<td>Health (Medicine, Chemistry, …), Bio-Products, Food, Agricultural…</td>
<td>Knowledge based</td>
</tr>
<tr>
<td>Environmental Sectors, Energy, Water, …</td>
<td>Engineering tools</td>
</tr>
<tr>
<td>Customised consumer goods…</td>
<td>Education</td>
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<tr>
<td>Design oriented Products…</td>
<td></td>
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<tr>
<td>Parts, components…</td>
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<tr>
<td>Factories Equipment (Basic Technologies)</td>
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<tr>
<td>Photonic Machines, Light technonolgies</td>
<td></td>
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<tr>
<td>Mechatronics, Embedding Electronics</td>
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<tr>
<td>Software for Products and Production</td>
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Grand Challenge: Dematerialisation of Products

- Reduction of the material-consumption by:
  - Lightweight construction, multi-material design, joining technologies
  - Miniaturisation of dimensions (parts, components, products)
  - Intelligent engineering with specialised materials (function oriented)
    - Implementation of new technologies (Nano, Graphene etc.)
    - Integration of functions (adaptronic, sensors, actors)
  - Mechatronik components, Embedding electronics, MID
  - Reduced process chains (near net technologies)
  - Process capability (waste, scrap, defects etc.)
  - Recycling technologies, remanufacturing technologies

- ...is a contribution to reduce energy consumption
Continuous Innovation for Products and Processes

**Technologies for...**
- High Performance
- High Speed, High Volume
- High Precision
- High Efficiency (Energy, Material)
- Technical Intelligence
- Human Interfaces
- Tools, Molds, Dies
- Transport, Storage

... Manufacturing Equipment

**Equipment for Industrial Manufacturing of Emerging Products....**
- Solar, Wind, etc. Environment
- all electric products......
- medicine products
- bio-products
- Health
- Tissue Manufacturing
- Food

... emerging Sectors

**Implementation of New Technologies for Innovative Products Processes, Machines, Systems**

**Embedding Electronics**

**Engineering Materials**
Knowledge based Manufacturing Engineering

Increasing the quality and efficiency of manufacturing engineering

- Scientific based Process Models
- Flexibility for turbulent Markets
- Customised Manufacturing Solutions
- Process Technologies beyond limits
- Remote Manufacturing
- Intelligent Machines
- Variancy
- Flexibility and High Performance
- High energetic efficiency
- Zero-Defects
The 4 major topics for emerging Manufacturing

<table>
<thead>
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<th>Manufacturing in urban environment &amp; mega cities</th>
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<tr>
<td>- sustainable consumption and production</td>
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<td>- sustainable mobility</td>
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<td>- emergent technologies</td>
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<td>- energy and material saving</td>
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<td>- renewable energy</td>
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<th>Volume production back</th>
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<td>- „jobs, jobs, jobs“</td>
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<tr>
<td>- „adding value“</td>
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<td>- with engineering competence</td>
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<td>- aging society</td>
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<td>- enabling technology for grand challenges</td>
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Manufacturing in urban environment & mega cities

- Products: customized technical consumer goods, design oriented products, configurable/modular construction

- Key-Technologies:
  - Emotional manufacturing
  - Zero Emissions of processes and factories: Noise, Air, Fluids, Waste….
  - Short Process chains, integration of processes
  - Desktop Machines: small, medium dimensions
  - Intelligent green logistics
  - Digital products – digital factories
  - Human centered workplaces
  - Tele working

- Factory layout: flexible, open, integrated, lowest floor space

- Production System: human centered, flexible hours of work, event-driven organization
MANUFUTURE next generation

Factory and Nature - The Green Factory: Lean, Clean, Green

- Total Energy-Efficiency Management
- Product Life Cycle LCA
- Zero Emissions (Noise, Air,...)
- No Waste Process....
- Sustainable Processes
- Carbon Footprint
- Green Logistics
- Remanufacturing and Recycling
- Dematerialisation
- Management of Hazardous Substances
- Technical Intelligence - Mechatronics
Volume production (back) to Europe

- European Trendsetting: **design oriented products, customized mass products**

- **Research focus:** low-technologies

- Integration of the engineering chain from „design to manufacturing“ and from „customer order to delivery“

- Make use of **flexible Automation and Technical Intelligence:**
  - Lean, clean, green manufacturing
  - Integration of process knowledge in the machine control and monitoring systems
  - IT- support for technicians and workers, e-learning at work
  - On-line peripheral services: maintenance, process know how

- Human oriented interfaces for workers: in-situ simulation and visualization

- products and work for low skilled labor, education and training with IT-Support

- Regional orientation: work conditions in line with the way of life, flexible time- and wage- systems
Manufacturing in the digital Age


- Engineering in a digital Environment with „Soft-Machines“ „Engineering Apps“
- Digital Products
- Digital Factories with changeable, individual Workflows
- Administration in a digital Environment

Global ICT - Networks – Product Life-Cycle Management – real time IT

Opportunities: Tools for Engineers (soft Machines), IT-Services, Efficiency of Engineers
Research for ICT in Manufacturing - Priorities

- ICT is one of the most important Key-Technologies for Manufacturing
  - influences all business, engineering, production and service processes in the life cycle of technical products
  - but customized and flexible Workflow-Systems required

- Support the efficiency and IT-Tools for Engineers
  - Open Engineering Platform and integration to Product life Cycle Management for requirements of factories (link digital/real worlds)
  - Multiple knowledge based Engineering tools (Soft Machines)

- ICT Security Standards and Services for Manufacturer (Infrastructure)
  - global standards for global cooperation in manufacturing
  - IT-Services for manufacturing and especially for SMEs

- E-Learning at work
Challenges for Manufacturing Development

- Structural change to meet the grand societal challenges

- Renewing the fields of SRA: innovative products, new business models, knowledge based engineering

- Implementation of technologies to bring back mass production to Europe.

- Technologies to increase the efficiency of resources (energy, material) for green factories made in Europe

- Realize high efficient and zero emission manufacturing in urban environments

- Closing gaps “digital and real” and focus on IT-Engineering tools (soft machines)
internet based consultation

Manufuture next generation SIA

Manufuture web site questionnaire for stakeholder feedback (June 2011)

Integration of feedback to formulate Manufacturing 2030
The four major topics

prime focus of interest: Volume production in Europe

- Factory as a good neighbor
- Green factory
- Volume production in Europe
- Next generation IT

Manufacturing in urban environment

- strong
- medium
- low
Thank you for your attention