Next Generation Manufacturing

Manufacturing 2030

Engelbert Westkämper

with contributions from ISG Manu*Future*

and 80 stakeholders

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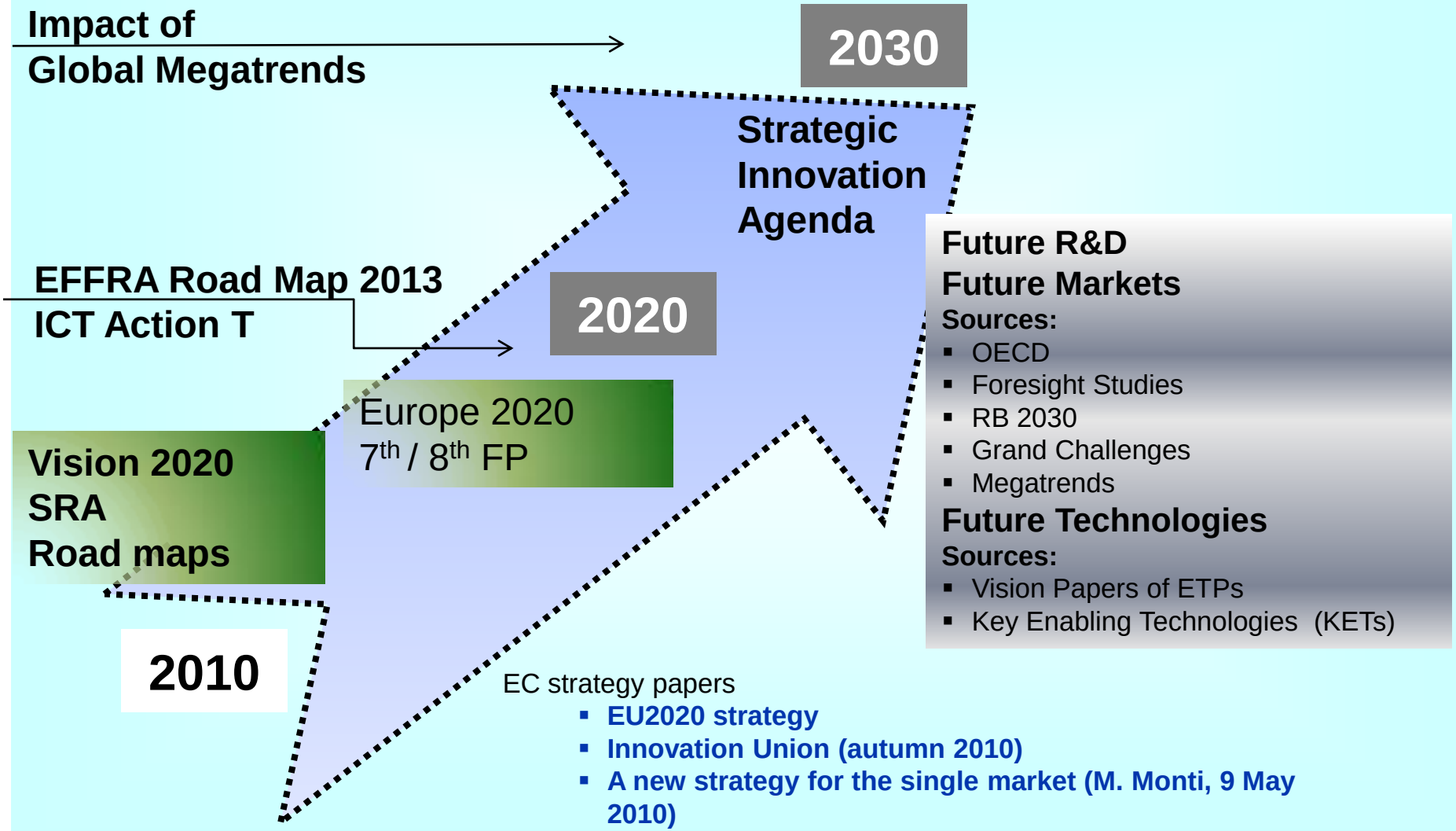
From 2020 to 2030



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Manufuture Strategic Research Agenda (SRA)

The Paradigm and SRA fields are still relevant … but need new orientations

From cost orientation to
High Adding Value
by
Competitive & Sustainable Development

for….
… growth, jobs
… competition
… environment

Research for Factories of the Future

Innovative Products

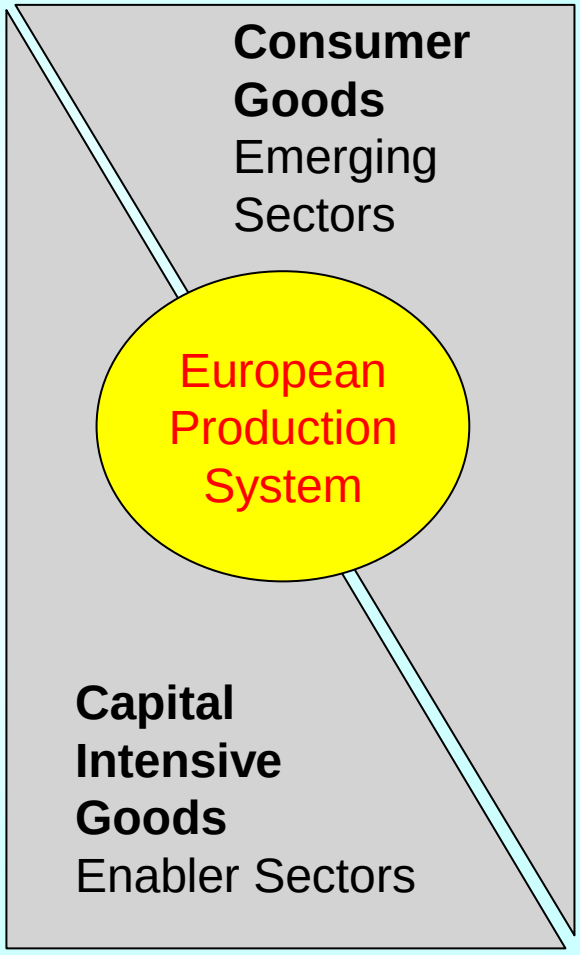
New Business Models

Manufacturing Engineering

Emergent Technologies

Infrastructure

Education



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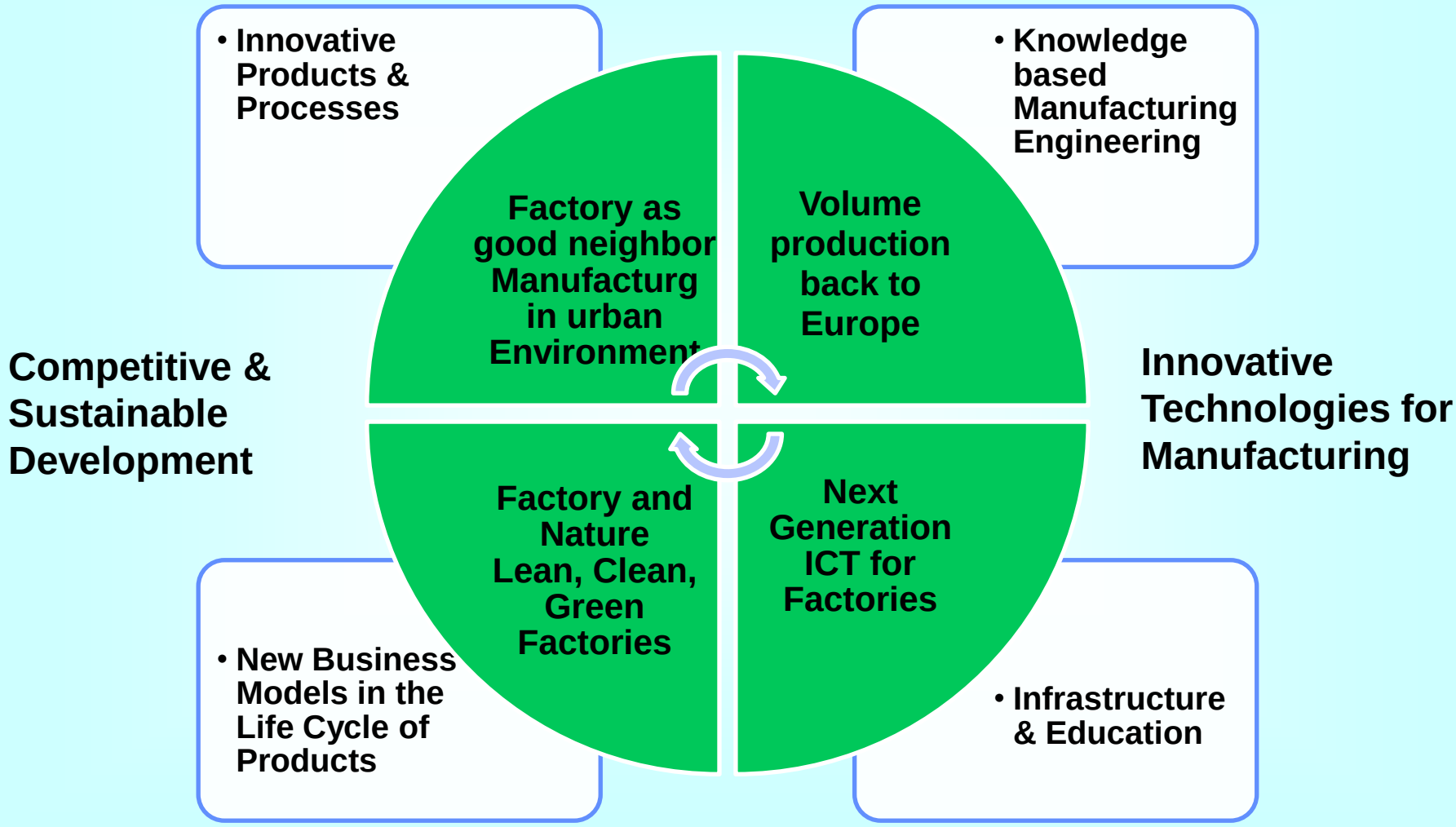
Megatrends with Impact on Manufacturing

- **Ageing**
  - Future markets and products
  - Human work and organisation
- **Individualism**
  - Individual and customised products
  - Relation of human being and work conditions
- **Knowledge in the global ICT**
  - Knowledge driven Product-Development
  - Optimisation of manufacturing processes
  - IP and IT security
- **Globalisation**
  - Global process-standards in OEMs
  - Products and manufacturing technologies for the global markets
  - Local conditions and regulations
  - Competition of locations
- **Urbanisation**
  - Environment, Mobility, Traffic, …
  - New products for mega-cities
  - Work in mega-cities
  - Factories in urban environment
- **Sustainability**
  - Priorities for economic, ecologic, social efficiency of manufacturing
- **Finance**
  - Turbulences in finance of investment
  - R&D and long term assets
  - Economic cycles
- **Public debt**
  - Adding value - Resilience
  - Growth for employment
  - Taxes, general conditions

Topics of the Strategic Innovation Agenda



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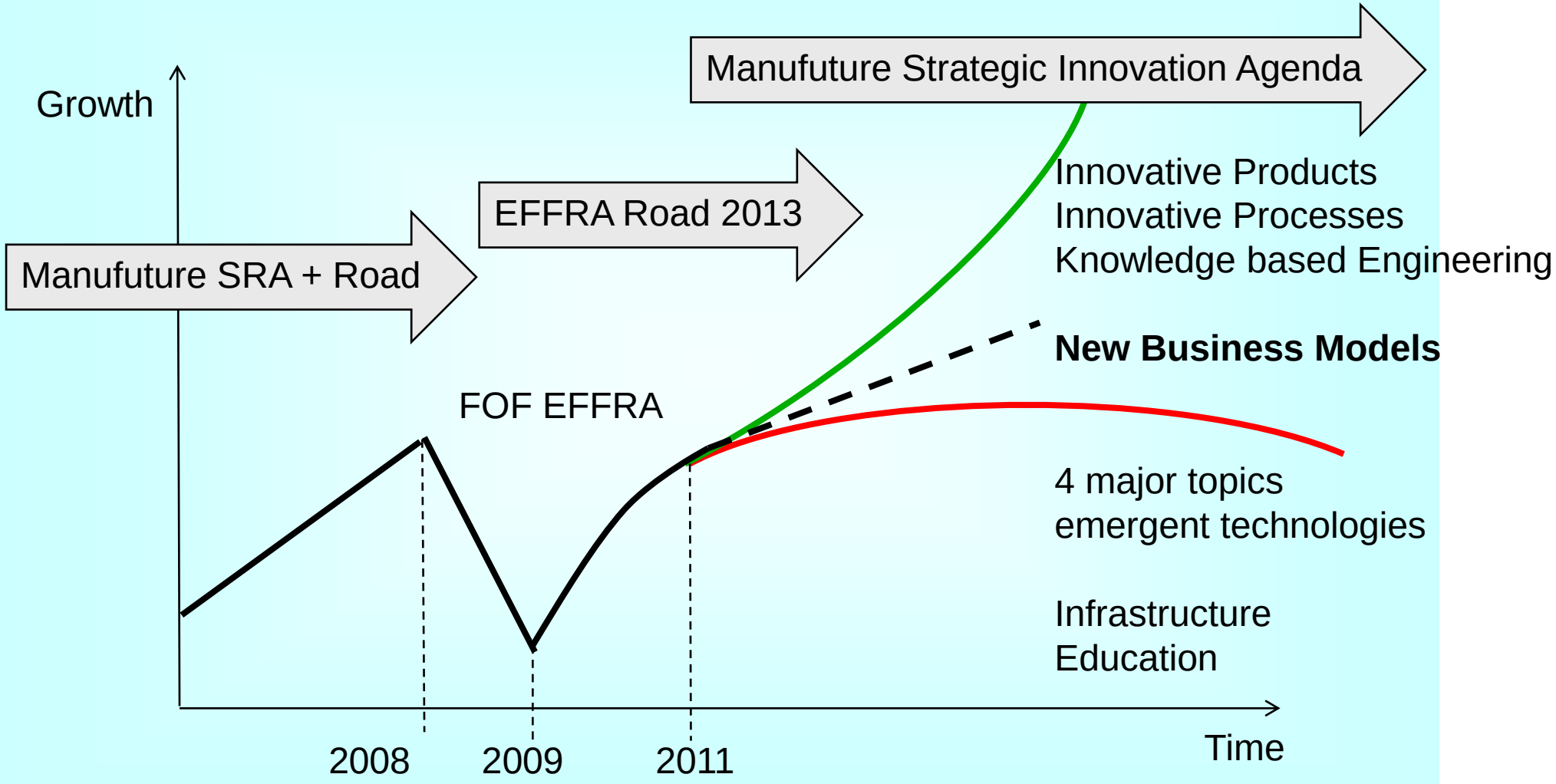
Research and new Business Models



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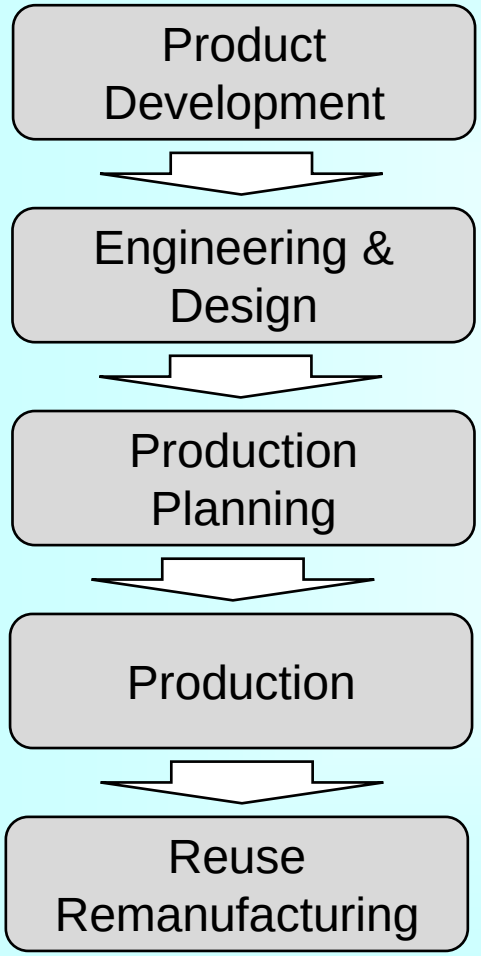
New Business Models along the life cycle of products



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

Increasing the creativity and efficiency of products ...

… by …

… for existing Markets

Implementation of New Materials / Nano's
Weight reduction (dematerialisation)
Embedding of sensors / electronics
New functionalities / technical intelligence

… for emerging Markets

E-Mobility (E-Cars, Engines, Batteries, …)
Health (Medicine, Chemistry, ...),
Bio-Products, Food, Agricultural…
Environmental Sectors, Energy, Water, …

… for low technologies

Customised consumer goods…
Design oriented Products…
Parts, components….

… for enablers

Factories Equipment (Basic Technologies)
Photonic Machines, Light technonolgies
Mechatronics, Embeddining Electronics
Software for Products and Production

Engineering Competence

Implementation of new Process-Technologies
High skill, Motivation

Collaboration Cooperation

Knowledge based Engineering tools

Education

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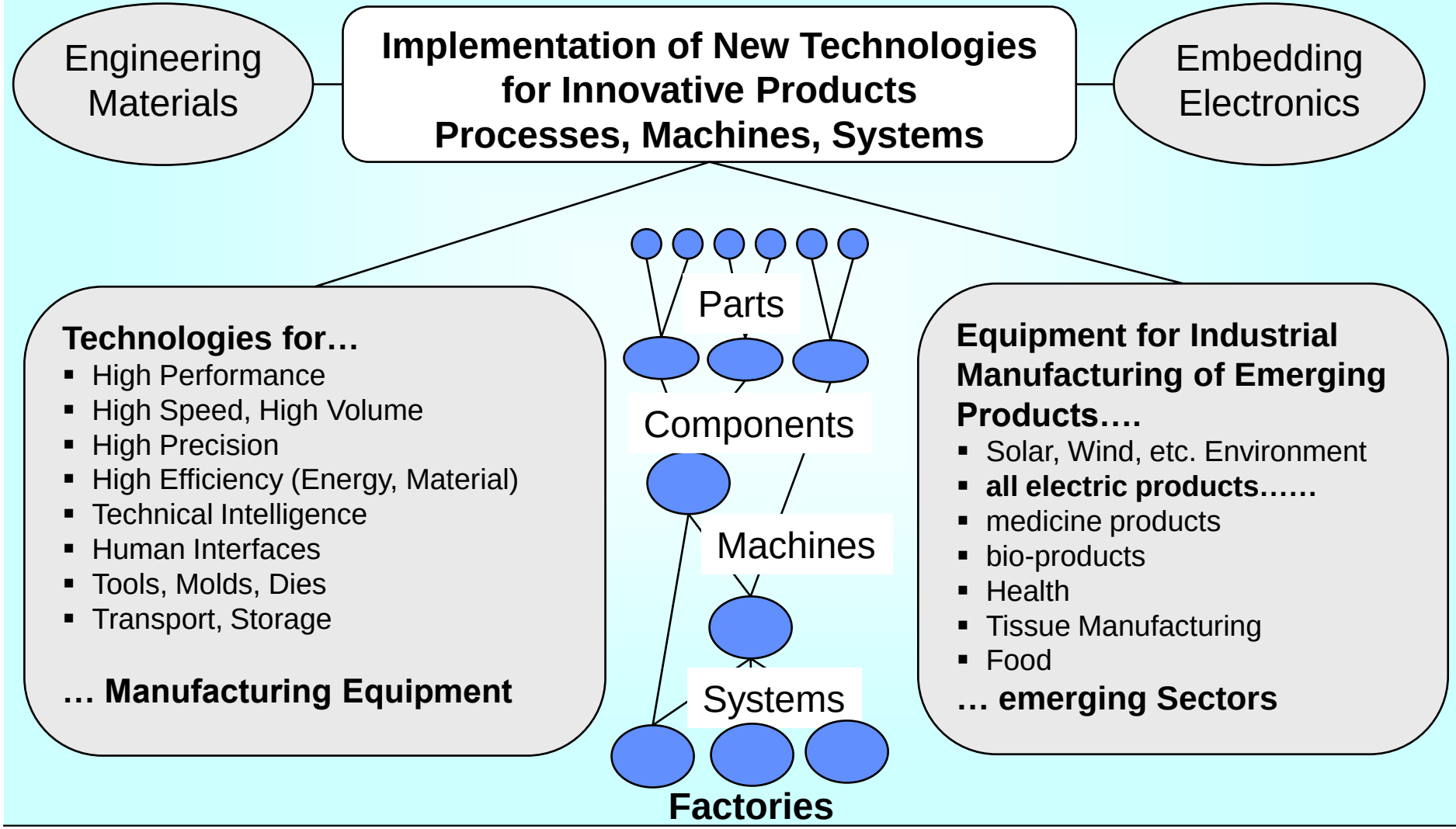
Grand Challenge: Dematerialisation of Products

- **Reduction of the material-consumption** by:
  - Light weight 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



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Knowledge based Manufacturing Engineering

Increasing the quality and efficiency of manufacturing engineering

Scientific based Process Models

Customised Manufacturing Solutions

Manufacturing Engineering
Digital and virtual
Product Engineering,
Process planning
and Process control
with learning elements and
In situ-Process-Simulation

Flexibility for turbulent Markets

Process Technologies beyond limits

Remote Manufacturing

Intelligent Machines

Variancy

Zero-Defects

Flexibility and
High Performance
High energetic efficiency

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The 4 major topics for emerging Manufacturing

grand challenges
JOBS, INDUSTRIAL COMPETITIVENESS, SUSTAINABILITY

Manufacturing in urban environment & mega cities

- sustainable consumption and production
- sustainable mobility
- emergent technologies

Factory and nature lean, clean, green factories

- energy and material saving
- renewable energy

Volume production back

- „jobs, jobs, jobs“
- „adding value “
- with engineering competence

Next generation ICT for manufacturing

- aging society
- enabling technology for grand challenges

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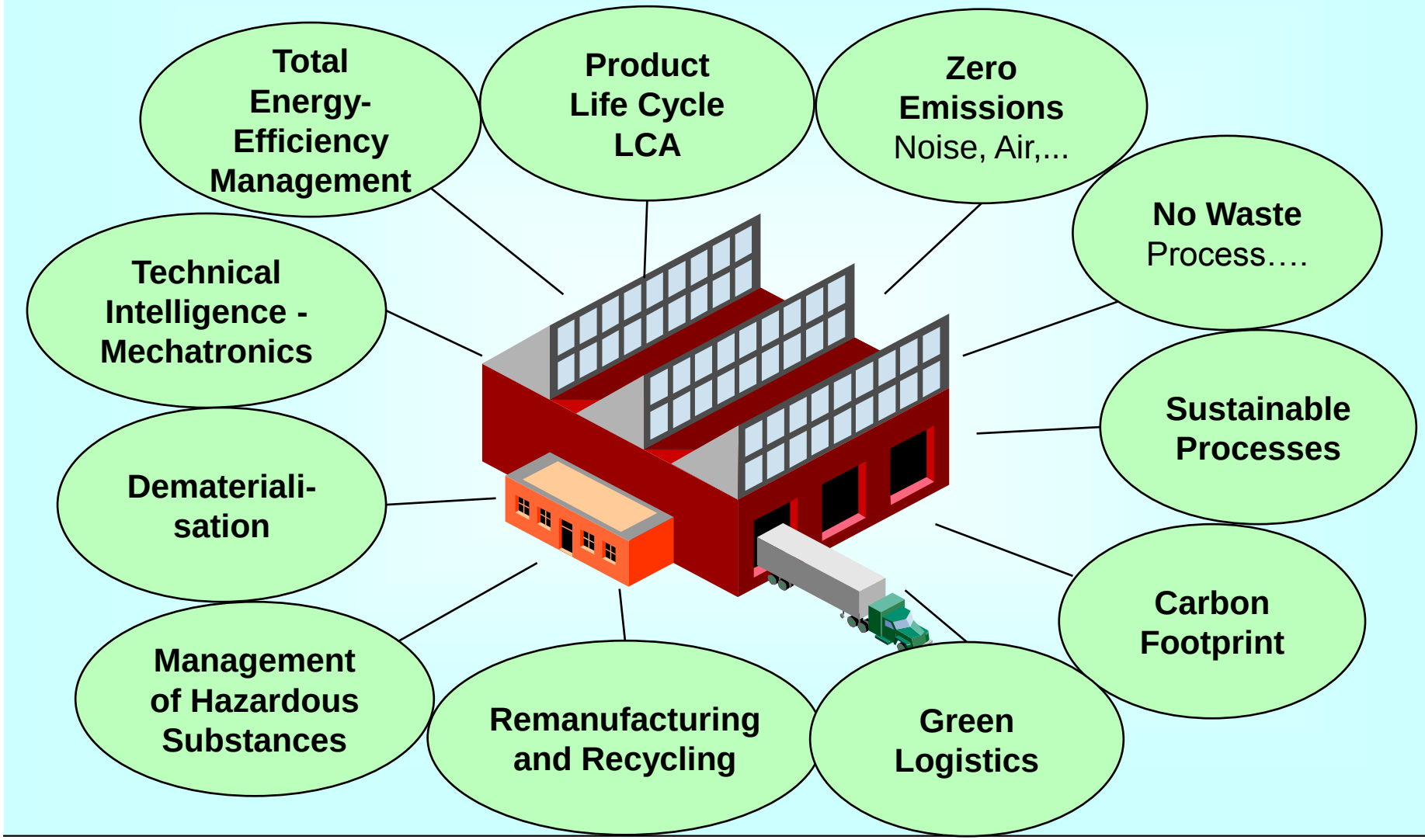
Manufacturing in urban environment & mega cities

- 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

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

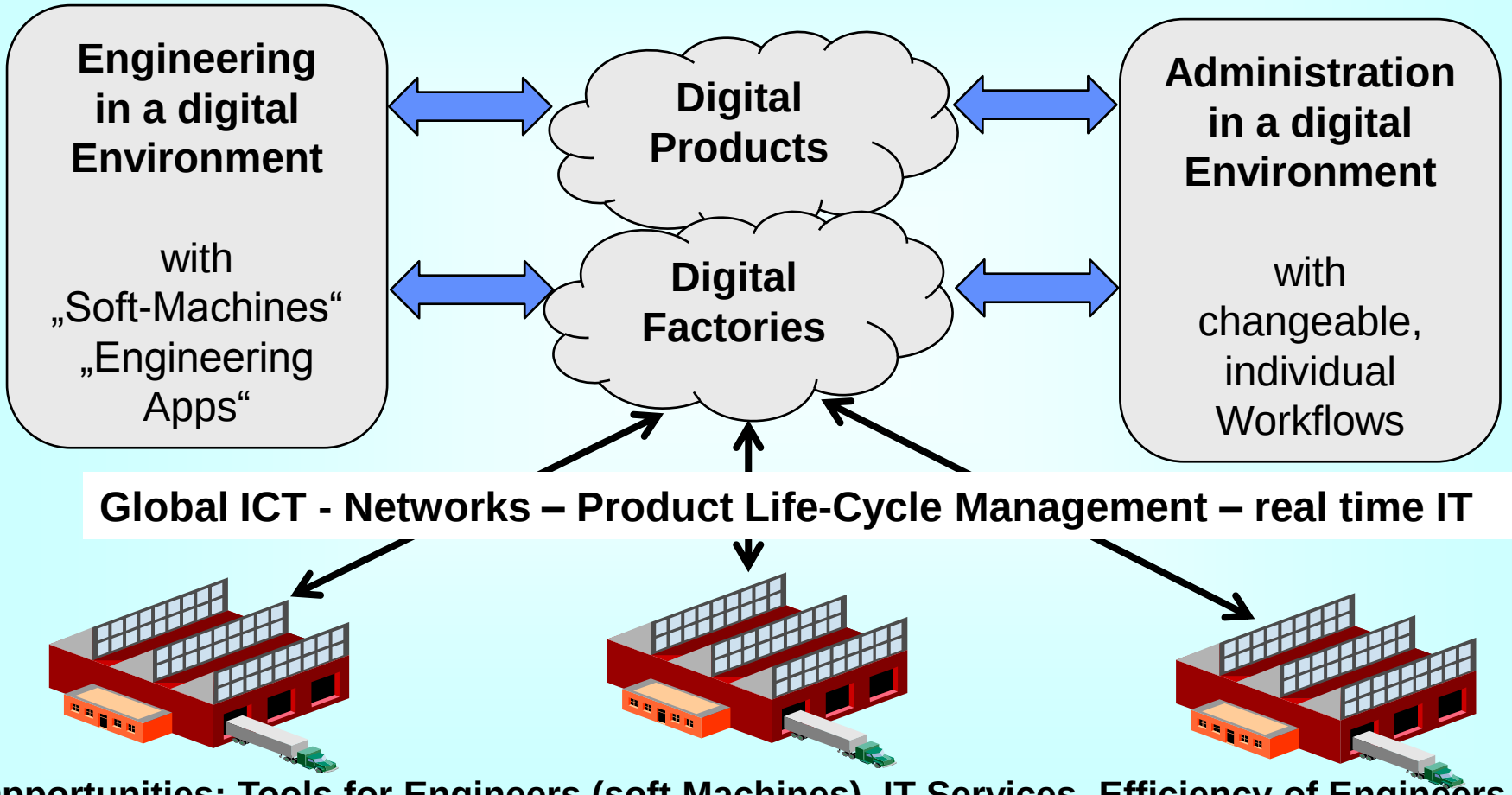


Volume production (back) to Europe

- 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

Threats: ICT-Security, gap digital-real world, ICT costs, bureaucracy



Opportunities: Tools for Engineers (soft Machines), IT-Services, Efficiency of Engineers

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Research for ICT in Manufacturing - Priorities

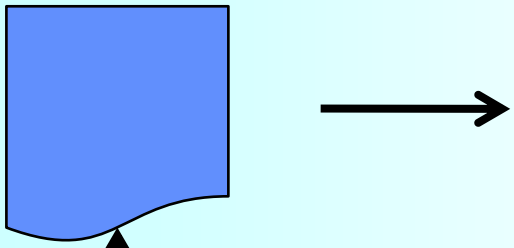
- **ICT is one of the most important Key-Technologies for Manufacturing**
  - influences all business, engineering, production and service processes in the life cycle of technical products
  - but customized and flexible Workflow-Systems required
- **Support the efficiency and IT-Tools for Engineers**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

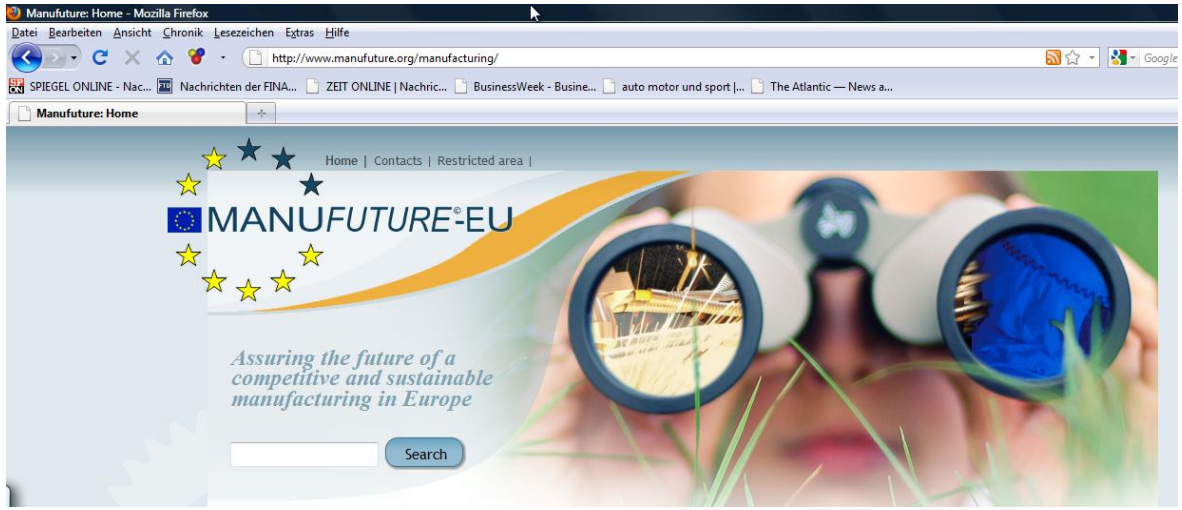
Challenges for Manufacturing Development

- **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

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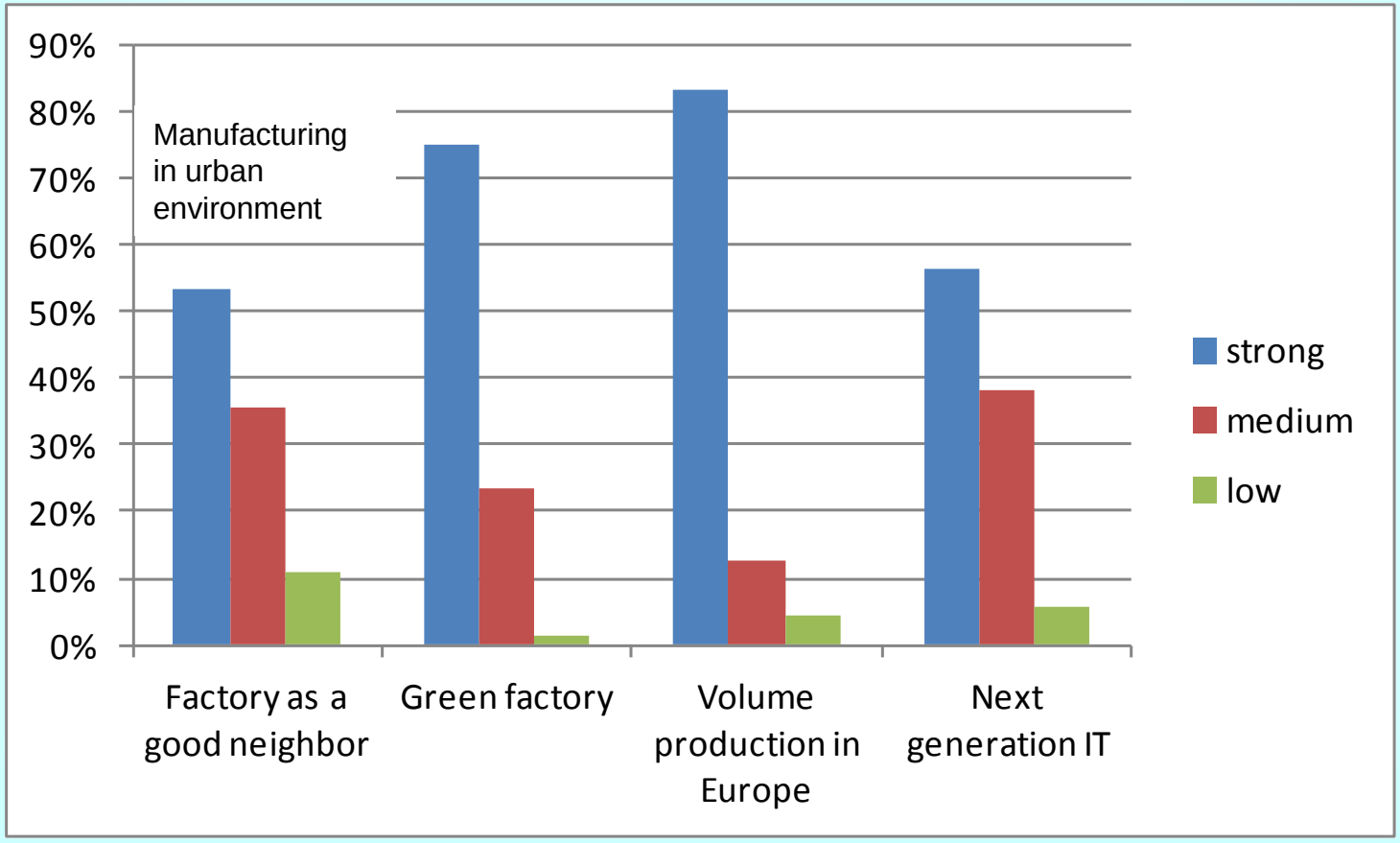
The four major topics

prime focus of interest:
Volume production in Europe



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Thank you for your attention