

Manufacturing 2030 in Europe

Discussions in Manufuture ISG

Manufuture developed the Vision 2020, the Strategic Research Agenda and Road Maps as basics for the European Research in FP7 and FP8. The vision was mainly influenced by the challenges toward competition and sustainability by transformation from cost orientation to adding value with technical and organizational innovations. Manufuture developed a strategic research Agenda “2008” and Roadmaps to support the process of structural changes and orientation to higher efficiency and changeability. Technology development was driven by the activation of technological potentials in the process chains from basic materials to finished products and from customer’s orders to the end of life to increase adding value. Manufuture proposed fields of proactive actions for cooperative research in Europe across the 40 industrial sectors. Core fields of the strategic research agenda are part of the Factory of the Future (FOF) program and on the way now for implementation.

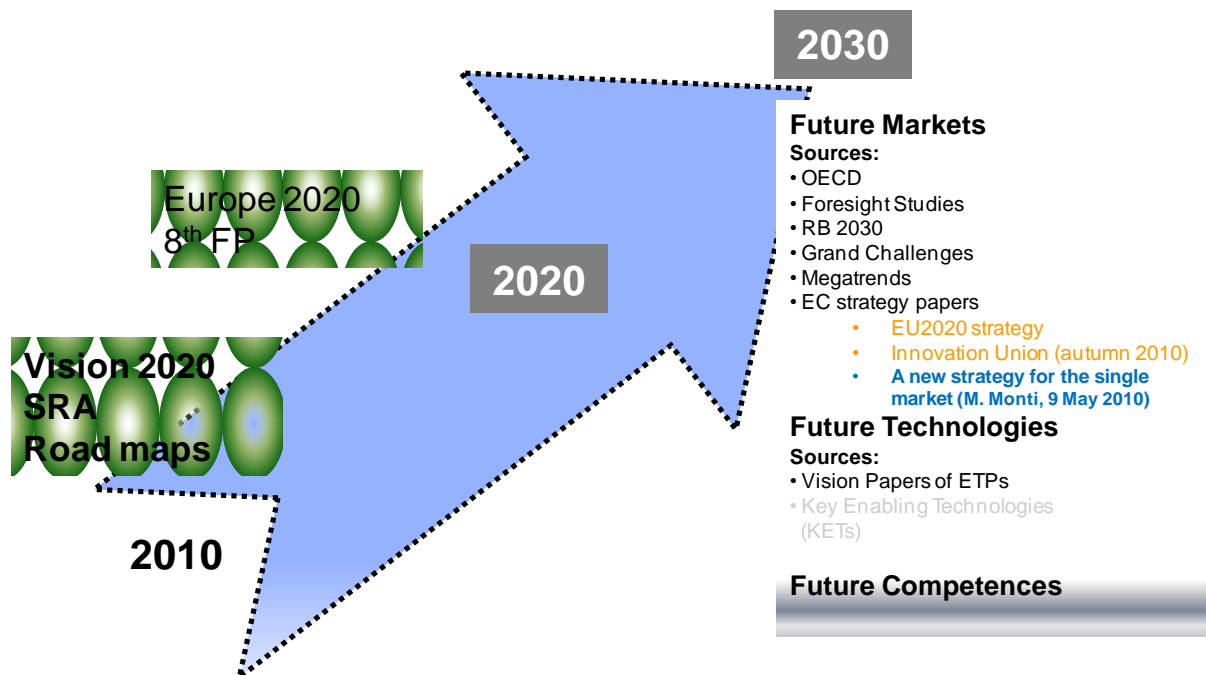


Figure 1: From Vision 2020 to Vision 2030

European research and innovation policy will change its perspective, expressed by the LUND (Swedish Presidency) declaration: “European research must focus on the Grand Challenges of our time” **“European research must focus on the Grand Challenges of our time moving beyond current rigid thematic approaches. This calls for a new deal among European institutions and Member States, in which European and national instruments are well aligned and cooperation builds on transparency and trust.”**

That means to shift the focus from technology push to market pull approach, which will be defined by the so-called „societal challenges“. In total this represents a complete **paradigm shift for FP8**, for the „simple but important“ reason to enhance the economic impact of public research.

Manufacturing is the Key Economic area to create high adding Value by transformation of material and energy to products. In a global environment with rapidly changing factors and new challenges for the future development of manufacturing it is essential to concentrate forces in R&D for competitive and sustainable development.

European Manufacturing industries need the next orientation towards 2030 for the strategic orientation of the next research program FP8, the national and regional priorities in research and strategic orientations of enterprise developments, the vision continues the fundamental change in the manufacturing paradigms as formulated in the past and take into account the changing requirements after the economic crisis 2009/2010 and which open the mind for future markets (figure 1) by Key Enabling Technologies (KET). The Vision 2030 is a contribution to the next generations of manufacturing taking into account the megatrends, which influence markets, processes and growth of the European economies.

Impact of Megatrends

Under the influence of megatrends a structural change in nearly all 40 sectors of manufacturing towards competition by intelligent solutions and sustainability is required. Figure 2 shows the main trends and their impact in manufacturing.

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| <ul style="list-style-type: none"> ■ Ageing <ul style="list-style-type: none"> - future markets and products - Age of personnel ■ Individualism <ul style="list-style-type: none"> - Individual and customised products - Human being and work in factories ■ Technologies/Knowledge <ul style="list-style-type: none"> - Knowledge driven products - Knowledge driven processes - Science based technologies ■ Globalisation <ul style="list-style-type: none"> - Global sourcing – global distribution - Global logistics - Global communication standards (WEB) - Global process-standards - Global quality standards - Global competition | <ul style="list-style-type: none"> ■ Urbanisation <ul style="list-style-type: none"> - Mobility, Traffic, ... - new products for mega-cities - Manufacturing in Mega-cities ■ Sustainability <ul style="list-style-type: none"> - Priorities for economic, ecologic, social efficiency ■ Finance <ul style="list-style-type: none"> - Turbulences in finance of investment - R&D and long term assets - Economic cycles ■ Public debt <ul style="list-style-type: none"> - Adding value - Growth - Employment - taxes |
|--|--|

Figure 2: Megatrends influence manufacturing development

Ageing population influences future products and markets and the work of 70 million people in manufacturing. Ageing people is a resource with high experience but changing human conditions. More and more direct work in manufacturing is relocated to indirect work and towards engineering and after sales business. The diffusion of ICT to nearly each workplace opens new fields of work for elder people and human machine interfaces.

Individualism boosts the customization of products towards complexity and variety of products and processes. Individualism is supported by the application of Internet-Technologies in sales and sourcing and reduces the distances between manufacturer and their customers. It will contribute to the migration of manufacturing sites in the centers of markets.

As results of fundamental research and education **knowledge will drive technologies** towards technical innovations and manage complex products and processes with higher reliability and efficiency. Already today about 20 % of the workforce in industry are engineers knowledge is the future source for adding value by implementation of implicate knowledge in products und machines by cognitive methodologies to increase the utilization and efficiency in the technical life of each product. Scientific based knowledge supports the learning effects in manufacturing. The qualification and skill of manufacturing people is increasing caused by the requirements of complexity and variety.

Globalisation in Manufacturing is a fact today. Driven by the migration of consumption and production in the growing new industrialized countries (mainly BRIC-states) the global sourcing, production and distribution equalizes the quality and technology standards. Different surrounding conditions influence the speed of migration.

Half of the world population is living in mega cities. This **urbanization** changes the requirements for future products, markets, logistics, traffic-technologies and regulations for manufacturing in the mega cities (personal resources, restrictions, work regulations etc.).

Sustainability is a common interest of the world's societies. Public Restrictions to reduce the environmental impact and the consumption of energy and material is a critical success factor for manufacturers. Manufacturing is the enabler for innovative technologies for environmental protection with a strong growing world market.

Finance influences the investment in manufacturing with high impact as we learned in the last economic crises. Many factories did not survive caused by the economic turbulences. New models of management are required to reach higher resilience and fitness in the turbulent environment.

The **public debt** of European states influences the taxes and the investment of states in the infrastructure (education, communication, transport) with impact on the

conditions of manufacturing. The states are highly interested to increase the adding value by manufacturing.

The general objective of future development is the structural change of the eral economy in Europe towards long term challenges.

The new challenges

The Development of the European Strategy 2020 was highly influenced by the economic crises (Figure 3). Manufacturing industries are able to support the mid term ambitious goals, but they need a long term orientation for their investment in technologies, facilities and in R&D. The European Strategy 2020 *a re-focusing of EU research and innovation (R&I) policy on major **Societal Challenges***, facing European Society,

- *Challenges bringing huge **opportunities for business***: i.e. increased demand for sustainable products/services and processes, within ‘sunrise’ as well as traditional industries
- *integrating **research and innovation** policies* so as to create the conditions for a more dynamic, inclusive and sustainable Europe

The European Commission has launched “**EU 2020 Strategy**” to help to

- *come out* stronger from the crisis and
- *turn the EU into* a smart, sustainable and inclusive economy, delivering high levels of employment, productivity and social cohesion.

“**EU 2020 Strategy**” sets out

- *a vision of Europe's social market economy for the 21st century*

Europe must provide

- a basis for its *future competitiveness*
- Solutions to growing *Societal Grand Challenges*

Figure 3: EU Strategy 2020

There are many options for the European way. Manufacturing as the core of the European economy has the potential for the societal grand challenges and future development. Main challenges for the manufacturing development following the megatrends are:

- **Knowledge oriented business, technologies and solutions to activate the economic potential along the life cycle of each technical product.**
- **Activating the technical and economic potential of sustainable manufacturing.**
- **Implementation of technologies to bring back mass production to Europe.**
- **Activate the potential of customized and near to market products.**
- **Realize high efficient and zero emission manufacturing in urban environments.**
- **Strengthen the competition in the global economy.**
- **Implementation innovative culture of work by taking into account the ageing population.**

In Summary Manufacturing is a key technology and has even in conventional areas a high potential as enabler of future production and adding value in Europe.

The role of manufacturing in the Innovation Process

It is necessary to increase and focus research toward future visions and requirements toward competitiveness and sustainability. Manufacturing includes humans as workers, engineers, technicians, administrators, managers. Their education should be a part of a strategy to 2030.

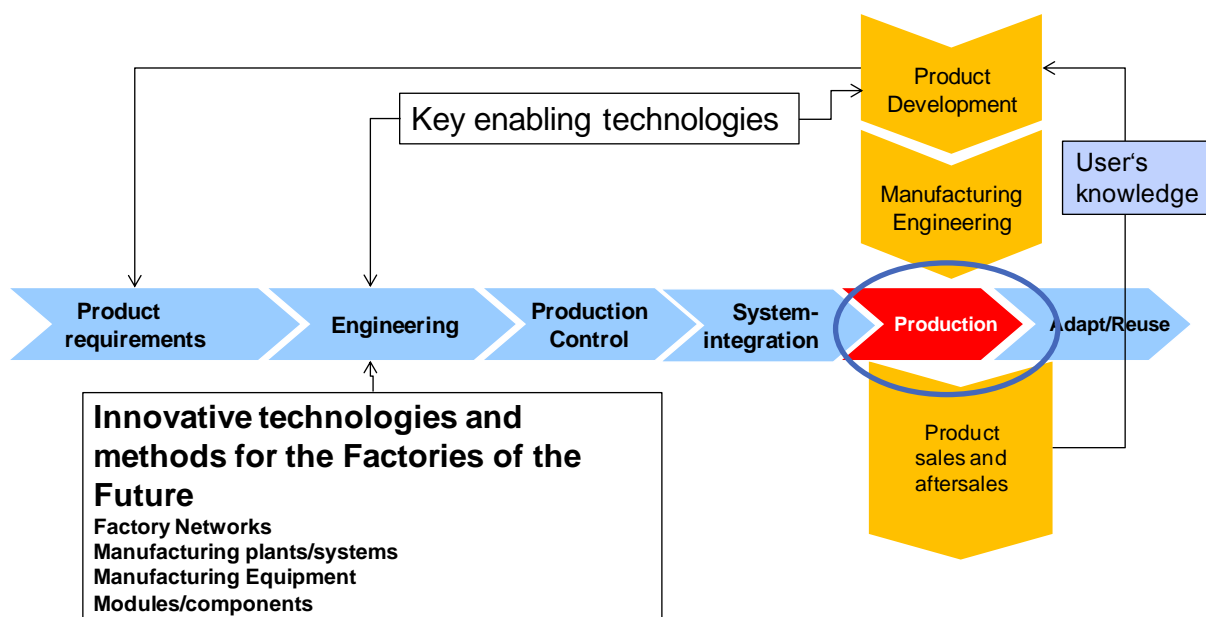


Figure 4: The role of manufacturing as enabler and as value creator

Annex List of KET for Manufacturing

Industrial manufacturing first and foremost means high value added products (products and value added) with the help of skilled people and their knowledge, and factory equipment /machines and tools (or in other words assets) within a factory:

- high tech products made by high tech production processes (e.g.: premium cars, high tech machine tools, aircraft engines, high speed trains, airplanes and accessories to name just a few)
- as lean and clean as possible, - ideally in a zero emission and zero waste factory. Industry will therefore inevitably be the engine of the future low-carbon, resource-efficient and knowledge-based economy.

A very good example is dry machining of metals in the automotive industry. By removing coolants, it is now possible to avoid emissions, waste and potential hazards and to save energy and money at the same time. Started back in 1994 with the basic investigations, followed by various experimental and running a pilot production, in 2001 was the first introduce of dry machining into volume production, of aluminum wheel carriers. (Dry machining could increase to 60 % by the year 2012 in the Mercedes-Benz Untertürkheim plant)

Other examples welcome

Competiveness in the global environment

Manufacturing is a transformation process to add value from Input (Material, Energy) to Output (Products, Services). The efficiency of this transformation process is the critical success factor on a global environment, where the costs of input are increasing and the revenue depends on global situation. The main resource we have in Europe for competitiveness is the knowledge and skill of people and the infrastructure of our regions with a traditional culture in manufacturing. Individualism (megatrend) requests the competence to design and manufacture individual products in high dynamic, high performance and changeable manufacturing. Taking into account the industrial structure of with deep and broad competences in manufacturing technologies and many SMEs it is evident, that individualism is the biggest chance for the European development. Individual products made for individual customers require a flexible high productive manufacturing technology on high level of quality and reliability.

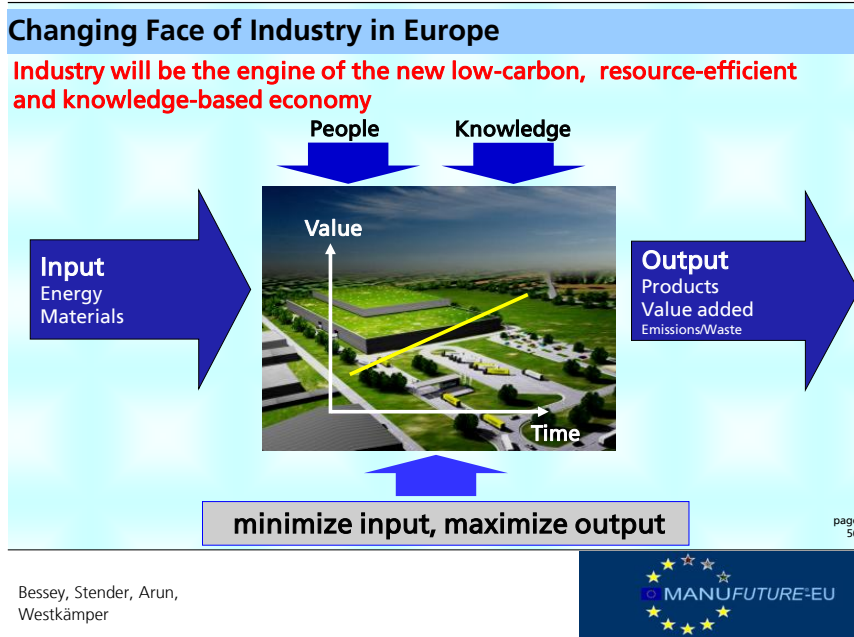


Figure 5: Manufacturing and Competition

Technical intelligence can be implemented to reach high performance and reliability. Not mass production but customized production in an ICT-Environment is the core of the future orientation. Skill and competences of people have to be supported to increase the efficiency of processes in the future digital environment. Human productivity, skill and competence can be increased by the implementation of ICT-innovative solutions and tools (Engineering, Training, e-learning, etc.).

Human competence as driving force for the manufacturing of customized products and flexible manufacturing has the potential to answer the grand challenges of globalization and bringing back mass production to Europe. It is not one special technology, which influences the future perspective but the full spectrum of technologies required in the process chains from raw material to finished products and to the end of life. It has the possibility to win back material resources by recycling and remanufacturing.

Societal grand Challenge Sustainability

Under the influence of the environmental impact and climate change societal challenges cover issues such as:

- green manufacturing

and other topics relevant for our society to ease the “burdens” of life in demand of the European citizens and worldwide (figure 5).



Figure 6: Sustainability and Manufacturing

Stronger regulations for emissions and expanding costs of energy and material are trends which influence the manufacturing area extremely. Manufacturing has the option to reduce the consumption of energy and material by taking the challenge for sustainability as part of the overall management objective. This opens the way for technical innovations and economic success. It has the potential for emerging market in the manufacturing of technical solution for environmental protection and industrialization of manufacturing of environmental friendly solutions (energy, water, air). Factories of the future take back product after their usage for remanufacturing and material oriented recycling. Their products follow lines to **dematerialization**:

- reduce weight – increase intelligence
- miniaturization of components
- specialization of materials
- reproduction and substitution of rear materials
- increase life time of products (utilisation)
- Technologies for upgrading and reproduction
- Substitution of energetic processes
- Total Energy Efficiency management

Active orientation toward the so called green manufacturing follow well known methodologies like lean manufacturing or value oriented manufacturing chains, which reduce loss of material, energy and other resources in the life of products.

Objectives of Manufacturing Management

Concrete objectives can be summarized as shown in the next figure (figure 6). Global competition and sustainability are the main objectives to strengthen the European development into a smart, sustainable and inclusive economy, delivering high levels of employment, productivity and social cohesion.

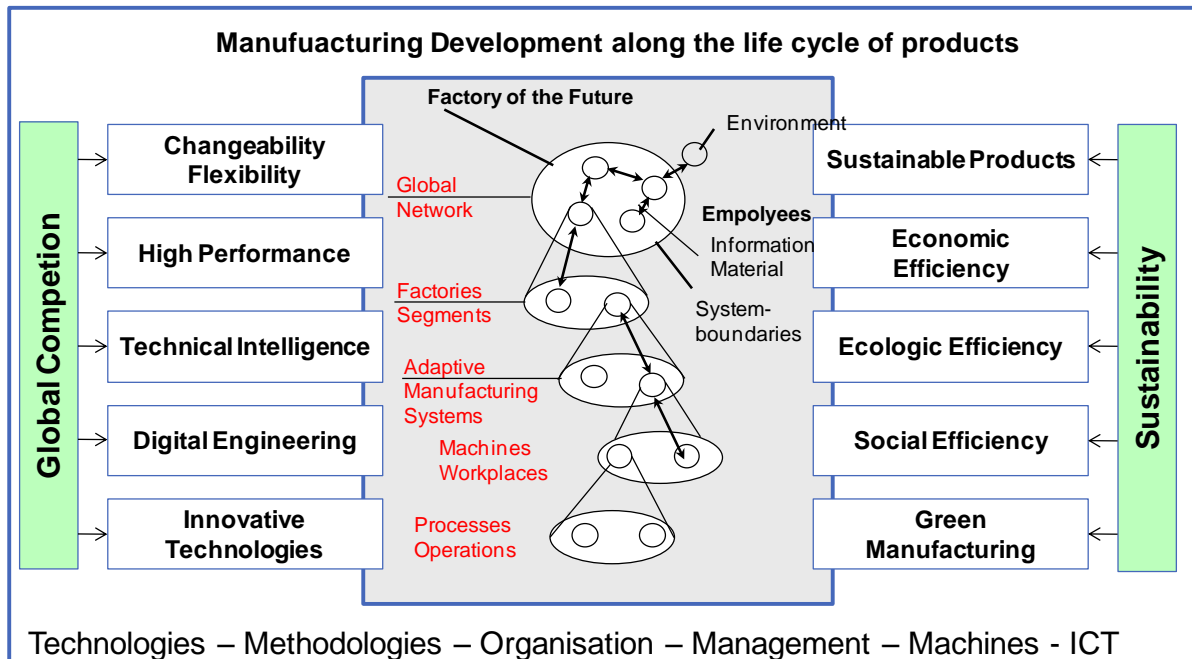


Figure 7: Manufacturing objectives

Experts agree, that it is necessary to activate the potential in all manufacturing technologies required for future products e.g. basics and conventional because of their big impacts on employment and ecologic, economic and social efficiency.

To realize growth and reduce unemployment by bringing back volume production to Europe, we need conventional technologies but in a way, that industries fulfill the requirements of economic, ecologic and social standards (sustainability) on European level. Following the life of products from idea to the end of life, it seems to be possible to add value by product oriented services. By the way, the key enabling technology is the infrastructure for industrial IT.

Green manufacturing is the grand opportunity for the transformation of the European manufacturing to the requirements of the next decades.

Fields of Research for manufacturing

The vision of Manufacturing 2030 proceed the Research Agenda (SRA) of Manufature and boost the paradigm of competitive and sustainable manufacturing under the aspects of megatrends:

- From cost and short profit orientation towards adding value
- From economic efficiency to sustainable and green manufacturing
- From hire and fire to societal grand challenges

There is an enabling role to take by industries who deliver equipment and capital intensive goods to the users of factories in a way of customised innovations.

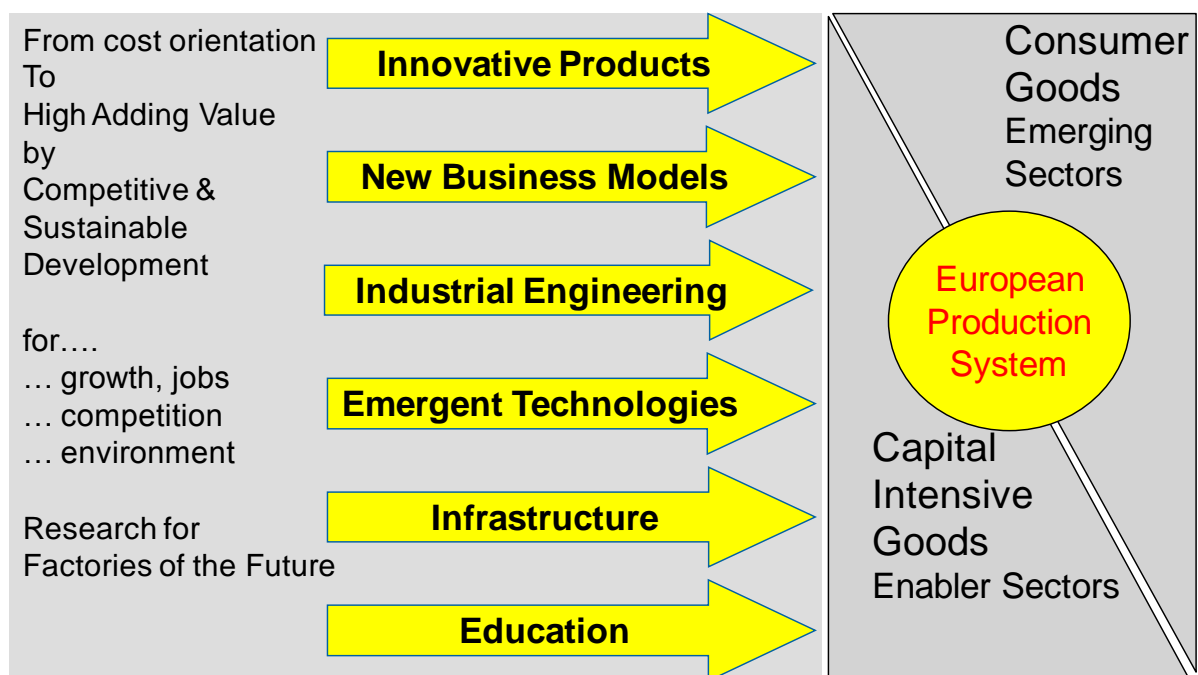


Fig 8: Fields of actions in Manufacturing.

The capital intensive goods sectors (Machines, Ships, Trains, Aerospace, Agricultural, Chemistry etc.) as well as medium and low consumer goods (automotive, white and brown consumer goods, textile, pharma) need high end customized manufacturing solutions.

Delivery of everything what is required for manufacturing on highest technology level and lowest consumption of energy and material is today's opportunity for Europe. This must be based on high competence in making customized solutions. World Marked share >40 % seems to be possible but this requires customer driven innovation even in conventional technologies. We are not at the end of the technical potential when we take into account: expanding variety of materials, intelligent mechatronics, high precision, lean- clean- green methodologies, ICT-Solutions for engineering and management.

By the way, the engineering competence is the key to accelerate the implementation of manufacturing in emerging sectors like energy (wind, Solar etc.), health (medicine technologies), Mobility (electrical cars etc.) LCD/LED, Photonics etc., Environmental technologies (water, air). Inside of factories are fields for emerging infrastructural solutions for higher efficiency in energy or materials consumption. Reducing material by remanufacturing and industrial renewing of technical products is an emerging sector taking into account the increasing costs of resources.

From the successful regions in manufacturing in Europe we learn that there are some more critical success factors: The kind of management in crisis, the regional brightness and deepness of technologies, the “Efficiency of Engineering” for customized products, the skill and competence of employees.

The following figures show some new areas and opportunities for manufacturing in Europe (based on fig. 7).

1. Innovative Products

The first figure (figure 8) shows fields of innovation for future products taking into account the potentials of materials and products-technologies. For all these future products Europe needs the production technologies on industrial standards (competition, sustainability). Many well known processes have to be adapted or changed for the requirements of future products (Competition in Engineering).

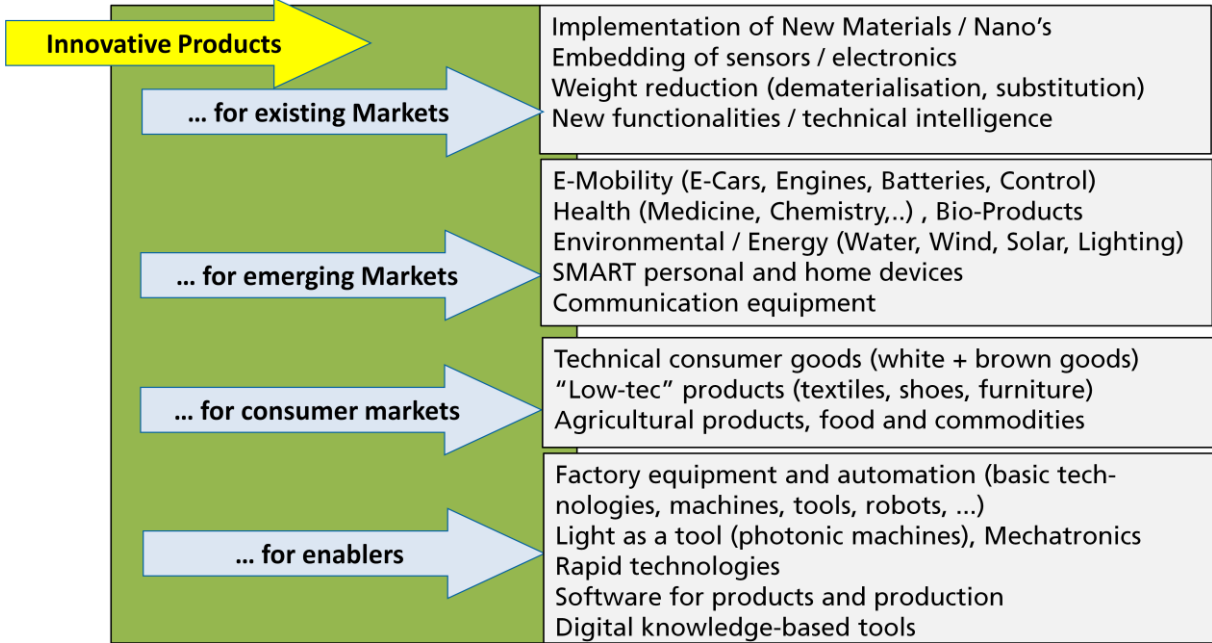


Figure 8: Areas for product Innovations in Lead Markets

2. New Business Models

The crisis showed us, that manufacturing industries need robust business and management models for sustainability in turbulent environment. Europe has the

tradition and the competence to change short time profit optimization toward robustness. (figure 9)

Main objectives of this field are the

- Resilience and sustainability of companies
- Activation of potentials in the product life cycle
- The implementation of ICT for operations in turbulent environments
- The usage of ICT in the customization of relations
- Managing the complexity of products and processes
- Implementation of e-learning for employees

Beside of this, there are new requirement for managing **global operations and regional synergies**. Another aspect is the fact, that manufacturers are able to follow each product over its life in the global communication. But it is necessary to find solutions for security of technical knowhow. The digital production can be used in pre- and after sales as well as for education at work. Additional fields of actions are in the computerized technical support and service: Key technology ICT for Manufacturing, SaaS, Grid etc.

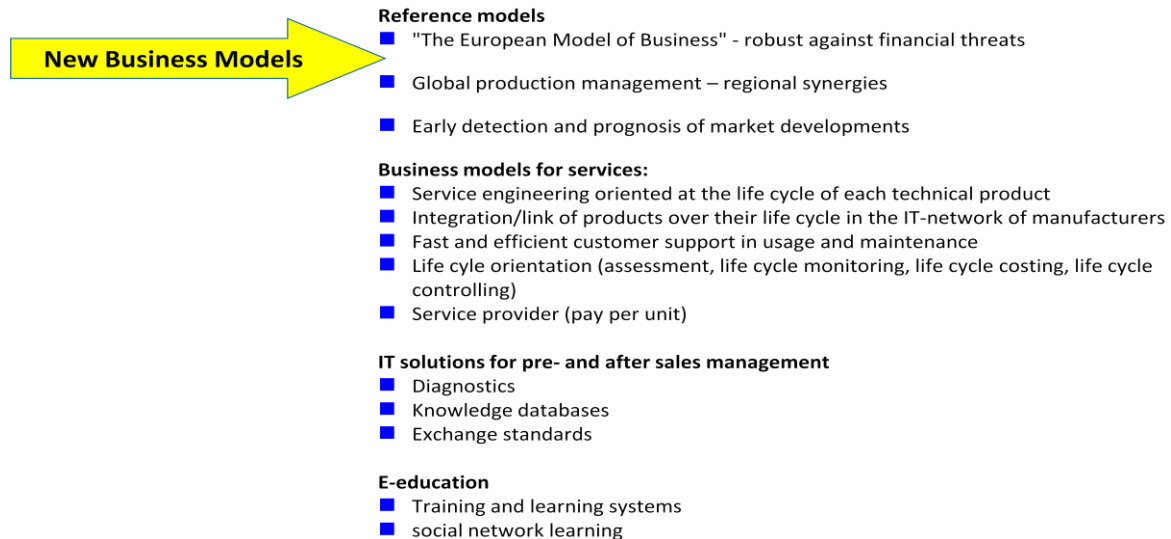


Figure 9: Development of new business models

A special point in the future development is the protection of know how.

The development of new business models is an interdisciplinary task: technology, IT, service provider

3. Efficiency in Engineering

Customization and optimization of the efficiency requires higher personal skill in engineering and production. The specific objectives of this field of actions are:

- Productivity in customized innovation
- Quality, Reliability and Capability of products
- Implementation of dematerialized solutions
- Proactive optimization of the life benefits

Engineers need basic knowledge and tools for their work. In this world marked European Industry is behind. We make best machines but not the machines (knowledge based) for engineers to develop high end products or to manage the complexity of products.

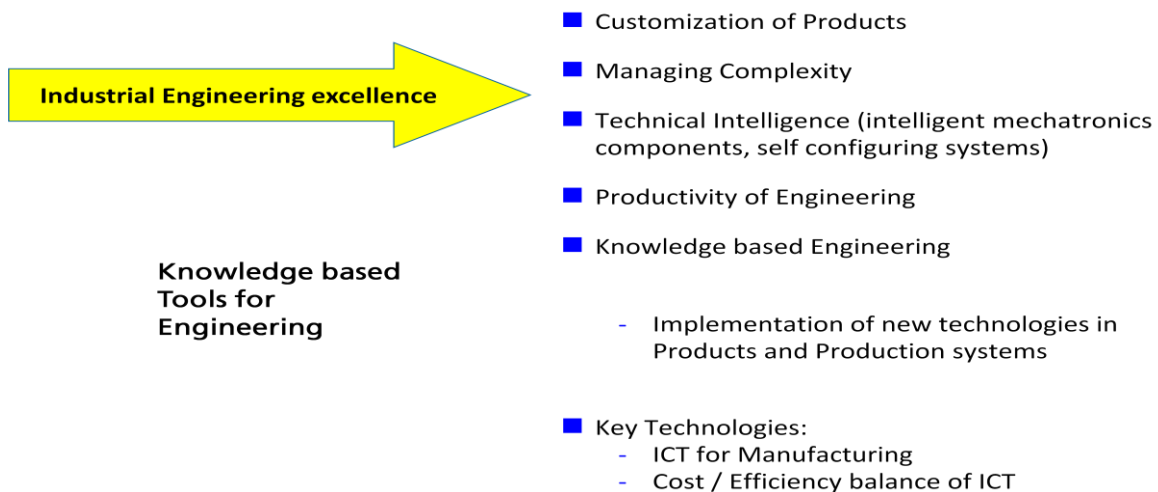


Figure 10: Tools and Machines for Engineers

We expect a billion world market in the field of knowledge based engineering systems. (digital products, digital factory, knowledge tools, security in the networking etc.)

4. Emerging Factories and technologies

Emerging factories reflect on the megatrends and new challenges. They implement technologies for high efficiency of materials and energy and make use of technical intelligence in the life cycle of Factories. The digital world is connected to the real world and usage (figure 11).

Emergent Technologies

Emergent technologies and process integration for:

- Materials and processes for intelligent manufacturing of SMART and new products
- Innovative metrology – inline
- Agile manufacturing systems for turbulent markets
- Efficiency-leap with ICT - in the global networked community

Figure 11: Emerging Technologies and Factories

4 major topics...

With all our knowledge we should be able to realize emerging types of factories for intelligent production of dematerialized Products (low weight, micro dimensions, soft- instead of hardware etc.)

“top down” approach: the 4 major topics

grand challenges JOBS, INDUSTRIAL COMPETITIVENESS

factory as a good neighbor

- > sustainable consumption and production
- > sustainable mobility

- Manufacturing in cities / metropolitan areas
- Factory integrated in the living environment
- On-site configuration
- Customized products - production
- Late customization
- Event-oriented production

factory and nature (green factory)

- > energy and material saving
- > renewable energy

- lean clean green
- lowest resource consumption / energy
- low to zero emissions
- close loops for products / production
- sustainability in material, production processes / workers
- Closed loops for critical resources (rare earth metals)

factory and humans

- > „jobs, jobs, jobs“

- volume production in Europe (new production sticks to Europe)
- highly competitive products (cost, quality, performance)
- high bandwidth of products (simple – sophisticate)
- mastering of highly sophisticated manufacturing (micro, nano) / logistics / new business models
- Timely product innovation and delivery – high speed of change

factory and ICT, next generation IT for production

- > aging society
- > enabling technology for grand challenges

- smart, grid, cloud, ... - computing
- „internet 2.0/3.0 – social networks“ for production
- internet of things
- virtual <-> real production / smooth transition
- hard and soft learning-knowledge back-bone for life time learning
- Safety for data and processes / Plug and produce

Following megatrends it is necessary to realize factories of emotions inside of cities for design oriented products and let people work where they live (no noise, no scrap,

etc.). Bringing volume production back by innovative solution or make factories lean, clean and green could be a way to European answers to the megatrends. Another option is driven by ICT-Solutions toward that what we call learning factories or ICT oriented networking in manufacturing

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