

Executive Summary

# EFFRA RESEARCH PRIORITIES



**EFFRA**

EUROPEAN FACTORIES OF THE FUTURE  
RESEARCH ASSOCIATION

*a MANUFUTURE initiative*



# Building the future together

*Boosting productivity is vital for strengthening Europe's competitiveness on the world stage. This research strategy is a building block in the process as it helps to ensure research leads to commercially viable products and processes for the global markets of tomorrow.*



**Creating strong consensus among European stakeholders:** *The technology roadmap is the result of extensive consultations which took place between October 2008 and January 2010.*

**E**FFRA has drawn up a reference document which describes the four research priorities it will pursue under the 'Factories of the Future' public-private partnership, entitled the 'Strategic Multi-annual Roadmap.' This summary paper gives a detailed overview of the document and outlines the main goals of each priority area, while explaining the social and economic objectives which will be achieved in pursuit of these aims.

These priorities were defined after careful consultation and thoroughgoing deliberations with hundreds of different stakeholders from across the private sector in Europe who represented the main enabling technology providers of European manufacturing industry, along with academics

from research institutes and universities and the users and producers of production technologies.

The process began in October 2008 with an open consultation overseen by EFFRA's Industrial Research Advisory Group, who

ensured that the principles of fairness, openness and transparency were upheld.

In the light of new developments and changing market conditions, the consultation remains ongoing, with new input incorporated on a continuous basis.

## EFFRA Research Priorities

### Sustainable Manufacturing

- People-friendly Factories
- Eco-friendly Factories

### High-productivity Manufacturing

- Adaptive production equipment
- High-precision manufacturing
- Zero defect manufacturing

### ICT-enabled intelligent Manufacturing

- Smart Factories
- Digital Factories
- Virtual Factories

### Materials in Manufacturing

- Materials efficiency
- Manufacturing processes for new high-performing materials

# Sustainable Manufacturing

*Sustainable manufacturing is the lynchpin of green growth, a dynamic economy and a competitive industrial base able to cope with the challenges of the modern world.*

**S**ustainable manufacturing is important for creating a durable economy which is based on green growth and continued investment in jobs and wealth creation. Europe is confronted with several challenges, such as climate change, the drive to secure energy independence, an ageing society and the need to develop new technologies to remain competitive on the world stage.

Achieving sustainable growth means building an economy which is resource-efficient, sustainable and competitive. Europe is a world leader in developing new and green technologies and should exploit this potential. In addition, it should bolster the already strong competitive advantage afforded by its manufacturing base, in order to create a low-carbon economy which is dynamic and at the same time eco-friendly.

## People-friendly factories

In the light of demographic changes such as shrinking birth rates and an increasingly ageing workforce, companies have to find new ways of providing working environments tailored to their workers' needs. Factories need to be modernised to attract a much broader societal base, such as the elderly, women and the young. This leads to the need

to create working spaces where people like to work, where they are more productive and where they feel cared for and respected.

A key element is to cultivate new forms of interaction between machines and people so that factories continue to be operated profitably while attracting an ever more highly-skilled workforce. In particular, human-robot



**Factories where people like to work:** Pleasant workspaces and innovative human-machine interfaces are some of the prerequisites for occupational well-being.

collaboration will be enhanced through a number of features built into robots, such as voice recognition and natural language and gesture comprehension. This means new production environments will be human-centred, entailing new and innovative developments

in ergonomics, the customisation of machinery and the optimisation of working conditions and methods.

## Eco-friendly factories

Research here aims to make the production process more eco-friendly while maintaining productivity and competitiveness. To achieve this, a number of new developments will be pursued, such as techniques to monitor the environmental impact of changes to different products, along with decision-making mechanisms which take the environment into account.

A key element here is to develop new solutions to reduce greenhouse gases by using more renewable resources, thereby decreasing energy consumption. This will have the effect of making manufacturing processes more cost-effective, while bolstering their environmental performance.

# ICT-enabled Intelligent Manufacturing

*The bedrock of the manufacturing process, ICT boosts efficiency, cuts costs and provides high-quality jobs.*

Information and communications technology (ICT) is an essential component in the manufacturing process. It improves the efficiency, adaptability and sustainability of production systems and allows these to be incorporated into flexible business models and agile manufacturing processes. In addition, it enables industry to adapt to an increasingly globalised market which requires constant innovation in terms of production, process and output.

Research and innovation in ICT for manufacturing is vital for achieving all of EFFRA's research priorities, as it helps integrate any newly-developed ICT into production lines and existing industrial environments.

## Smart Factories

Smart factories use simpler and more streamlined ICT for energy-efficient, reliable and cost-effective production. Future production sites for a large variety of sophisticated products will offer shorter cycle times and the ability to control variables in the manufacturing process. Owing to the increasing convergence of machine control and personal computer technology, important developments in robotics, automation, planning, simulation and optimisation technologies are also foreseen in this sub-domain.



*ICT for smarter and more agile production processes: Fostering interaction between humans and intelligent production systems.*

## Digital Factories

Digital factories help to reduce the need for physical prototyping and the construction of pilot plants when designing future factories. Specialists in fields such as mechanical, software and materials engineering will use digitalised factories to enhance simulation, modelling and knowledge management.

Research in this area will also cover the life-cycle management of products, from the design phase all the way through to production, maintenance, disassembly and recycling.

## Virtual Factories

Virtual factories support the

management of ever more complex supply chains between manufacturing plants around the world.

They include a network of devices, such as, for example, the Radio Frequency Identification (RFID) of work in progress, wireless sensor networks and machine-to-machine communication.

These will contribute to the real-time monitoring of complex material flows and the more efficient use of resources. In addition, they will give rise to further services, such as advanced maintenance technologies for assets used in the manufacturing process.

# High-Productivity Manufacturing

*Productivity is Europe's greatest asset for securing long-term prosperity and maintaining competitiveness on the world stage.*

Europe's average growth rate is lower than that of its main competitors, largely owing to a productivity gap which has been widening over the past decade. Much of this is because business structures across Europe vary widely and certain barriers to markets persist,

at the same time robust, reliable and cost-effective. The current market is characterised by demands for increasingly complex products, higher quality, faster delivery and shorter lag times between successive product generations. Innovations to address this include new high-

future. Innovative manufacturing technologies such as rapid micro-manufacturing will move to 3D optimised micro parts which have complex internal structures, e.g. advanced cooling channels and material gradient structures. As such, integrated compact systems design will also play a key role.

These micro-manufacturing systems will consist of easily configurable assembly lines which use less space for the assembly and testing of small parts. Such parts include micro electromechanical systems (MEMS) which incorporate sensors and actuators, among other enabling components.

## Zero defect manufacturing

Customisation dramatically drives up production costs, owing to higher setup costs and the need to adapt processes and production equipment. Innovative solutions are needed to support these 'made to order' strategies by improving quality control and boosting efficiency. New monitoring methods are needed, based on supervision and the control of process parameters and proactive controls.

Innovations in this area include advanced decision-making tools to help create cost-effective process chains by applying 'quality by design' processes and implementing defect-tolerant configurations.



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**High precision manufacturing:** *The miniaturisation of new products leads to the adoption of micro-scale production.*

but a key reason is structurally lower investment in research and innovation.

While Europe is still the world leader in terms of manufacturing, its export share is falling at a discernible rate and data from the EU show that countries such as China and India are rapidly catching up.

## Adaptive production equipment

Adaptive production addresses the need to create manufacturing systems which are flexible while

performance manufacturing technologies which produce greater outputs at higher speeds with greater process capability, using self-adapting equipment that requires less shop-floor space. Furthermore, production cycles will be streamlined and process planning made more efficient.

## High-precision manufacturing

Miniaturisation of products and production equipment will be key issues for manufacturing in

# Materials in Manufacturing

*Materials are the key enabler in the manufacturing process. They ensure sustainability, drive down costs and offer new ways of reducing energy consumption.*

In the shift from producing traditional mass-produced goods to ones which are more personalised and energy-efficient, industries in Europe are now making use of materials which are more functional, lightweight and less of a burden to the environment. This poses new challenges for the manufacturing process.

Moreover, increasing pressure on global resources highlights the need to improve materials efficiency. Figures show that other advanced economies such as Japan have been able to double their materials efficiency over the past 30 years, whereas Europe, in spite of good progress, continues to lag behind.

For more information,  
please visit the EFFRA  
website:

[www.effra.eu](http://www.effra.eu)



**Reaping the benefits of new materials:** Roll-to-roll production is a striking example of high-tech manufacturing processes used in tandem with new materials.

## Materials efficiency

Research in this area will explore the efficient use of resources such as metals, water, lubricants or rare earth elements. Materials efficiency can be improved by recycling or streamlining different stages of production. Moreover, methods which make heavy use of resources such as cutting, grinding, milling or etching can be replaced by 'net-shape' or additive production methods.

A key element is the use of sensors and software tools to track the material flow and compare the efficiency of alternative production methods. Integrating materials consumption parameters in modelling algorithms allows for a simulation-based analysis and optimisation of the overall manufacturing chain

in terms of resource efficiency.

## Manufacturing processes for new high-performing materials

Modern high-performing materials such as alloys, intermetallics, bioceramics metal-ceramic composites, fibre-based structures, nanophased components or "carbon neutral" materials present new challenges for manufacturing and thus require new production processes.

This research area also covers activities which add new features to materials during of the manufacturing process so as to increase the value of the final product. Examples include roll-to-roll manufacturing and the surface modification of flexible materials.

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