European Commission

This fiche is part of the wider roadmap for cross-cutting KETs activities

'Cross-cutting KETs' activities bring together and integrate different KETs and reflect the interdisciplinary nature of technological development. They have the potential to lead to unforeseen advances and new markets, and are important contributors to new technological components or products.

The complete roadmap for cross-cutting KETs activities can be downloaded from:

http://ec.europa.eu/growth/industry/key-enabling-technologies/eu-actions/ro-ckets

Potential areas of industrial interest relevant for cross-cutting KETs in the Manufacturing and Automation domain

This innovation field is part of the wider roadmap for cross-cutting KETs activities developed within the framework of the RO-cKETs study. The roadmap for cross-cutting KETs activities identifies the potential innovation fields of industrial interest relevant for cross-cutting KETs in a broad range of industrial sectors relevant for the European economy.

The roadmap has been developed starting from actual market needs and industrial challenges in a broad range of industrial sectors relevant for the European economy. The roadmapping activity has focused on exploring potential innovation areas in terms of products, processes or services with respect to which the cross-fertilization between KETs can provide an added value, taking into account the main market drivers for each of those innovation areas as well as the societal and economic context in which they locate.

Taking the demand side as a starting point, cross-cutting KETs activities will in general include activities closer to market and applications. The study focused on identifying potential innovation areas of industrial interest implying Technology Readiness Levels of between 4 and 8.

MA.1.7: Micro-precision into micro- and macro-production equipment

Scope:

To provide for high-precision manufacturing and micro-precision or micro-manufacturing more accurate by one order of magnitude in both micro- and macro-production environments, from a few microns up to several metres.

Demand-side requirements (stemming from Societal Challenges) addressed:

Depending from the application or the type of processes used for production, manufacturing and automation can especially contribute to tackle the following societal challenges:

- Secure, clean and efficient energy
- Climate action, resource efficiency and raw materials

Demand-side requirements (stemming from market needs) addressed:

- Provide for rapid and flexible production capabilities to match supply with volatile demand of today's rapidly changing markets
- Flexibly integrate design specifications into efficient operational routines by keeping a comparable throughput time in different configurations
- Provide for fast product/service systems able to combine rapid and flexible production capabilities with enhanced product design capabilities and exploit minimal distribution lead-times to match supply with volatile demand of today's rapidly changing markets
- Provide for the production of high-quality products
- Provide for the production of durable products
- Provide for alternative manufacturing approaches coping with the need of utilizing new and advanced materials in products, adding functionalities to products, dealing with complex structures and shapes

Specific technical / industrial challenges (mainly resulting from gaps in technological capacities):

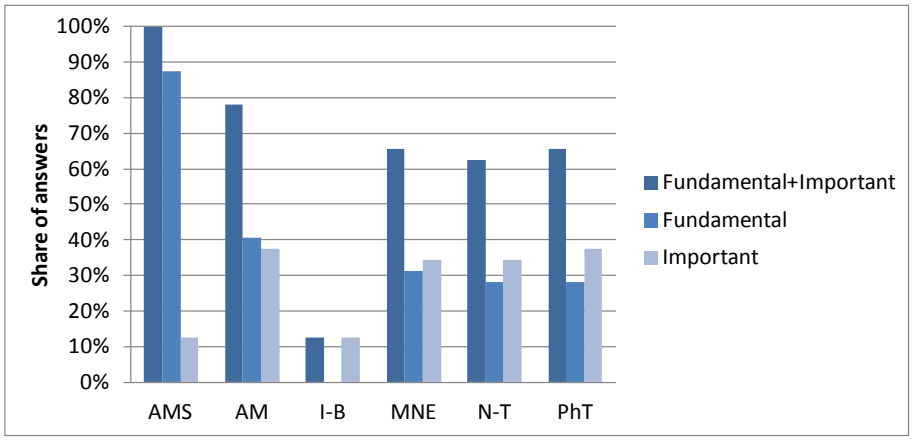
- Deployment of high precision manufacturing and micro-manufacturing of complex products to increase with one order of magnitude the accuracy of machines and controls
- Development of shaping technology such as forming and machining, to address challenges related to "difficult to shape" materials and to explore new processing methods to achieve micro-nano-sized microstructure components
- Design of new machine conception approaches together with innovative technologies for enabling manufacturers achieve high quality and high precision in manufactured products that can range in their size from a few microns up to several metres

Contribution by cross-cutting Key Enabling Technologies:

In respect to this Innovation Field, the integration of KETs could contribute to the development of micro-precision into micro- and macro-production equipment, thanks to the development and deployment of high precision manufacturing and micro-manufacturing of complex products to increase with one order of magnitude the accuracy of machines and controls (e.g. forming and machining), and to the exploration of new processing methods to achieve micro-nano-sized components.

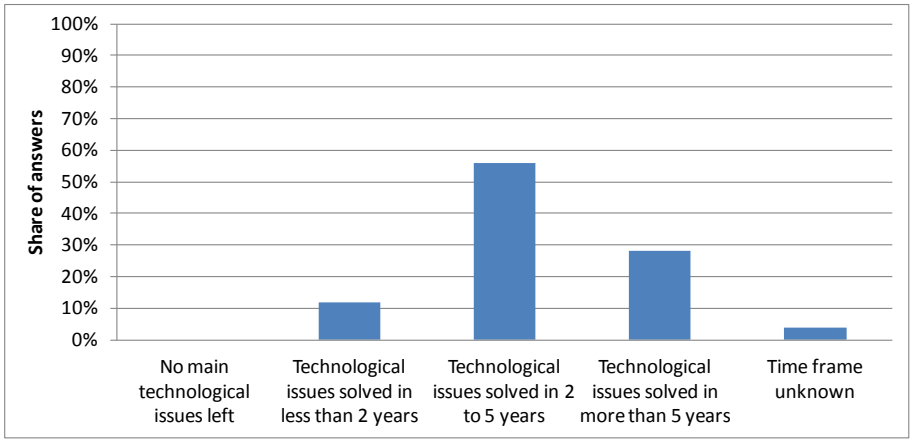
To this aim, the combination of KETs experts' opinions collected through the dedicated survey (whose result is depicted in the below bar chart), the examination of KETs-related patenting activity in respect to this Innovation Field, and desk research activities, have allowed identifying a rather strong interaction of KETs with respect to this Innovation Field, with either fundamental or important contribution mainly by the following KETs:

- Advanced Manufacturing Systems (AMS)
- Advanced Materials (AM)
- Micro- and Nano-Electronics (MNE)
- Nanotechnologies (N-T)
- Photonics (PhT)



Timing for implementation:

According to the majority of KETs experts' opinions (whose result is depicted in the below bar chart), desk research, and in line with the KETs-related patenting activity in this field, it is considered that the main technological issues holding back the achievement of cross-cutting KETs based products related to this Innovation Field could be solved in a time frame of 2 to 5 years, yet significant consensus by experts indicates also greater periods being necessary:

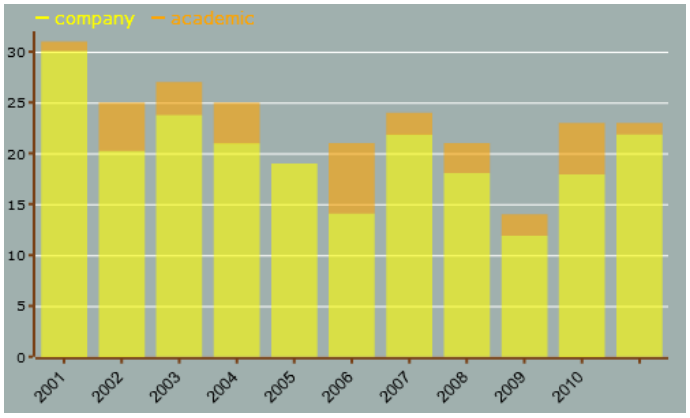


Hence, depending on the specific technical and/or industrial challenges holding back the achievement of cross-cutting KETs based products related to this Innovation Field, the provision of support in the short to medium term should be taken into consideration within this framework.

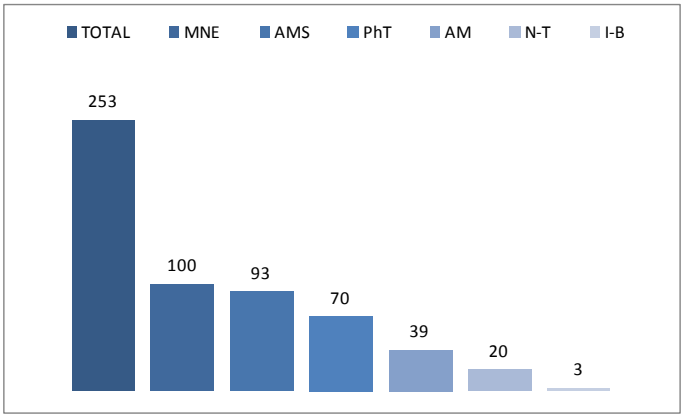
Additional information according to results of assessment:

- ***Impact assessment:***
  - Product miniaturization and micro-systems have been strong drivers of technological change, with a significant impact on the manufacturing industry. Precision micro-parts are the key enabler to product functionality and performance in a broad range of applications such as life sciences, medical devices, consumables and telecommunication facilities.
  - Within this framework, high-precision manufacturing, micro-precision manufacturing and micro-manufacturing, such as, but not limited to, micro-machining, micro-forming for metals and alloys, micro injection moulding for polymers, micro powder injection moulding for ceramics, and other methods, have significantly gained in importance. While computer aided, these technologies are capable of generating complex geometrical shapes despite the miniaturized environments in which they operate.
  - Yet, not only miniaturized and micro-systems/parts can benefit from especially high-precision and micro-precision manufacturing, as also macro-systems requiring micro-topographies can benefit greatly from these technologies.
- ***Results of patents scenario analysis:***
  - 253 exclusively KETs-related patents identified in the period 2001-2011 for the specific Innovation Field

- Stable/decreasing trend curve (number of patents per year)
- Highest share of industrial applicants:



- Patents by KET(s):

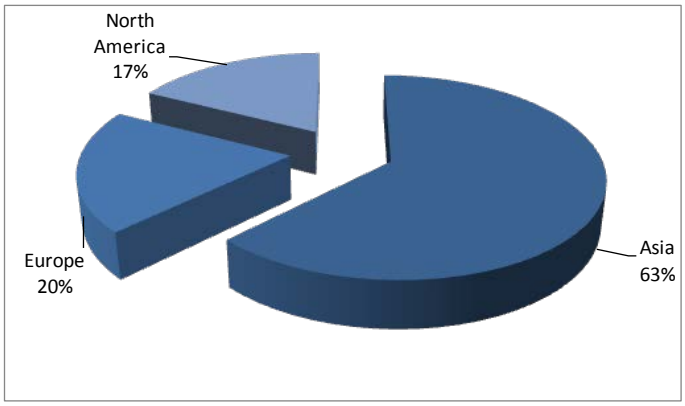


- Patents by KET(s) and relevant combinations of KETs:

KET(s)	*Number of patents*
AM	39
AM / MNE	9
AM / MNE / N-T	1
AM / MNE / PhT	2
AM / N-T	7
AM / PhT	3
AMS	93
AMS / AM	3
AMS / AM / N-T	1
AMS / MNE	14
AMS / MNE / PhT	2
AMS / N-T	3
AMS / PhT	4
IBT	3
MNE	100
MNE / N-T	7
MNE / N-T / PhT	2
MNE / PhT	27

KET(s)	*Number of patents*
N-T	20
N-T / PhT	3
PhT	70

- Patent distribution by (Applicant) organization geographical zone:



- Patent distribution by geographical zone of priority protection: