

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.1.8: Quality control for robust micro- and nano-enabled production

Scope:

To develop rigorous in-situ quality control systems with high 3D resolution and accuracy measurement capability, over large areas or with high aspect ratio on complex parts, in less temperature-controlled environments and a speed/throughput compatible with industrial standards.

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):

- Development of methods for handling of parts, metrology and inspection also to ensure ability to manufacture at scale (volume) with high reliability
- Development of fast and reconfigurable low/medium and high resolution measuring systems for accurate and time efficient measurements
- Use of new quality monitoring tools for multiple specifications on product shape and material quality able to quickly handle unusual or out-of-control situations
- Development of rigorous quality control systems which provide the ability to analyse or measure in three dimensions with high resolution and absolute accuracy over large areas or with high aspect ratio on complex parts, in less temperature-controlled environments and a speed/throughput compatible with industrial standards (in-situ control)
- Development of common, validated measurement methods, calibrated scientific instrumentation as well as qualified reference samples and a robust manufacturing of these reference samples

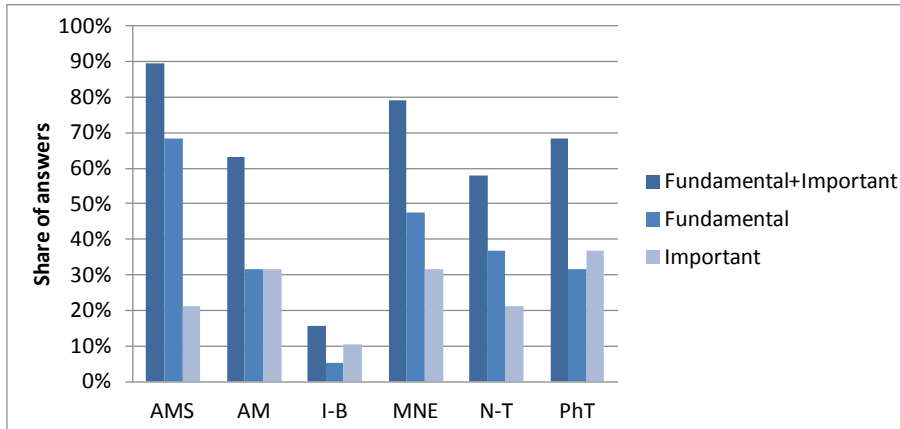
Contribution by cross-cutting Key Enabling Technologies:

In respect to this Innovation Field, the integration of KETs could contribute to the development of advanced quality control for micro- and nano-enabled production, building on the development of methods for handling of micro- and nano-parts, of fast and reconfigurable low/medium and high resolution 3D measuring systems, of new quality monitoring tools for multiple specifications on product shape and material quality, robust enough for industrial environments.

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:

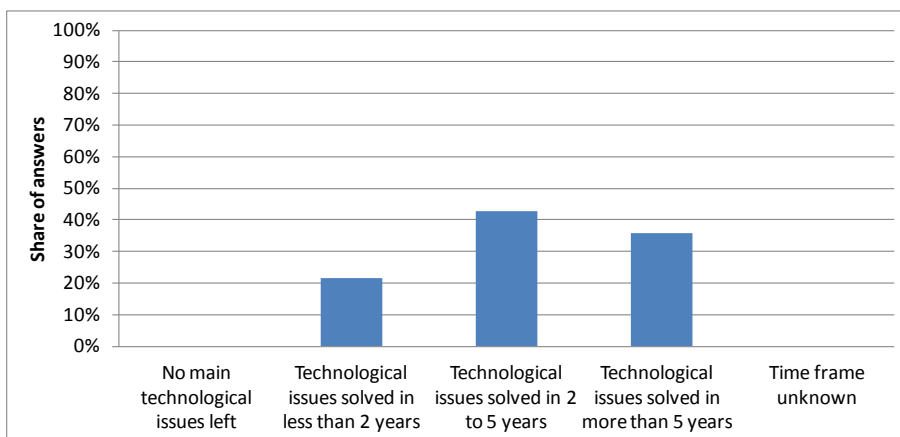
- Advanced Manufacturing Systems (AMS)

- 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:

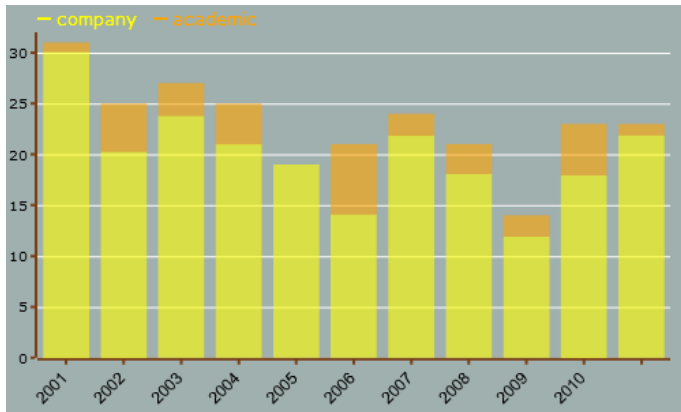
➤ Impact assessment:

- High-precision manufacturing, micro-precision manufacturing and micro-manufacturing require not only reliable manufacturing technologies but also reliable testing and quality inspection methods and equipment that are capable of detecting faults at the same accuracy level that is provided by the manufacturing technologies themselves.
- Quality assurance of high-precision manufacturing, micro-precision manufacturing and micro-manufacturing fundamentally serves in this case as an integral component of the production chain.
- Applications of quality assurance of high-precision manufacturing, micro-precision manufacturing and micro-manufacturing can include printed circuit boards, nozzles, miniature dies, coated surfaces, height

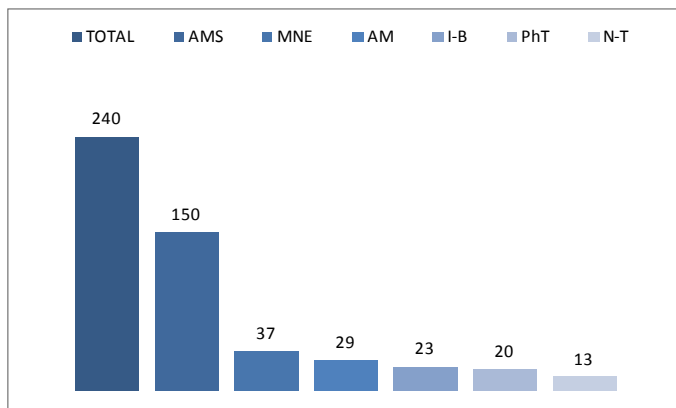
levels on calibration disks, galvanized and/or sputtered surfaces, drill holes including internal geometries, roughness measurements at milled components, and much more.

➤ **Results of patents scenario analysis:**

- 240 exclusively KETs-related patents identified in the period 2001-2011 for the specific Innovation Field
- Decreasing trend curve (number of patents per year)
- Highest share of industrial applicants:



- Patents by KET(s):

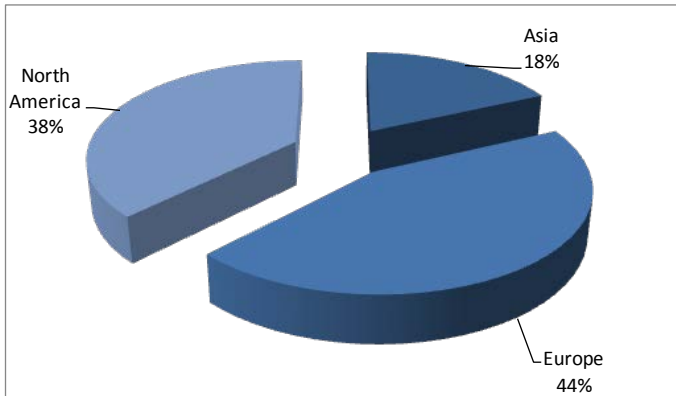


- Patents by KET(s) and relevant combinations of KETs:

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

<i>KET(s)</i>	<i>Number of patents</i>
MNE / N-T	7
MNE / N-T / PhT	2
MNE / PhT	27
N-T	20
N-T / PhT	3
PhT	70

- Patent distribution by (Applicant) organization geographical zone:



- Patent distribution by geographical zone of priority protection:

