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.1.6: Rapid manufacturing for custom made parts

Scope:

To develop new processes enabling flexibility and rapid change, including optimal topological features, added functionality and levels of personalization not previously possible at large scale. Examples include printing inks/processes (including 3D printing), on-demand (nano)coatings, use of different materials.

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):

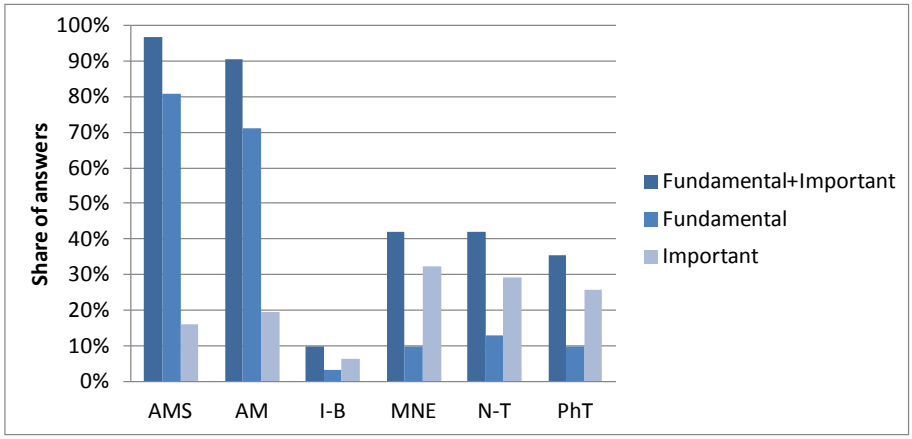
- Improvement of additive manufacturing, and extension of its applicability to various material classes (plastics, metals, composites, living tissue)
- Development of novel lasers including ultra-short pulse lasers emitting in the IR, VIS and UV and adaptive and dynamically-controlled laser-based materials processing systems and further development of their mass customization in manufacturing applications
- Photonics-based materials processing technologies
- Provide new custom made parts or spare parts on demand which are light-weight and topologically optimized either to sub-divisions of sectors/products or personalized to an individual
- Enable process flexibility and rapid change (e.g. laser processing, additive manufacture, modular tooling, direct fabrication with no tooling)
- On-demand manufacturing of customer-centric products
- Development of materials for optimal topological features, added functionality and levels of personalization not previously possible at scale
- Improvement of Rapid Manufacturing Technology (e.g. beam-based, scanning optics) to address high performance, process productivity and flexibility to frequently changing operating or product-mix conditions
- Derive a synchronized, closed loop between customer orders, production scheduling, and manufacturing execution; all while simultaneously coordinating the flow of materials and information along the supply chain
- Development of new manufacturing techniques that enable in parallel the fast customization, assembly and manufacturing of complex products as well as fast and effective product updatability, reconfigurability and disassembly by either the original manufacturer, the end user or specialized service providers
- Development of manufacturing solutions for modular, updatable, reconfigurable and disassemblable products

Contribution by cross-cutting Key Enabling Technologies:

In respect to this Innovation Field, the integration of KETs could contribute to the development of advanced rapid manufacturing processes for custom made parts, building on the improvement of additive manufacturing and the extension of its applicability to various material classes (plastics, metals, composites, living tissue), the development of novel flexyble, easily reconfigurable and rapidly changing materials and technologies for mass customization in manufacturing (e.g. laser processing, additive manufacture, modular tooling, direct fabrication with no tooling), the development of photonics-based materials processing technologies in general, the improvement of process flexibility and rapid change capability.

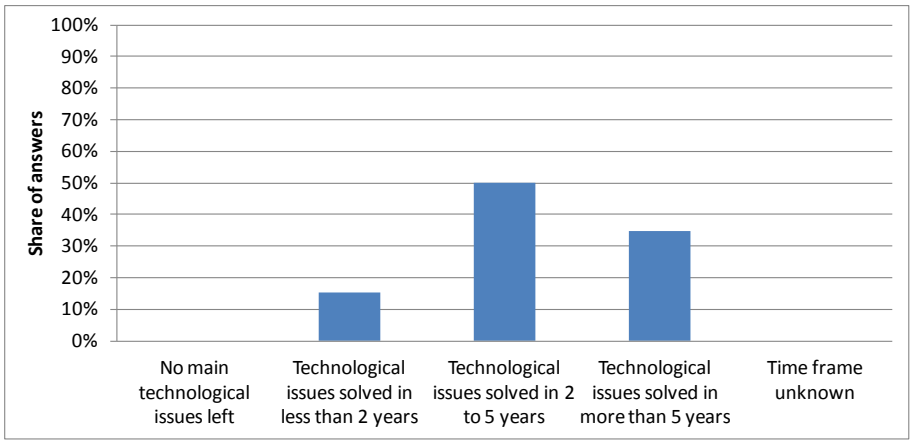
To this aim, the combination of KETs experts' opinions collected through the dedicated survey (whose result is depicted in the below bar chart), the examination of KETs-related patenting activity in respect to this Innovation Field, and desk research activities, have allowed identifying a rather strong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



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:

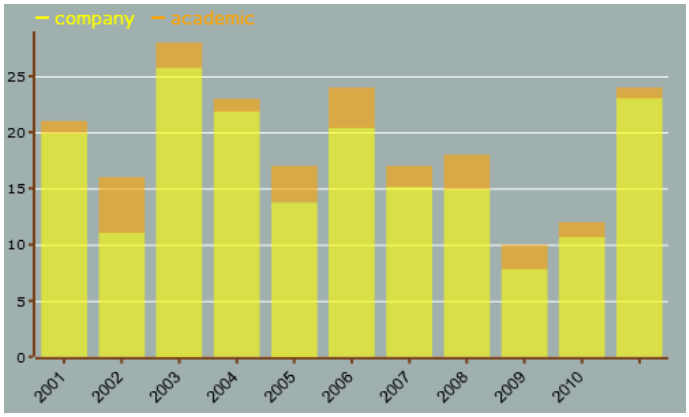


Hence, depending on the specific technical and/or industrial challenges holding back the achievement of cross-cutting KETs based products related to this Innovation Field, the provision of support in the short to medium term should be taken into consideration within this framework.

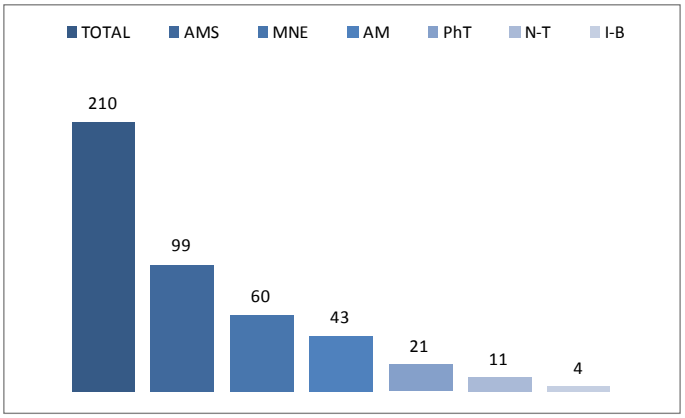
Additional information according to results of assessment:

- ***Impact assessment:***
  - Advanced manufacturing technologies are of cross-cutting nature, providing a crucial input for process innovation in any manufacturing sector. Their uptake in production process would increase the competitiveness of the EU's manufacturing industry.
  - The global market for industrial automation solutions was estimated at 114 billion Euro in 2011, 35% of it in Europe, and is forecast to reach 140 billion Euro by 2015. In addition, the market volume for resource-efficiency technologies is estimated at 128 billion Euro.
  - Within this framework, there are certain advanced manufacturing segments with particularly high growth, such as 3D printing for example, for which the global market volume is expected to increase from 1.6 billion Euro in 2012 to 8 billion Euro in 2021 (Source: Advancing Manufacturing paves way for future of industry in Europe; European Commission - MEMO/14/193, 17 March 2014).

- ***Results of patents scenario analysis:***
  - 210 exclusively KETs-related patents identified in the period 2001-2011 for the specific Innovation Field
  - Scattered trend curve (number of patents per year)
  - Highest share of industrial applicants:



  - Patents by KET(s):

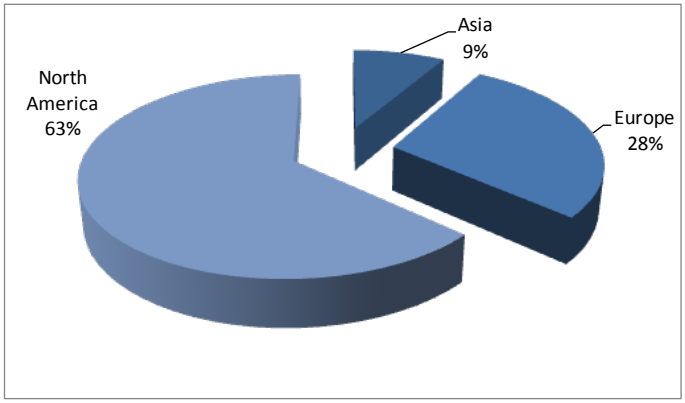


  - Patents by KET(s) and relevant combinations of KETs:

KET(s)	*Number of patents*
AM	43
AM / MNE	2
AM / N-T	7
AM / PhT	1
AMS	99
AMS / AM	1

KET(s)	*Number of patents*
AMS / MNE	5
IBT	4
MNE	60
MNE / N-T	1
MNE / PhT	10
N-T	11
N-T / PhT	1
PhT	21

- Patent distribution by (Applicant) organization geographical zone:



- Patent distribution by geographical zone of priority protection: