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.1.1: Advanced joining technologies for long life joints of diverse materials

Scope:

Improved, new or hybrid joining technologies enable competitive incorporation of materials into structures, including “self-assembly”, increase the lifetime of assemblies thus reducing maintenance costs and support products adapted to extreme environments (deep sea, space, engines, medical).

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):

- Use welding, joining or other assembly technologies as a means for modularization and efficient use of (new) multi-materials and integration of new materials with a high degree of automation and quality control to accelerate their adoption into products
- Understand and control cause-effect relationships and materials process interactions for joining to maximize final product performance
- Development of improved, new or hybrid joining technologies to maximize material performance and material efficiency
- Development of high productivity and “self-assembly” technologies to reduce operational cost and to improve manufacturing competitiveness
- Practical validation of the new processes needs to be determined on demonstrator work pieces or early stage prototypes
- Optimization of rivet-less solutions for assembling metallic large structural parts
- Optimization of modelling of corrosion and ageing of materials at joints so as to limit structural weakening
- Use appropriate simulations of both equipment and manufactured parts to support prototyping

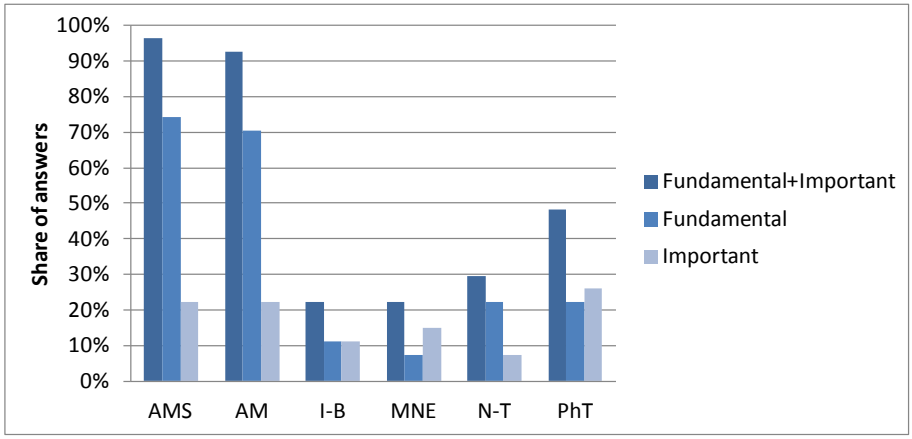
Contribution by cross-cutting Key Enabling Technologies:

In respect to this Innovation Field, the integration of KETs could contribute to the development of more advanced joining technologies for long life joints of diverse materials, building on solutions such as new or hybrid joining technologies , the efficient use of (new) multi-materials, the development of high productivity and “self-assembly” technologies, etc.

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

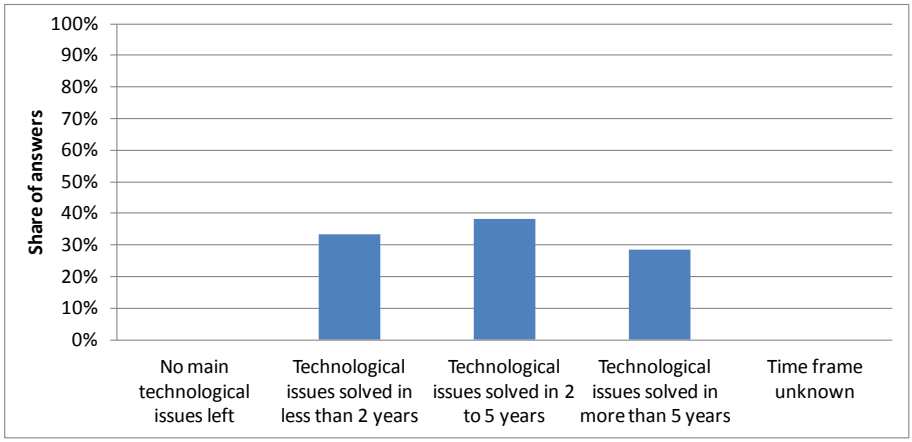
respect to this Innovation Field, with either fundamental or important contribution mainly by the following KETs:

- Advanced Manufacturing Systems (AMS)
- Advanced Materials (AM)
- Photonics (PhT), to some extent



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 both shorter and 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 term should be taken into consideration within this framework.

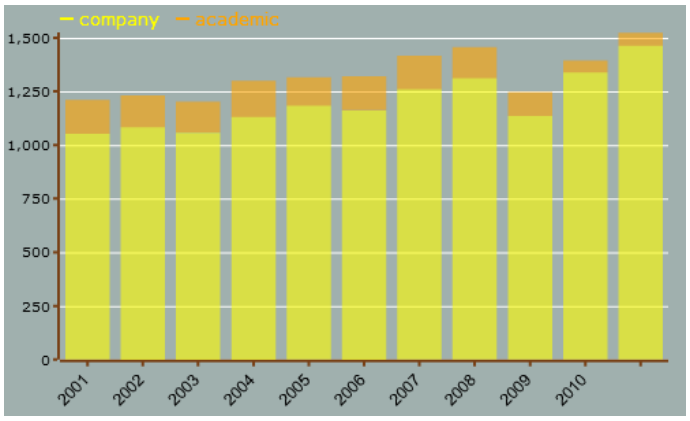
Additional information according to results of assessment:

➢ ***Impact assessment:***

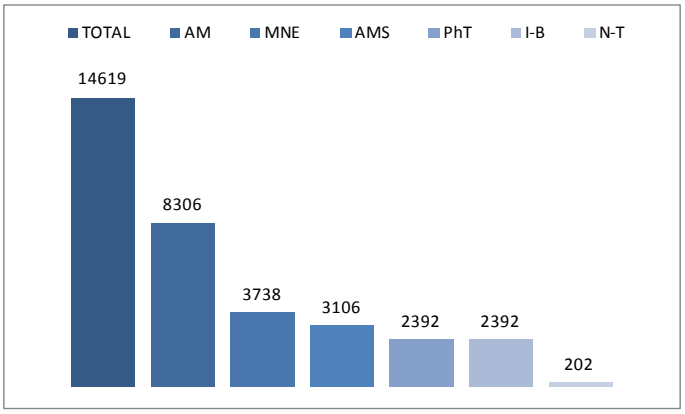
- The overall total of the production values for the manufacture of joining technology in Europe is composed of the production values for devices on the one hand and of the production values for complementary goods and services on the other hand. In the EU27, the production value of devices and systems in 2010 was around 8 billion Euro and was associated with a gross value added of 2.7 billion Euro, earned by 45 000 employees.
- As regards especially Germany, for devices and systems, the production value amounted to 3.8 billion Euro in 2011. This leads to a gross value added of 1.3 billion Euro which can be equated with the extra value created by the production. Around 18 000 employees contributed to this value added. In 2010,

the production value in Germany amounted to 2.9 billion Euro and yielded a gross value added of 0.9 billion Euro, earned by around 15 600 employees (Source: DVS – German Welding Society, "Macroeconomic and sectoral value added by the production and application of joining technology in Germany and Europe in 2013"; 2012).

- ***Results of patents scenario analysis:***
  - 14619 exclusively KETs-related patents identified in the period 2001-2011 for the specific Innovation Field
  - Slightly increasing trend curve (number of patents per year)
  - Highest share of industrial applicants:



  - Patents by KET(s):

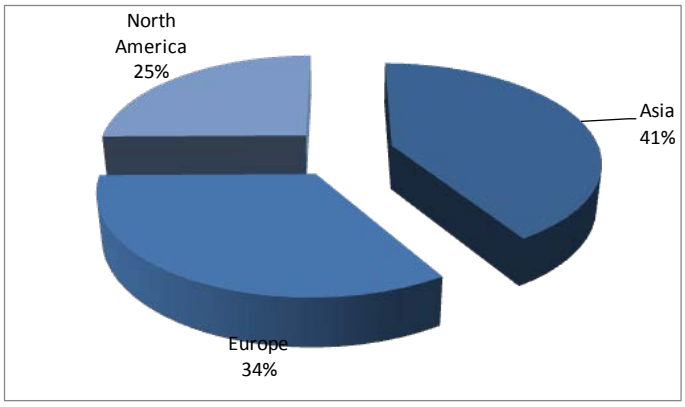


  - Patents by KET(s) and relevant combinations of KETs:

KET(s)	*Number of patents*
AM	8306
AM / IBT	11
AM / IBT / N-T	1
AM / MNE	915
AM / MNE / N-T	25
AM / MNE / N-T / PhT	4
AM / MNE / PhT	222
AM / N-T	141
AM / N-T / PhT	11
AM / PhT	622
AMS	3106
AMS / AM	292

KET(s)	*Number of patents*
AMS / AM / MNE	44
AMS / AM / MNE / N-T	1
AMS / AM / MNE / PhT	7
AMS / AM / N-T	4
AMS / AM / PhT	11
AMS / IBT	1
AMS / MNE	262
AMS / MNE / N-T	1
AMS / MNE / PhT	32
AMS / N-T	6
AMS / PhT	83
IBT	45
IBT / N-T	1
MNE	3738
MNE / N-T	44
MNE / N-T / PhT	10
MNE / PhT	1117
N-T	202
N-T / PhT	24
PhT	2392

- Patent distribution by (Applicant) organization geographical zone:



- Patent distribution by geographical zone of priority protection: