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.3.2: Flexible, reconfigurable and modular machinery and robots

Scope:

As-autonomous-as-possible reconfiguration of machinery and robots to support mass customized and highly personalized products and fast reactions to shifts of market demands, e.g. through self-adjustment, correction, control and networking, to decrease, for example, changeover time and energy usage.

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

- Tackle the “secure, clean and efficient energy” as well as the “climate action, resource efficiency and raw materials” societal challenge

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

- Provide for cost optimization including through predictive maintenance
- Provide for rapid and flexible production capabilities to match supply with volatile demand of today’s rapidly changing markets

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

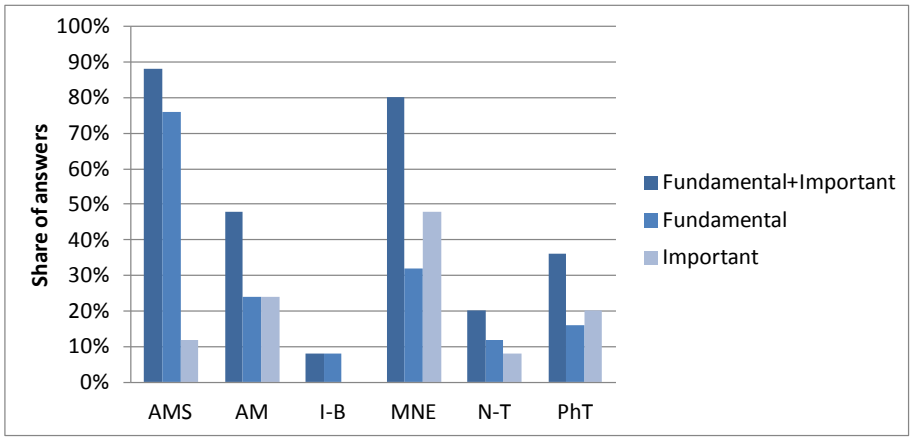
- Plug and play solutions for integration of factory components and modules
- Conceive manufacturing systems from scratch as combinations of smart and exchangeable mechatronic modules, taking the most out of a combination of electro-mechanical and embedded and learning controllers for adapting the system behaviour to changing environments and system degradations
- Development of multi-layer controls and model based real-time compensation routines, embedding machining process knowledge, for novel self-learning systems
- Development of intelligent plug-and-play systems which feature sensing and actuator structures integrated with adaptive control systems and with active compensation features for fully optimizing the performance of the manufacturing systems in terms of autonomy, reliability and efficiency along their lifecycle
- Development of innovative ICT tools for supporting the as-autonomous-as-possible reconfiguration of machinery and robots, as basis for supporting mass customized and highly personalized products and fast reactions to shifts of market demands

Contribution by cross-cutting Key Enabling Technologies:

In respect to this Innovation Field, the integration of KETs could contribute to the development of advanced highly flexible, reconfigurable and modular machinery and robots to support mass customized and highly personalized products manufacturing. The integration of KETs could particularly contribute to the development of plug and play solutions, smart and exchangeable mechatronic modules, embedded and learning controllers for adapting the system behaviour to changing environments and system degradations, supported by the development of innovative ICT tools.

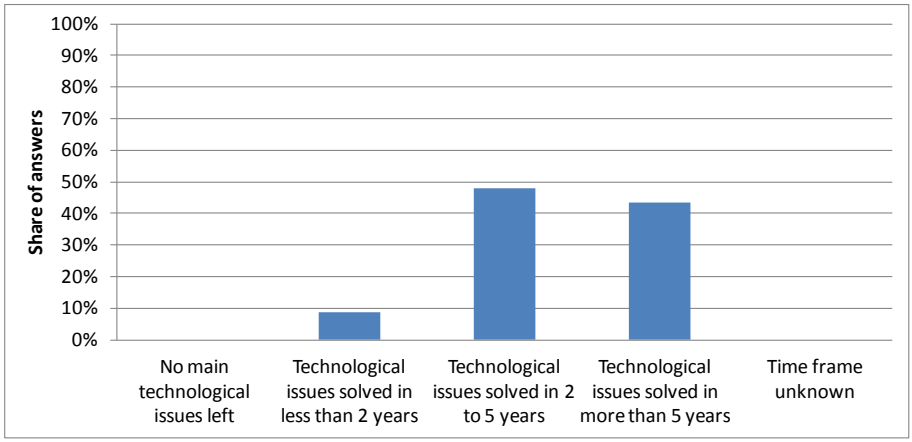
To this aim, the combination of KETs experts’ opinions collected through the dedicated survey (whose result is depicted in the below bar chart), the examination of KETs-related patenting activity in respect to this Innovation Field, and desk research activities, have allowed identifying a rather strong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

- Advanced Manufacturing Systems (AMS)
- Micro- and Nano-Electronics (MNE)
- 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:



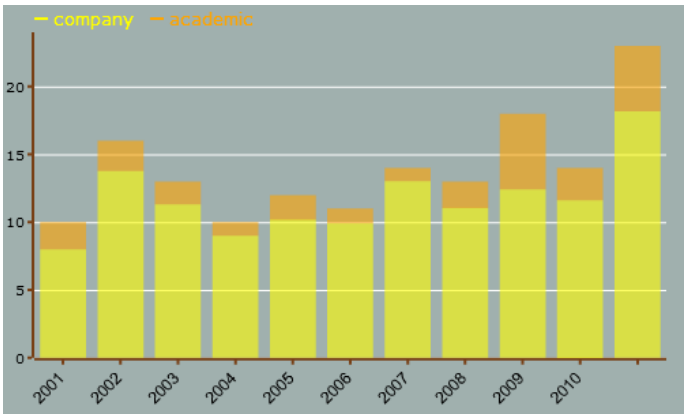
Hence, depending on the specific technical and/or industrial challenges holding back the achievement of cross-cutting KETs based products related to this Innovation Field, the provision of support in the short to medium term should be taken into consideration within this framework.

Additional information according to results of assessment:

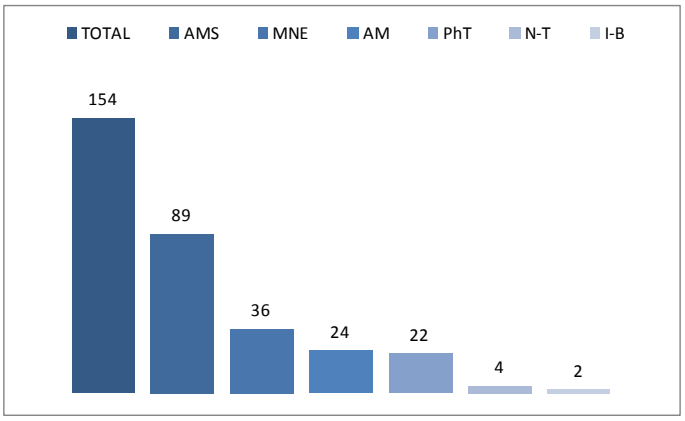
- ***Impact assessment:***
  - Continuing market demands for specialist products at "mass production prices" are being met increasingly by agile manufacturing often making use of flexible, reconfigurable and modular machinery and robots.
  - Actually, agility in manufacturing extends through the supply chain, business management, design, production control, servicing, and product up-dating, also making wide use of Information Technology.
  - Yet, the introduction in this overall system of agile responsive machinery based on modular principles as well as of reconfigurable robots has already effected many improvements in manufacturing and will continue to do so.
  - Agile manufacturing represents particularly a very interesting approach to developing a competitive advantage in today's fast-moving marketplace. It allows for rapid response to the customer – turning speed and agility into a key competitive advantage.
  - Source: www.leanproduction.com

➢ ***Results of patents scenario analysis:***

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



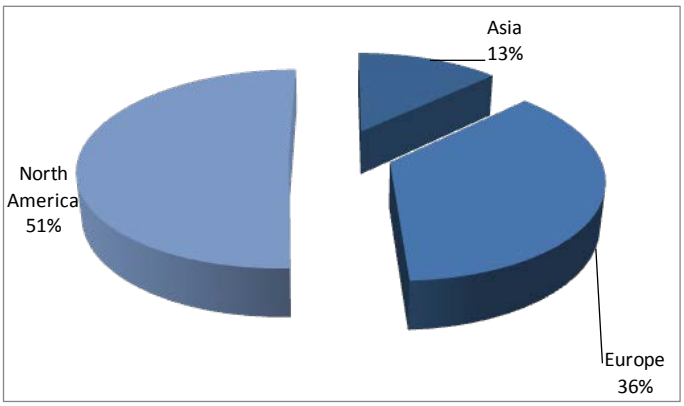
- Patents by KET(s):



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

KET(s)	*Number of patents*
AM	24
AM / MNE	2
AM / MNE / PhT	1
AM / N-T	3
AM / PhT	1
AMS	89
AMS / MNE	5
AMS / PhT	1
IBT	2
MNE	36
MNE / PhT	12
N-T	4
PhT	22

- Patent distribution by (Applicant) organization geographical zone:



- Patent distribution by geographical zone of priority protection: