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 Electronics and Communication Systems 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.

E&C.1.2: User-friendly human-machine interfaces

Scope:

To enable easy human-machine interactions and interfaces that increase user-friendliness through e.g. real-time human language technologies, multimodal interfaces mimicking human communication skills, safe natural proximity and hands-free interaction and up to virtual reality for high complexity systems.

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

- “Inclusive societies” need an efficient interaction between all sorts of systems and humans whatever their technical and communication abilities, including bridging the age and disability gap with regards to digital technologies
- “Innovative and reflective societies” are supported by machines and systems designed to enable human users to take best advantage of technologies’ potential and leave room to individual and collective creativity
- “Health and wellbeing”, “secure, clean and efficient energy”, “smart, green and integrated transport”, various environment and resource management and surveillance systems or advanced production chains are served with expert systems that enable trained operators to raise their overall awareness, take very reactively the good decision and make sure it is efficiently and safely implemented, which calls for expert systems’ operator-friendly interfaces
- Protecting security of Europe and its citizens without hampering freedom requires that many systems in interaction with humans are able to undertake seamless identification of users and operators

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

- With many technologies becoming causes of fears, misunderstanding and exclusions, offering a more natural way to interact with and within information-rich environments is a condition for sustained societal trust in technological progress, thus a condition for “smartification” of our environment
- Many recent successful innovations as smart phones or tablets have been based on smooth, ergonomic and personalized interfacing, improving overall user experience of technology services. This is a long-term trend in all sorts of markets and “mass-customization” starts with human-machine interfaces
- The human factor remains a significant source of accidents and inefficiencies in complex systems, calling for ever-improving training of operators but also for better decision-making assistance, vigilance monitoring and various forms of personal assistance. Well-designed interfaces will deliver high value services at a low human attention cost
- New interfaces create standards that then require wide deployments and ubiquitous applications, including on specifically constrained environments as embedded in vehicles, in remote areas, on nomadic devices, etc. Advanced systems need advanced interfaces whatever their operational constraints (shock resistance, electro-magnetic aspects, weight, power management, etc.)

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

- Development of tools for content creation and manipulation (content capture: sensors for human senses; content manipulations: 3D authoring tools; oralization tools)
- Development of human language recognition technologies (spoken and written) to provide language transparency in real-time to allow all citizens to become e-included in the information society
- Development of multimodal user interfaces with the environment aiming at mimicking human communication skills that use several modes of communication (“hands-free computer interfaces”)
- Development of technology for ”virtual reality”: interactive technology for communication, business and entertainment applications
- Increase of the usability of highly complex Information Technology (IT) systems though more intuitive interfaces
- Development of solutions for enabling ubiquitous deployment of electronics, as large area sensors and actuators, so as to optimize opportunities for human interactions with machines, including with flexible printed electronics
- Development of the specific protection systems to support human-machine proximity and cooperation, as with collaborative robotics in manufacturing

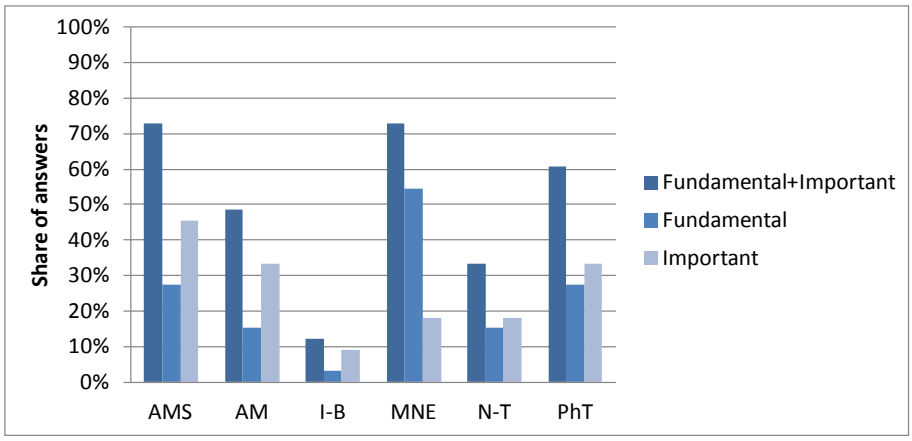
Contribution by cross-cutting Key Enabling Technologies:

In respect to this Innovation Field, the integration of KETs could contribute to the development of more advanced as well as user-friendly/intuitive human-machine interfaces based on devices able to capture signals, sensors to mimic human senses, instruments for content manipulation and other technologies that can be integrated for the development of multimodal user interfaces, capable to mimic human communication skills through several modes of communication.

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:

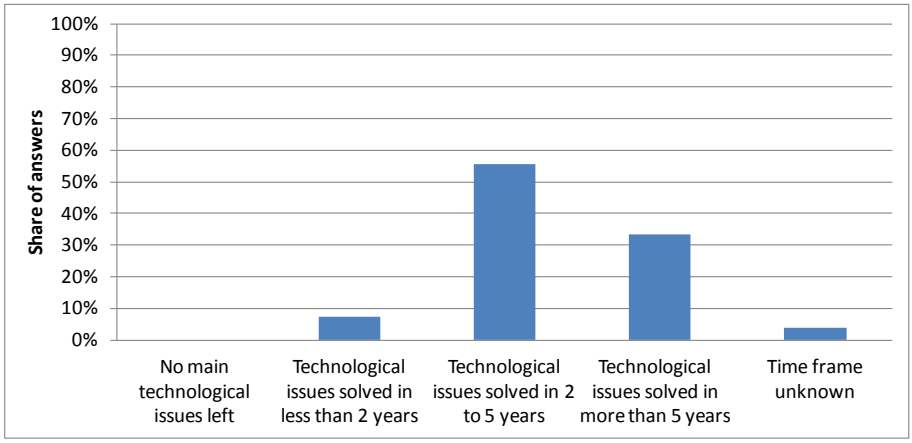
- Micro- and Nano-Electronics (MNE)
- Advanced Manufacturing Systems (AMS)
- Photonics (PhT)
- Advanced Materials (AM)

To a lesser extent Nanotechnologies (N-T) and Industrial Biotechnologies (I-B)



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 longer 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.

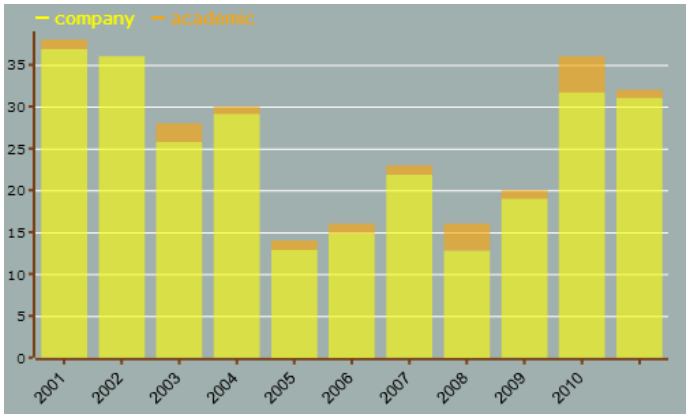
Additional information according to results of assessment:

- ***Impact assessment:***

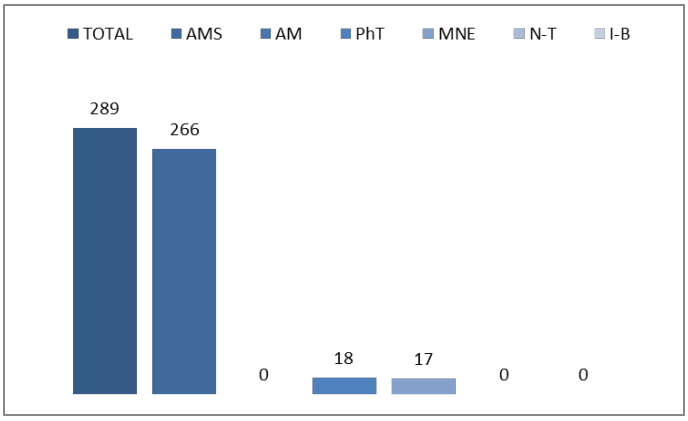
  - Improved interaction systems between machines and humans are levers for breaching barriers towards the adoption and deployment of many technologies, including robots, enhanced reality, multi-service converged equipment, connective devices, etc.
  - One of the aspects of that better interaction is the reduction of the burden of tasks bringing no or little added value to the end user. The ability of machines to identify people, "understand" human behaviour and react consequently – e.g. automated connectivity or sleep/active mode switch – is one of the levers for making "smart" technologies less intrusive and more acceptable. This is particularly important to reduce the digital divide with little e-skilled population as ageing or disabled people.
  - Another aspect is enabling machine operators to take better advantage of technical potentialities by providing the operator with just the right information at the right time and in the right format, supporting efficient and sound decision-making and operational decisions. This is particularly crucial where safety is involved, as in vehicle cockpits or for precision surgery. Solutions integrating KETs into cross-cutting combinations will benefit from multi-sources sensing capabilities, supporting multi-criteria data pre-analysis by the machine, allowing best analysis and reaction to human behaviour.
  - "Natural" interaction with machines, e.g. based on language or ordinary body movements, also enable to stimulate individual and collective creativity.
  - Ergonomics and human machine interfaces are getting more and more important roles in a technology successfully meeting its markets, and can be major non-price competitiveness factors for Made in Europe technology products.
  - Wearable computers with advanced human-machine interfaces were introduced by the American Army already in 1989. This was a small computer that was meant to assist soldiers at the battlefield. Since then the concept has grown into the current Land Warrior program and proposal for future systems. The advanced development in this sector make it a clear dual use technology that can be applied into the civilian sector.

- ***Results of patents scenario analysis:***

  - 289 exclusively KETs-related patents identified in the period 2001-2011 for the specific Innovation Field
  - Increasing again trend curve (number of patents per year) after some years of decrease
  - Highest share of industrial applicants:



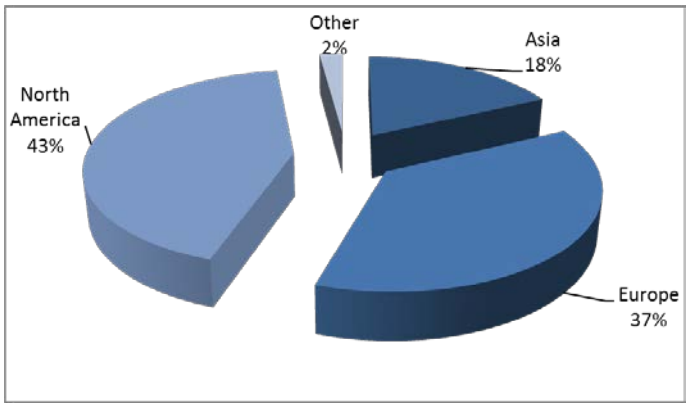
- Patents by KET(s):



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

KET(s)	*Number of patents*
AMS	266
AMS / MNE	4
AMS / MNE / PhT	1
AMS / PhT	2
MNE	17
MNE / PhT	7
PhT	18

- Patent distribution by (Applicant) organization geographical zone:
- Many European companies in the top applicants (from Netherlands, Switzerland, Germany, Finland, France), also many Japanese and US, and players coming from a wide variety of sectors: computer industry (Toshiba, Sony, Nec, Intel, Motorola, etc.), transport systems (Siemens, Honeywell, Rockwell, Valeo, Honda, Daimler, GE), electronics (Philips, Matsushita, Qualcomm, Thomson CSF, Movea), energy (ABB, Siemens), software (SAP, Microsoft), etc.



- Patent distribution by geographical zone of priority protection: