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 Transport and Mobility 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.

T.1.2: Unmanned vehicle controls

Scope:

To develop complete vehicle control chains - including environment data acquisition and processing, choice of reaction strategy and related actuation - enabling high level capabilities for autonomous or remote controlled operations of all sorts of unmanned vehicles, including driverless trains, drones, autonomous cars, satellites, space probes, planetary exploration robots, etc.

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

- Tackle the “Smart, green and integrated transport” societal challenge
- Contribute to the achievement of the EU Transport 2050 strategy (COM/2011/0144 final) objective of a 60% reduction of CO_2 emissions from transports, at least 40% for shipping
- Support the Smart Vehicle initiative of the i2010 strategic framework on the innovation society (COM(2005) 229 final)
- Continuously enhance safety, resistance/resilience and security of vehicle operation all along end-to-end transport chains
- Increase recyclability of vehicles and systems and resource efficiency in the manufacturing processes and reduce dependency to rare or foreign controlled materials and components (as per the Raw Materials Initiative (COM(2008)699) and numerous waste management regulations)

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

- Reduce vehicle operation costs, including through increasing energy efficiency and reducing final vehicle energy bill, but also through optimising overall vehicle lifecycle cost of ownership, including maintenance, repair and overhaul
- Reduce or maintain numbers and rates of accidents in Europe at an acceptable number, whatever traffic growth
- Enable new transportation services dealing with changing mobility and transportation needs, changing trade patterns as well as citizen and logistic chains request for affordable, timely, comfortable, seamless and ubiquitous transport services
- Enable time to market reduction and production ramp up / adaptation so as to cope with European and global market requests on new vehicle supply

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

- Development of unmanned mobile platforms adapted to the different types of payloads/services, as flying, aerostatic, for rails or roads, off-road, for planetary exploration, for extreme conditions as near fires, etc.
- Development of payloads enabling civilian unmanned / automated services, as search and rescue, traffic observation, freight transportation, area surveillance, humanitarian demining, sport events filming, infrastructure inspection, phytosanitary products precision spreading, etc.
- Setup of system architectures and sensing/actuation subsystems supporting autonomous or remote controlled operation
- For space missions necessitating the vehicle to come back on Earth, development of capsules (possibly re-usable) with deployable and / or inflatable heatshield, ablative or permanent, and aero-braking systems for safe atmosphere re-entry, and setup European capabilities for plasma shock testing
- Equipment of vehicles with accurate guidance systems for precision operation / parking / landing / docking, potentially at high speeds as in the case of space rendez-vous
- Enabling of long duration full operational autonomy of unmanned systems in case of control link spoofing, masking or other reason for being cut
- Development of lightweight automated features, including robotic arms / robotic systems for potentially complex activities (e.g. drillers and container sealing and handling systems for soil sample collection, excavation and handling capability for landmine removal, etc.)
- Setup of highly secure reliable low power data transmission, potentially for long distances and with high volumes of data to be transferred

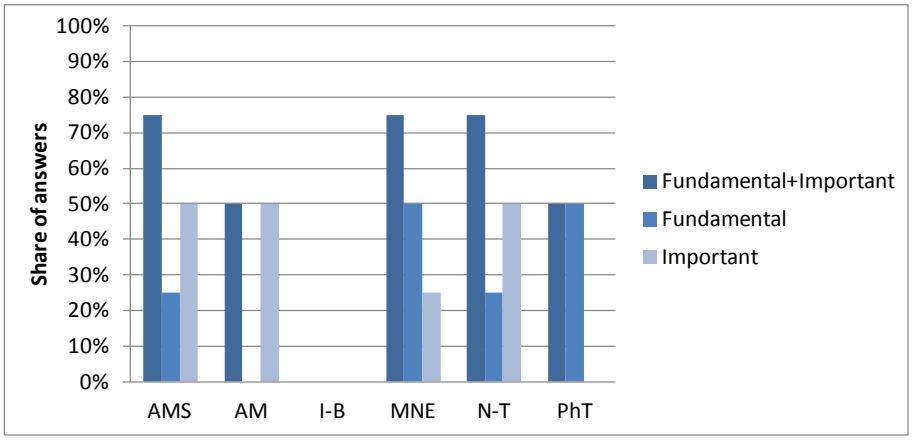
- Development of sense & avoid navigation systems allowing safe unmanned vehicle insertion and control into normal traffic and human activities

Contribution by cross-cutting Key Enabling Technologies:

In respect to this Innovation Field, the integration of KETs could contribute to the development of advanced complete vehicle control chains - including environment data acquisition and processing, choice of reaction strategy and related actuation - enabling high level capabilities for autonomous or remote controlled operations of all sorts of unmanned road, rail, flying and space vehicles, robots and drones, enabling civilian unmanned/automated services (as search and rescue, traffic observation, freight transportation, area surveillance, humanitarian demining, sport events filming, infrastructure inspection, phytosanitary products precision spreading, etc.).

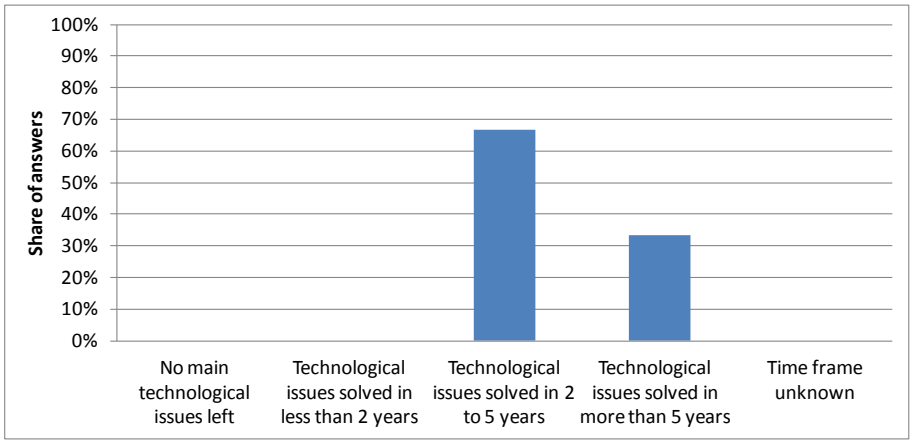
To this aim, the combination of KETs experts' opinions collected through the dedicated survey (whose result is depicted in the below bar chart), the examination of KETs-related patenting activity in respect to this Innovation Field, and desk research activities, have allowed identifying a rather strong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

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



Timing for implementation:

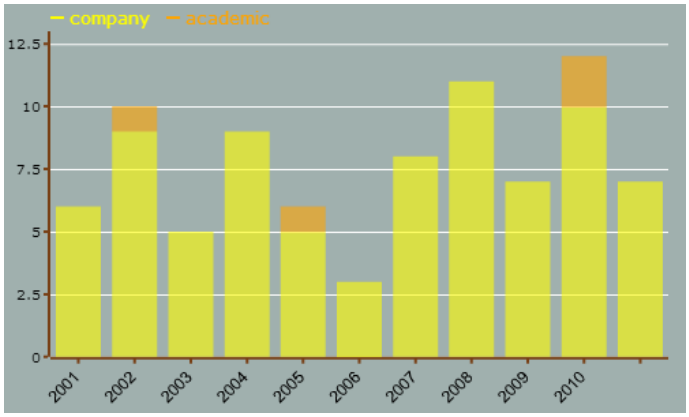
According to the majority of KETs experts' opinions (whose result is depicted in the below bar chart), desk research, and in line with the KETs-related patenting activity in this field, it is considered that the main technological issues holding back the achievement of cross-cutting KETs based products 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:



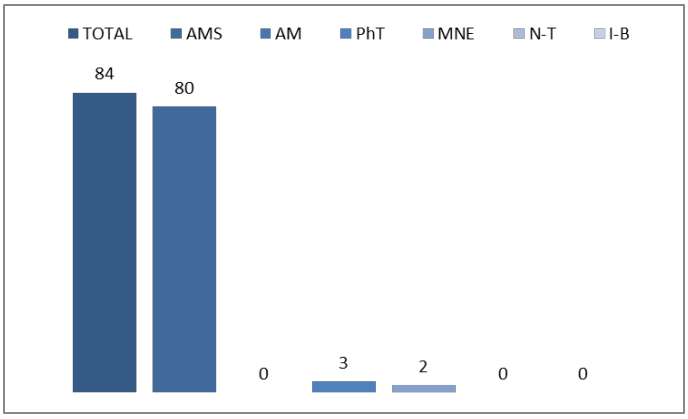
Hence, depending on the specific technical and/or industrial challenges holding back the achievement of cross-cutting KETs based products related to this Innovation Field, the provision of support in the short to medium term should be taken into consideration within this framework.

Additional information according to results of assessment:

- ***Impact assessment:***
  - Formerly military, drone technologies are now well recognized as inherently dual, and drone platforms being equipped with various sorts of sensing or communicating payloads are now well identified as key elements for innovative and cost-effective solutions in civil security, environment monitoring, scientific research, journalism and entertainment, meteorology.
  - Fully automated urban transport or space vehicles have been in operation for years, with resultant impact on operational costs, timeliness and safety. Further developments to apply vehicle control automation to vehicles evolving in more complex frameworks or under high responsibility conditions have the potential to bring similar progress.
  - Amongst possible applications: increasing car driver assistance gradually moving to full automation capability, single pilot passenger air transport, autonomous robots operating in severe environment or sharing workspace with other machines and humans in factories or warehouses, etc.
  - In addition to technology, the legal and regulatory framework is a major enabler or showstopper for development in this Innovation Field.
  - In the patents scenario analysis, the top 30 patent applicants show a large national diversity, with a large number of players from the USA, some from 6 European countries (Germany, Italy, France, Netherlands, UK, Sweden) but also from Japan, Russia, Israel, Canada, Korea.
- ***Results of patents scenario analysis:***
  - 84 exclusively KETs-related patents identified in the period 2001-2011 for the specific Innovation Field
  - Unstable number of patents per year
  - Highest share of industrial applicants:



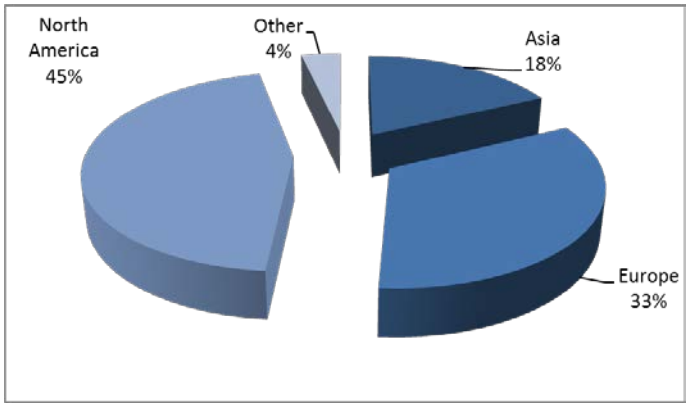
- Patents by KET(s):



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

KET(s)	*Number of patents*
AMS	80
AMS / MNE	1
MNE	2
PhT	3

- Patent distribution by (Applicant) organization geographical zone:



- Patent distribution by geographical zone of priority protection: