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.4.3: Advanced embedded positioning and navigation

Scope:

To develop beacon-based, satellite-based or inertial systems, eventually coupled, able to deliver a highly precise and dependable positioning and navigation service, whatever the vehicle and operational conditions, cost-effectively and with low weight and cost-effective embedded systems.

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
- Deliver safer and less congested travel as well as smoother and quicker journeys, as requested for the Trans European Transport Network (TEN-T) policy (Regulation (EU) No 1315/2013 of the European Parliament and of the Council of 11 December 2013 and repealing Decision No 661/2010/EU Text with EEA relevance)
- Achieve SESAR 2020 objectives for the European Air Traffic management, as regards environment (emissions and local nuisances), safety and ability to efficiently cope with growing traffic volumes
- Continuously enhance safety and resistance/resilience of vehicle operation all along end-to-end transport chains
- Support the Smart Vehicle initiative of the i2010 strategic framework on the innovation society (COM(2005) 229 final)
- Ensure operational implementation of European international transport agreements (as TRACECA, SEETO and NDPTL)

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

- Reduce traffic management direct (fees for operators) and indirect (such as costs of jams on citizen health, economy competitiveness, environment, etc.) operational costs
- 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, citizen request for affordable, timely, seamless and ubiquitous transport services
- Support integration of lean global logistic chains taking advantage of communication and tracking technologies for preventing incidents and offering in-trip services

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

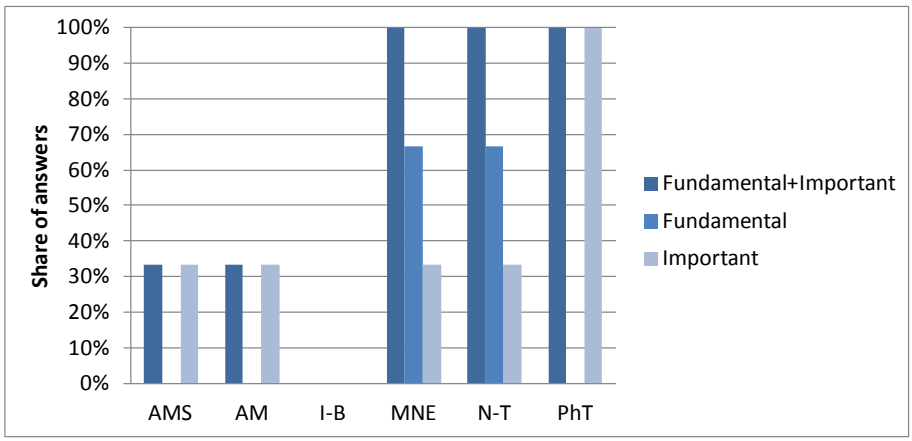
- Development of lightweight and low cost inertial systems able to provide highly precise positioning and pointing information over long journeys and whatever the operational conditions
- Take advantage of multi- global navigation satellite system (GNSS) systems reception capabilities (Global Positioning System (GPS), Galileo, Beidou, Glonass) to enable cost-effective but highly dependable satellite positioning
- Optimization of coupling of various navigation means (beacon-based, satellite-based and inertial) so as to increase precision, robustness (especially in urban areas / indoor or in other constrained environments) and dependability
- Minimization of external perturbations to the positioning equipment, such as radiation, vibrations, temperature shifts, etc.
- Development of active compensation high resolution Line Of Sight actuation control techniques (as with star trackers, sun sensors, magnetometers), mainly for spacecraft
- Implementation of compact, accurate, high stability and robustness time measurement solutions, from ion traps to optical atomic clocks
- Take advantage of improved positioning and navigation systems to improve models used for unmanned or highly automated operations (as flight models for autopilots)
- Build on advanced positioning capabilities to support innovative on-board services and/or provide accurate information to the traffic control services
- Make sure Galileo Public Regulated Service (PRS) is supported by relevant European ground receivers able to deliver the best possible related service

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 beacon-based, satellite-based or inertial systems, taking advantage of multi-GNSS systems reception capabilities (GPS, Galileo, Beidou, Glonass) to increase precision, robustness (especially in urban areas/indoor or in other constrained environments) and dependability, whatever the vehicle and operational conditions.

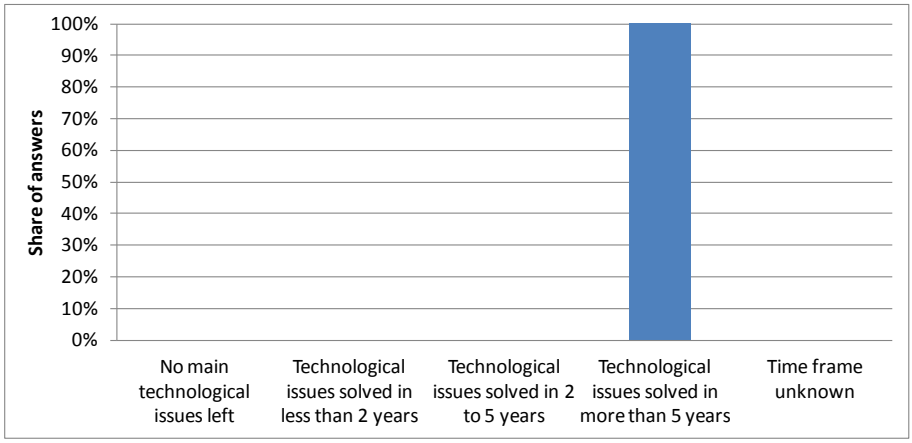
To this aim, the combination of KETs experts' opinions collected through the dedicated survey (whose result is depicted in the below bar chart), the examination of KETs-related patenting activity in respect to this Innovation Field, and desk research activities, have allowed identifying a rather strong 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)
- Nanotechnologies (N-T)
- Photonics (PhT)
- 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 more than 5 years:

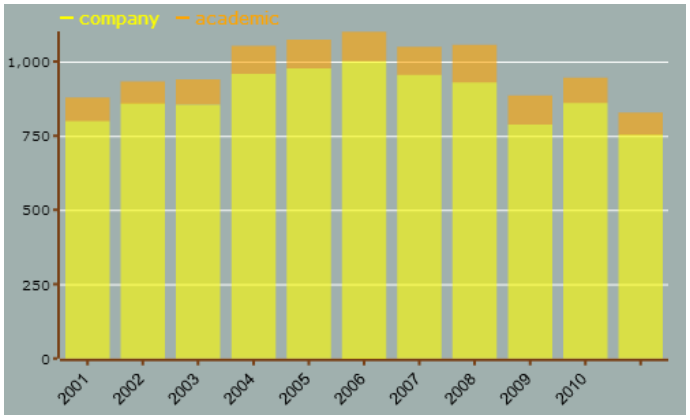


These technologies are actually following continuous improvement processes. Hence, depending on the specific technical and/or industrial challenges holding back the achievement of cross-cutting KETs based products related to this Innovation Field, the provision of support in the short to medium term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

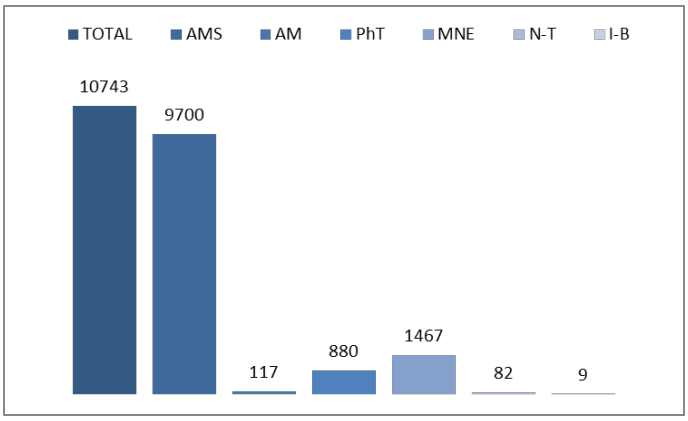
Additional information according to results of assessment:

- ***Impact assessment:***
  - Inertial or satellite-based navigation or positioning means are directly supporting safety improvements in air and seaborne transportation as well as in space ops. Precision is one aspect, but robustness whatever the weather conditions (Rio-Paris Air France crash in 2009 is considered due to weaknesses in the aircraft set of navigation instruments) or the geography, including near ground/near shore, is still to be improved.
  - Benefitting from aerospace developments, navigation and positioning systems are major enablers for advanced ground transportation services, including driver assistance, traffic management, jams avoidance or parking place detection, but also unmanned vehicle autonomous operations, stolen vehicle retrieval or even maybe upcoming capabilities such as collision avoidance.
  - KET-supported miniaturization – eventually integrated with indoor capabilities – enables integration of these precision positioning capabilities into mobile devices, supporting the emergence of many services of the innovation-based society.
  - By definition, the original Global Positioning System (GPS) was developed for military applications. Nowadays, it is well understood that the potential and further development of other similar systems are able to provide significant useful applications in civilian situations. Its dual use is therefore clearly established and implemented.

- ***Results of patents scenario analysis:***
  - Considering the very effective identification of patents related to that dynamic innovation field, 10.743 relevant KETs related patents were identified in the period 2001-2011
  - Stable trend curve (number of patents per year), starting a slight decrease in the recent years
  - Highest share of industrial applicants:



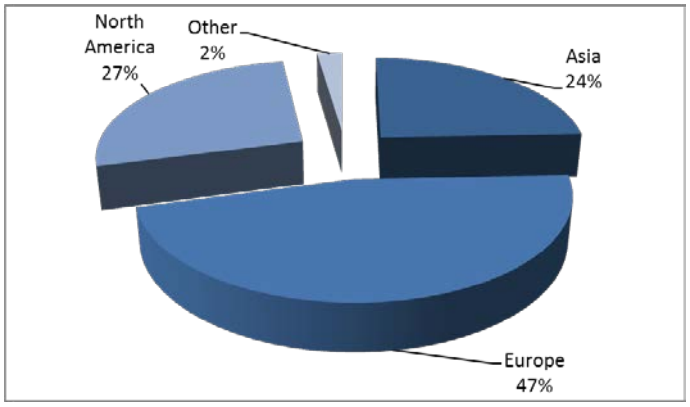
  - Patents by KET(s):



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

KET(s)	*Number of patents*
AM	117
AM / IBT	3
AM / IBT / MNE	1
AM / IBT / N-T	2
AM / MNE	23
AM / MNE / N-T	8
AM / MNE / N-T / PhT	1
AM / MNE / PhT	3
AM / N-T	19
AM / N-T / PhT	2
AM / PhT	8
AMS	9700
AMS / AM	54
AMS / AM / IBT	1
AMS / AM / IBT / N-T	1
AMS / AM / MNE	16
AMS / AM / MNE / N-T	7
AMS / AM / MNE / N-T / PhT	1
AMS / AM / MNE / PhT	1
AMS / AM / N-T	9
AMS / AM / N-T / PhT	1
AMS / AM / PhT	3
AMS / IBT	4
AMS / IBT / N-T	1
AMS / MNE	936
AMS / MNE / N-T	28
AMS / MNE / N-T / PhT	2
AMS / MNE / PhT	73
AMS / N-T	52
AMS / N-T / PhT	4
AMS / PhT	219
IBT	9
IBT / MNE	1
IBT / N-T	2
MNE	1467
MNE / N-T	38
MNE / N-T / PhT	6
MNE / PhT	285
N-T	82
N-T / PhT	13
PhT	880

- Patent distribution by (Applicant) organization geographical zone:



- Patent distribution by geographical zone of priority protection: