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 Agro-Food 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.

AF.1.2: Assessment and prevention tools to ensure safety of food products and the food chain

Scope:

To develop assessment and prevention tools (including sensors) aimed at diminishing the risk of biological contamination, chemical hazards (toxins), undesirable components (allergens) or fake components (fake meat) of food products including all along the food chain, thus ensuring safety of food products. These include solutions aimed at the traceability of foodstuff and at the identification of potentially risky events along the food chain. Product examples include, e.g. stable isotope labelling of foodstuff, monitoring systems for the real-time in-line process control for hygiene in food processing, etc.

In order to ensure safety of food products, not only devices, but also versatile and affordable sensors for the control of critical quality and performance attributes for food industries are required. The European food industry needs to integrate advanced technologies into food production, jointly with high-tech and eco-efficient processing systems and smart control applications. Sensors in food processing operations play a key role: they can enable systematic preventive approaches such as Hazard Analysis and Critical Control Point (HACCP) method, practical decision-making tools and early warning systems.

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

- Tackle the “Food security, sustainable agriculture, marine and maritime research and the bio-economy” societal challenge
- Contribute at the same time to the “Climate action, resource efficiency and raw materials” challenge as well as the “Health, demographic change and wellbeing” challenge

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

- Improve health, well-being and longevity by food products
- Improve food chain management
- Improve food safety

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

- Development of real-time, rapid and reliable methods as well as devices (including sensors) for detection and monitoring of contaminants in relation to foods
- Development of monitoring systems that also include in-line sensing capabilities for the real-time in-line process control for hygiene
- Identification and validation of biomarkers of exposure and susceptibility to key hazards
- Probabilistic modeling of intakes
- Understanding of toxicological thresholds
- Refinement and improvement of (quantitative) risk assessment procedures based on scientific understanding to address setting appropriate, robust and consistent standards that enhance safety and foster innovative food product design
- Development of decision support tools for the industry based on predictive microbiological models and models on occurrence, development, migration of chemical contaminants
- Preventing chemical hazards including toxins of biological origin through effective control procedures and traceability of foodstuff
- Development of stable isotope labelling of food products
- Development of modified atmosphere technologies
- Development of in-package food processing techniques
- Reduction methods of “anti-nutritive” components in food, such as allergens

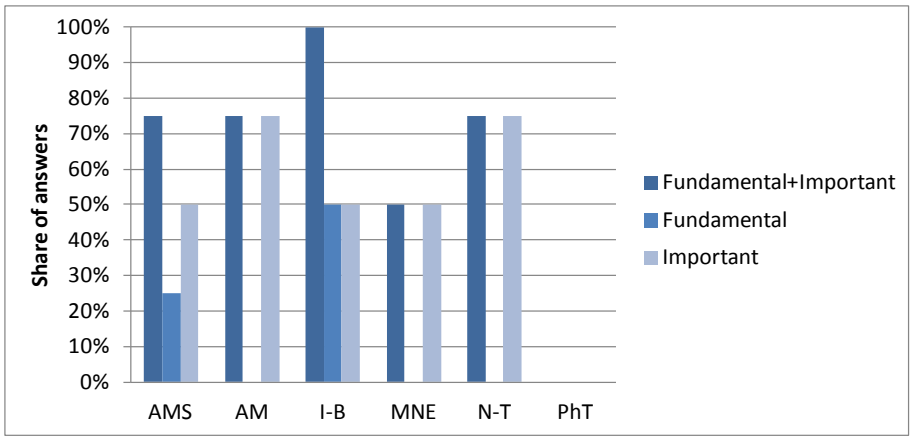
Contribution by cross-cutting Key Enabling Technologies:

In respect to this Innovation Field, the integration of KETs could contribute to the development of solutions to the challenges listed above, such as versatile and affordable sensors for the control of critical quality and

performance attributes of food, systems allowing the traceability of foodstuff or the identification of potentially risky events along the food chain.

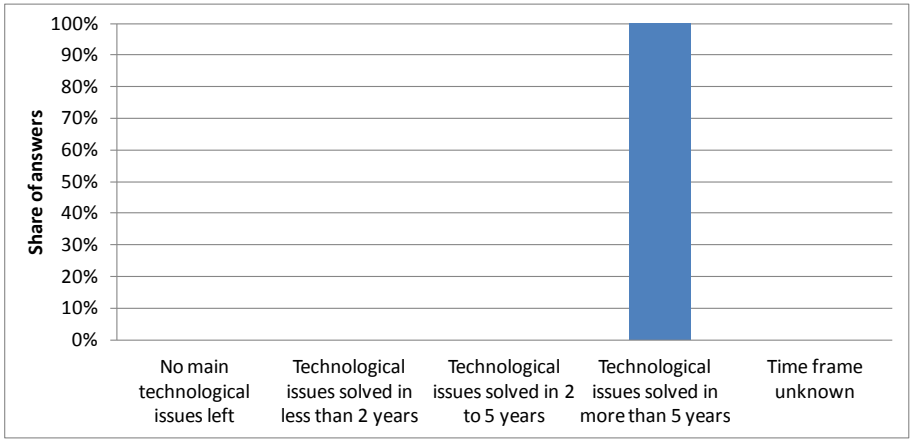
To this aim, the combination of KETs experts' opinions collected through the dedicated survey (whose result is depicted in the below bar chart), the examination of KETs-related patenting activity in respect to this Innovation Field, and desk research activities, have allowed identifying a rather strong 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)
- Industrial Biotechnology (I-B)
- Nanotechnologies (N-T)
- Micro- and Nano-Electronics (MNE)



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:

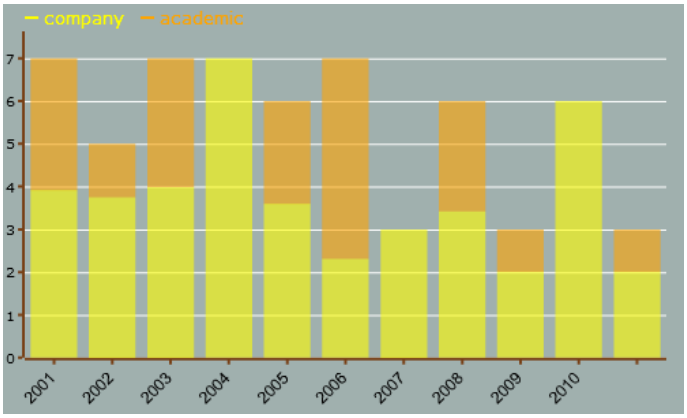


Hence, depending on the specific technical and/or industrial challenges holding back the achievement of cross-cutting KETs based products related to this Innovation Field, the provision of support in the medium term should be taken into consideration within this framework.

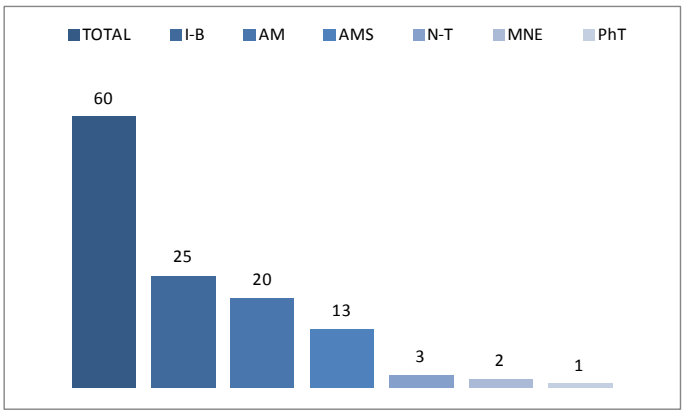
Additional information according to results of assessment:

- ***Impact assessment:***
  - The global food safety market has been growing, pulled by relevant regulation, norms and standards regarding food safety and hygiene. The factors responsible for food contamination include improper handling of food, contaminated input food materials, inadequate treatment/processing of food to destroy the contaminants, etc. Many outbreaks of foodborne illness have been reported due to pathogens in the food.
  - Within this framework, the global food testing market, which includes the food safety testing market, is expected to grow at a healthy growth rate of around 6% during the period 2013-2018 to reach 3.4 billion Euro in 2018 from 2. 4 billion Euro in 2013. The food testing equipment market on the other hand is worth 3 billion Euro with IR type of instruments occupying the highest share in-terms of technology. Competition from local companies with respect to instruments OEMs is the major challenge for the market (Source: Markets and Markets, Food Safety Testing Market By Contaminants, Technology, Food Types & Geography - Global Trends Forecast to 2018, 2013, www.marketsandmarkets.com).
  - As regards Europe, the need to prevent foodborne illnesses and poisoning risks have resulted in strict food safety regulations, which specify maximum permitted levels of any contaminant in food and that the food manufacturers are responsible for safety of food. Therefore, food safety testing has to be implemented during all stages of food production to ensure the absence of contaminations and to prevent any potential health risks on consumption of contaminated food. The regulatory bodies in Europe have been implementing Hazard Analysis Critical Control Point (HACCP) systems to ensure food safety. Implementation of these food safety regulations has been driving the food safety testing market. Globalization of food supply and demand of the consumer for food safety and information has further helped the market to grow.
  - As a result, the European food safety testing market is projected to grow at a compound annual growth rate (CAGR) of 6.5% by 2018. In 2011, foodborne related occurrences in Germany resulted in rigorous implementation of food safety regulations. In 2012, Germany dominated the food safety testing market and is projected to be the fastest growing food safety testing market in Europe. Moreover, the European Food Safety Authority (EFSA) have been strictly supervising the implementation of Hazard Analysis Critical Control Point (HACCP) systems by food manufacturers. The market has been driven by the testing of food material during every stage of food production and processing (Source: European Food Safety Testing Market By Contaminant, Technology, Food Type & Country - Trends & Forecast To 2018, www.marketsandmarkets.com).

- ***Results of patents scenario analysis:***
  - 60 exclusively KETs-related patents identified in the period 2001-2011 for the specific Innovation Field
  - Stable-decreasing trend curve (number of patents per year)
  - Shared between industrial and academic applicants:



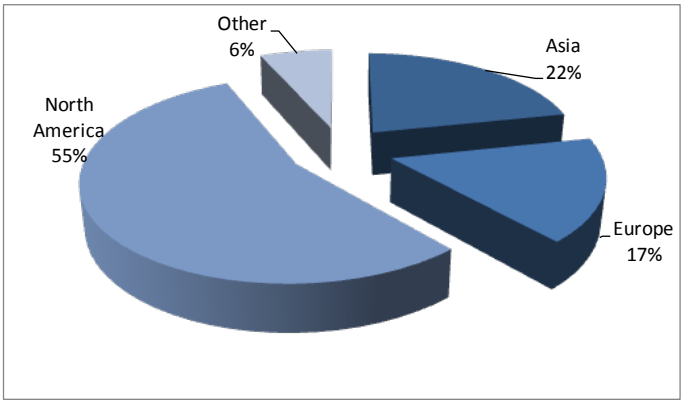
- Patents by KET(s):



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

KET(s)	*Number of patents*
AM	20
AM / IBT	1
AM / IBT / N-T	1
AM / N-T	1
AMS	13
AMS / AM	1
IBT	25
IBT / N-T	1
MNE	2
MNE / N-T	1
N-T	3
PhT	1

- Patent distribution by (Applicant) organization geographical zone:



- Patent distribution by geographical zone of priority protection: