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 Construction 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.

## CS.1.4: Lightweight structural beams and components

### Scope:

To develop lightweight structural beams and components allowing completely new shapes, huge reductions in weight of the structure, besides easing construction towards higher performance works.

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

- Tackle the "Climate action, resource efficiency and raw materials" societal challenge as well as the "Secure, clean and efficient energy" societal challenge in the first instance, thanks to lowering the amount of embodied energy in materials used during the construction process and the energy demand during the use-phase of buildings
- Contribute to achieve net zero-energy buildings in the future, serving as driver to boost the market for novel renewable energy applications in the residential sector (according to the Energy Performance of Buildings Directive (2010/31/EU))
- Contribute at the same time to the "Health, demographic change and wellbeing" societal challenge thanks to providing comfortable, well-designed, and energy efficient living spaces for all

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

- Enhance competitiveness of the construction sector
- Optimise the life-cycle cost of the built environment
- Provide comfortable, well-designed, energy efficient living spaces for people
- Reduce energy consumption (resulting in savings over the conventional energy purchase for private end-users and in the overall reduction of the energy demand on a global scale)
- Enhance the urban environment, creating a built environment that is accessible and usable for all
- Improve health, safety and security of the built environment
- Make construction activities more efficient, precise and with greater risk avoidance
- Improve health and safety conditions during construction processes

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

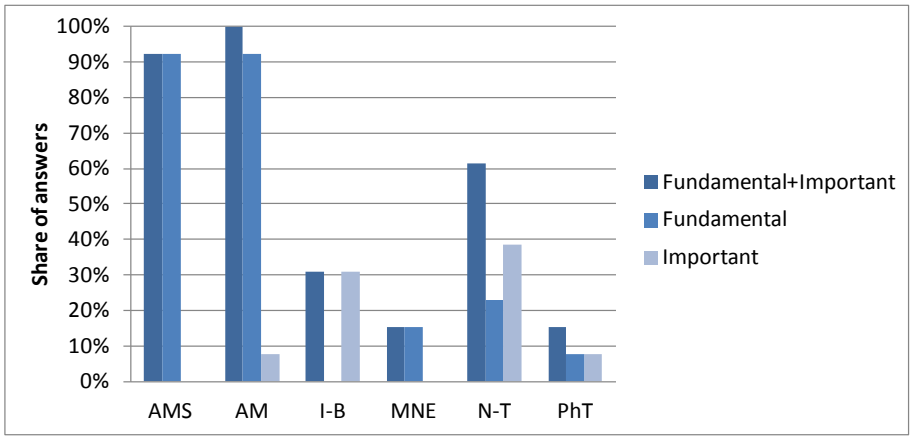
- Engineering of lightweight structural beams to ease construction towards higher performance works
- Engineering and development of automated manufacturing methods for large structures

### Contribution by cross-cutting Key Enabling Technologies:

In respect to this Innovation Field, the integration of KETs could contribute to the development of lightweight structural beams and components for high performance construction, including based on high-strength/low-weight fibre-reinforced polymer composite materials or new material architectures, combined with automated manufacturing methods for large and very large structures.

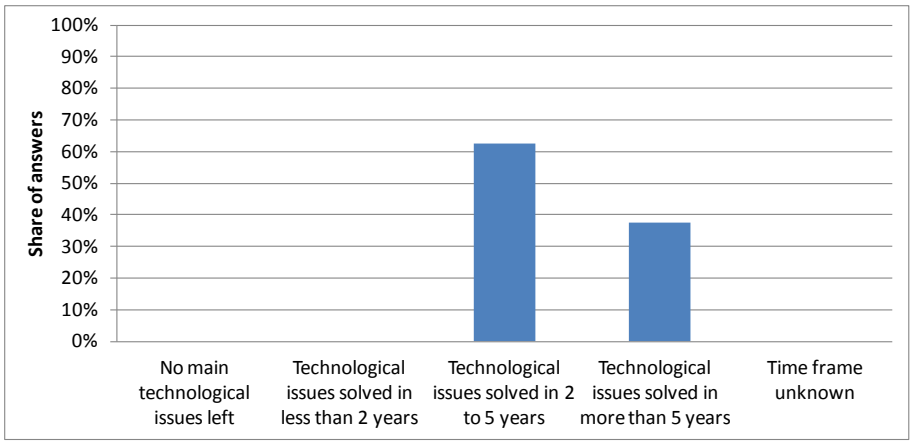
To this aim, the combination of KETs experts' opinions collected through the dedicated survey (whose result is depicted in the below bar chart), the examination of KETs-related patenting activity in respect to this Innovation Field, and desk research activities, have allowed identifying a rather strong 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)
- 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 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:***
  - The combined benefits of corrosion resistance and low weight of fibre-reinforced composites have proven attractive in many low stress applications in the construction sector. Decks for both pedestrian and vehicle bridges across waterways, railways and roadways are actually a commercial reality in both North America and Europe. An extension to the use of high performance fibre reinforced composites in primary structural applications, however, has been slower to gain acceptance although there is much development activity, with some pedestrian bridges being built entirely from composites. Composites present important opportunities to play increasing role as an alternate material to replace timber, steel, aluminium and concrete in buildings and civil infrastructure applications.
  - Fibre reinforced composites have greater strength capabilities and are less susceptible to environmental deterioration than steel. Fibre reinforced composites do not deteriorate in saline environment (which also includes areas that rely on the application of de-icing salts to maintain road access), which curtails the life of conventional structures. Additionally, fibre reinforced composites has strength to weight ratios of 50 times that of concrete and 18 times that of steel.

- Bridges account for a major sector of the construction industry and have attracted strong interest for the utilization of high performance fibre reinforced composites, as the latter have been found quite suitable for repair, seismic retrofitting and upgrading of concrete bridges as a way to extend the service life of existing structures. Fibre reinforced composites are also being considered as a solution for new bridge structures. The commercial viability for repairs has been proven with hundreds of field applications in Europe, Japan and North America.
- Advanced design approaches and increased manufacturing efficiencies developed for road bridge applications will benefit introduction of fibre-reinforced composites into a broader range of civil construction fields. Composites support beams are increasingly employed, with giant, pultruded carbon fibre beams now under test especially in the US for long span highway crossovers.
- The ability to use composites to design lightweight, prefabricated modules brings about immediate cost savings by minimizing the disruption of traffic and commerce. Pre-fabricated sections can be transported to the job site, ready for installation. The lightweight composite modules can be then installed in a matter of hours instead of the days or weeks it takes to replace a deteriorated bridge parts with a conventional one.
- The lightweight of composites is also especially valuable for the construction of waterway bridges incorporating a lift-up section to permit the passage of boats, and for ease of transportation and erection in remote areas without access to heavy lifting equipment. The composite deck has six to seven times the load capacity of a reinforced concrete deck with only 20% of the weight.
- Source: S. Nangia, G. Srikanth, A. Mittal, S. Biswas, Composites in Civil Engineering, http://tifac.org.in

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

- No exclusively KETs-related patents identified in the period 2001-2011 for the specific Innovation Field
- No significant patent-related figures can be reported in this field