This article traces the history of EU-funded research in two sectors – construction and machine tools research – from their origins in the early Framework Programmes to the present day and beyond. It illustrates how technical breakthroughs have been achieved by building on previous achievements, and the way in which powerful pan-European research networks have been constructed, paving the way for the Strategic Research Agendas that will drive much of the work of the forthcoming FP7. The feature also looks at the pioneering long-term impact assessments carried out by the Directorate responsible for the European Commission's Industrial Technologies research.

COLLABORATION AND INNOVATION – THE NEW BRICKS AND MORTAR OF THE CONSTRUCTION SECTOR

Construction is Europe's largest source of employment. With an annual turnover of almost €1 000 billion, a total direct workforce of more than 11 million and another 15 million employed indirectly, it contributes about 10% to GDP. The sector is a leading European exporter, reported as winning more than 50% of major international construction contracts and having a volume of business significantly greater than those of Japan and the USA. In terms of innovation, however, it has traditionally lagged behind other industrial sectors. The impetus of European research is bringing change, but conservatism, fragmentation and long product life cycles make this an area in which the exploitation of results is often a protracted process.

"In Europe, the construction sector is made up of around 2.5 million companies, 92% of which employ fewer than ten people," explains Johan Vyncke, head of the Structures, Geotechniques et Execution Techniques department at the Belgian Building Research Institute, and assistant coordinator of E-CORE (see below). "This is not an ideal environment for the rapid take-up of R&D results. It takes time and requires substantial effort for information on new materials, techniques and concepts to permeate through the layers ranging from architects, materials suppliers and contractors to bricklayers and other artisans.

"Moreover, the average life of a building is 50 years, and replacement rates are very low," Vyncke adds. "Given the long timeframes, clients tend to favour the most conservative options, which have long proven service records. In addition, regional traditions in building styles militate against radical change. Under these circumstances, research co-operation accompanied by widespread dissemination of results and best-practice guidelines is essential as the route to innovation. Equally important is the development of appropriate standards – for example, reflecting environmental and health and safety imperatives – to foster the spread of new, improved methods."

Progressive build-up

The construction industry's first real entry into EU-funded collaborative research came in the late-80s with participation in the Brite-Euram programme that was part of FP2 (1987-1991). In 1988, the various national construction research centres joined forces to create the European Network of Building Research Institutes (ENBRI), whose members have remained very active in subsequent Framework Programmes.

By the time of FP4 (1994-1998) they were involved in 101 projects, spanning the SMT, Brite-Euram, JOULE, and ESPRIT programmes. In FP5 (1998-2002), this number had risen to 138 – with ENBRI members leading 31 projects, which all included Industrial partners.

FP5's problem-solving focus steered research into areas such as innovative products and processes for repair and maintenance of structures, sustainable energy, and improved quality control using information and communication technologies. A substantial proportion of construction projects (16 of the 138) were networking activities involving the exchange of knowledge and information between large numbers of European organisations associated with specific RTD fields.

Networks widen

"At an early stage, it was generally recognised that stronger links than those between researchers were necessary to bring about change in the conservative and fragmented construction sector," recalls Vyncke. "To meet this need, the European Council for Construction Research, Development and Innovation (Eccredi) was formed late in 1995, bringing together 17 European industrial federations representing all the sector players – materials manufacturers, civil engineering firms, architectural design offices, etc. – and operating as a genuine industrial platform in stimulating joint research."

With Eccredi as a vehicle, and with the support of the Commission, the industry engaged in a number of European collaborations, all aiming to promote synergy between the individual construction RTD projects funded at a European level. Both the secretary general of Eccredi, Carlo De Pauw, and the President Scott Steedman, were heavily committed to making this a successful undertaking.

TRA-EFCT (Targeted Research Action on Environmentally Friendly Construction Technologies – 1997-2001) was the first such initiative, linking the coordinators of some 120 projects in a common action for dissemination and networking. It resulted in the organisation of more than 20 conferences and workshops helping promote coherence in the sector's RTD activities across Europe. A series of 13 final reports reviewed progress and presented project success stories covering materials, quality assurance, environmental technologies, construction management, hazard control, maintenance, repair and recycling.

Towards a Technology Platform

In 2001, TRA-EFCT was followed by the FP5 Thematic Network E-CORE (European Construction Research Network), which went one step further by bringing together the research directors of enterprises and institutions to develop a common RTD strategy. This concluded with a major European Conference 'Building for Europe' (B4E) in Maastricht, the Netherlands, in November 2004. The event also marked the launch of a European Construction Technology Platform (ECTP).

The ECTP is an industry-driven platform endorsed by the commitment of CEOs from large companies. A vision document for 2030 was developed and a Strategic Research Agenda has been drawn up. At the same time, the ECTP was the first to propose the idea of initiating National Technology Platforms to undertake similar actions at Member State level. These have already been set up in 15 of the EU-25 countries, and more are in the pipeline. Further ways of collaboration are also being explored, e.g. via the Eureka network and through bilateral or regional co-operations that give the flexibility to deal with local issues.

Need to look further

"The challenge for the future is to engage better with society and to achieve greater SME participation in the different EC RTD actions," Vyncke maintains. "Also, because the potential scope of research is so vast, there is clearly a need for the construction industry to talk more with other industrial sectors such as textiles, automotive, steel and manufacturing.

"Though our industry is slow to bring radical innovation to fruition, its size means that even modest advances can have massive economic and quality-of-life impacts. We can expect to see widespread adoption of emerging nanotechnologies, often developed for other purposes, in applications such as self-cleaning windows and surfaces that minimise energy losses or control moisture transmission. Virtual design and engineering is another area where cross-sectoral knowledge sharing will be of enormous value.

"Our participation in collaborative research has helped to put construction on the map as a forward-looking sector. The challenge now is to integrate further into the developing European Research Area and transform the outcomes of our co-operative efforts into lasting benefits for EU citizens."

> Concrete steps towards a silent revolution

Concrete is the staple material of modern construction. Conventionally, the wet mix must be compacted in order to fill voids, ensure uniform strength and obtain an acceptable surface finish. This is achieved by mechanical vibration, employing equipment that is noisy, heavy, costly and energy-intensive. The process is both environmentally undesirable and hazardous to the health of operators. In fact, many concrete workers stop working before reaching normal retirement age because of health problems. Self-compacting concrete could soon make this a thing of the past.

An FP4 Brite-Euram project launched in 1997 – Self-Compacting Concrete (SCC) – set out to lower the price barrier and to extend the use of SCC to poured-on-site applications. The consortium of nine industrial and research partners from France, Sweden, Belgium, the UK and Spain covered each stage of the production chain, from concrete material suppliers through to end-users, and scored a number of significant successes.

It produced guidelines that characterise the performance and define handling parameters for SCC giving scope for both housing and civil engineering projects. A new admixture was developed and patented, and a completely new stability test procedure devised. Finally, the project developed an expert system, called SCCMix, enabling engineers to specify cost-optimised mixes without resorting to extensive laboratory-based procedures.

The scale of its success earned the project a nomination as finalist in the 2002 Descartes Prize for Scientific Excellence. At the time, its achievements were described as 'the greatest innovation in concrete construction since the introduction of reinforced concrete in the 1850's' and '... the most significant research project ever for the health and safety of European workers.'

Project partners went on to join a number of alliances, both within Europe and beyond, to tackle the outstanding problems. The EC itself funded a further initiative, Testing SCC, within the FP5 GROWTH programme. In October 2004, this completed its brief to deliver test methods for determining the three key properties of fresh mixes – filling ability, passing ability and resistance to segregation. With progressive removal of the various bottlenecks global interest continues to rise. Of the participants from 35 countries attending the SCC 2005 conference in Chicago last autumn, over 70% were drawn from industry.

As one experienced concrete worker involved in the original European demonstrations commented: "What I noticed first was the silence. Usually, pouring concrete makes a lot of noise. Now you hardly need ear protectors. [...] My experiences are exclusively positive. There is less wear on the body and the concrete is much easier to work with. This must be the future."