



Challenging and Changing Europe's Built Environment

**A vision for a sustainable and competitive
construction sector by 2030**

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**European Construction Technology Platform (ECTP)
www.ectp.org**

Executive summary

Europe is facing serious challenges, which are evident in the built environment. Damage has been caused by unexpected weather patterns resulting from climate change. Higher sea levels threaten underground rail systems in northern cities. The infrastructure in Eastern Europe is in disrepair. Water supply and wastewater systems throughout the EU are increasingly dilapidated and ill managed. Construction workers die in site accidents due to lax safety. Traffic congestion and pollution discourage development and erode the cultural heritage of collective memory. Unguided city design encroaches on the natural environment. Natural resources (particularly fossil fuel resources) are depleted through their indiscriminate use. Finally, Europe's built environment does not reflect the growing diversity and steady ageing of its population.

These challenges are opportunities for the construction sector. Due to its size and the long life of structures, the built environment has a strong impact on society and on European growth and quality of life. We in the construction sector are involved in all stages of design, planning, construction and facilities management. For Europe to face its major technological, economic and social challenges, we must be proactive in understanding and communicating within our sector.

The European Construction Technology Platform (ECTP) is an initiative to mobilise the whole construction sector – contractors, authorities, architects and other designers, purchasing bodies, and the full range of suppliers, clients and users – to find a clear set of common priorities. We see construction change to be increasingly client-driven, sustainable and knowledge-based.

Research has a vital role to play in this process of transformation. The ECTP will act as an umbrella for research initiatives. The key goals are linked: to *maximize client potential* in *reaching sustainable development*. The strategic research themes are: *Materials and technology*, *Industry transformation*, and *Service*. Material and technology changes will come with the full integration of the developments in the fields of bio-, nano- and information technology. Industry transformation involves bridging the gap in communication between the technical and human side of things in order to discover new business opportunities. Service issues include the pursuit of health, safety and sustainability by meeting human needs and improving accessibility, quality of life and work. Facilitating socio-economic changes by innovating the collective memory is an important issue in the development of Europe's cities. Other priorities are to improve technological take-up, and develop both human and natural resources while increasing opportunities for competition.



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This vision document is supplemented by detailed documents produced by the ECTP Focus Areas (www.ectp.org). Readers are also referred to the E-CORE strategy for construction R&D (www.e-core.org/strategy).

Welcome to the future Europe

It is with great pleasure that we introduce this vision for the European construction sector.

As stated in the Kok report¹, Europe faces serious challenges as well as opportunities. We need to improve the health and quality of life of our citizens as well as substantially raise the level of environmental and economic performance. Any strategy to achieve these goals must first widen the definition of the construction sector to include the conception, construction, operation, retrofit and maintenance of the built environment. Only then can we realize our role in the changing Europe.

A network of research and development must be firmly founded to promote innovation. Research needs and priorities must be defined, resources pooled and results applied in practice. Communication between groups within the sector must be established and strengthened.

The ECTP is positioned to facilitate this communication, comprised as it is of representatives from every point in the design and construction process, and all stakeholders in the industry. The ECTP is supported by a strong network of national technology platforms acting as subsidiaries, with the objective of accessing the construction research of the member states and linking local actions to European initiatives. Being industry-driven and supported by authorities, it will contribute to forthcoming European and national programmes for research, development, innovation and demonstration of the built environment.

The vision of a new Europe is emerging before our eyes. We are positioned to develop the new methods, products and processes that are needed to sustain it. We must not lose this unique opportunity to rethink the process of designing and building our environment.



¹ The report, "Enlarging the European Union: Achievements and Challenges", by Mr Wim Kok, former Prime Minister of the Netherlands, argues that the expansion of the EU makes it possible to address its four major challenges: economic performance, internal cohesion, security and its external role.

Section 1 Rationale and challenges

The built environment can be seen as a synthesis of social, environmental and economic issues, reflecting immediate and long-term problems and opportunities. Since the design, construction and maintenance of buildings and infrastructure are essential for economic development and sustainable growth as well as for the quality of life of citizens, the answers to many of the challenges facing Europe depend on the construction sector. For example, the quality of indoor environment is pivotal for our well being but the delivery of 'healthy buildings' is still a domain for research. The impact of a healthy, comfortable, accessible, usable and safe indoor environment has enormous positive economic impact on productivity, health costs and liabilities.

Nearly 50% of the tangible cultural heritage has been lost during the last 100 years. The collective memory of the people of Europe is embodied in our urban and rural habitats, and is of priceless value. It provides a sense of (changing) identity and attracts people from all over the world, both as tourists, clients and contributors. How to include our collective memory in the built environment, both new and old, is another essential area of inquiry.



The construction sector accounts for an estimated 40% of resource consumption. We have a crucial role to play in achieving sustainability. Environmental issues that the sector faces on a daily basis include: reducing greenhouse gas, mitigating existing polluted areas, enhancing energy efficiency and conserving natural resources such as greenfield spaces, water, energy and balanced ecosystems. When it comes to the vital issue of energy, construction has an important role to play in reducing its use and finding alternative sources of generation. This will, of course, have economic as well as environmental benefits, and will place the European design and construction sector at the global forefront of sustainability, which can only increase its market value.

Some 80% of Europe's citizens live in cities. The challenge facing the great majority of European cities is to improve both the health and quality of life of their citizens, which will consequently improve their environmental and economic performance. Increasingly, citizens are turning their backs on city centres, preferring to live on the periphery. They rightly feel that their well being is affected by urban pollution and the state of housing in the inner city. This *urban sprawl* generates higher levels of traffic, focuses activity on the periphery and weakens the heart of the city. The construction industry should innovate in solving the twin problems of pollution and sprawl by developing ways to design and deliver multi-use, medium and high-density developments, which also include green space and recreation opportunities. This may mean the upgrading and redevelopment of rundown and neglected areas.

The seeds of tomorrow's Europe exist today. Civil infrastructure systems (transport and services) represent huge public investments and, unlike many other engineered systems, they are expected to provide reliable service for very long periods of time, their use spanning several generations during which society will experience dramatic changes. The challenge will be to find the best equilibrium between constructing new infrastructure and upgrading and maintaining existing systems.

European cities provide new homes for millions of people from other parts of the world. The Europe of today and tomorrow must cope with the tremendous challenge and opportunity of integrating diverse cultures, languages and social structures, to guaranteeing peaceful lives, mutual development and to meeting social and personal needs. The aging population is another significant socio-economic challenge for Europe. Demographic trends show that by the year 2020, about one third of the European population will be aged over 60. The built environment must be made ready for this shift by promoting a “design for all” approach – accessibility for all, involvement by all—a paradigm shift to include all European citizens, including those with mobility challenges and those of diverse backgrounds.



With a total annual turnover of nearly 1000 billion Euros, the construction sector is vital to the European economy. It forms the largest industrial unit in the EU, representing one quarter of total output. However, it faces increasing global competition. In order to create the financial opportunities necessary to develop the industry, business procedures as well as building costs and time-to-market will need to be addressed. The possibility of factory-made components, modular housing and recycled building materials should be explored.

By improving the construction process, we hope to achieve reductions of up to 30% of life-cycle costs, 50% of delivery time and 50% of work-related accidents. This would make it possible to invest at least 200 billion Euros per year in extra works to improve the built environment of European citizens. In addition, over 90% of workers are employed in very small firms with less than 10 people. The “tractor effect” of large companies and organisations to disseminate technology must be used. In general, construction has to evolve to become a more attractive career option for young people. Also, graduates need to perceive promising professional career opportunities in our sector, attracting society's best human resources.

By uniting diverse countries, we also unite a diverse knowledge base and broaden cultural understanding. If the European Union pioneers an inclusive, sustainable design/construction industry, this will increase worldwide demand for our improved knowledge base.

Section 2 Vision 2030

"In the year 2030, Europe's built environment is designed, built and maintained by a successful knowledge- and demand- driven sector, well known for its ability to satisfy all the needs of its clients and society, providing a high quality of life and demonstrating its long-term responsibility to the mankind's environment. Diversity in age, ability and culture is embraced. Equalization of opportunities for all is an overarching principle; construction has a good reputation as an attractive sector to work in, is deeply involved in research and development, and whose companies are well known for their competitiveness on the local and regional as well as global levels."

In order to reach this vision, objectives and typical research targets are specified in the following pages for two key aspects of construction: *Meeting client requirements* and *Reaching sustainability*.



Section 3 Meeting client requirements

Objective

“Europe provides a variety of attractive, healthy, safe, accessible, useable and sustainable environments in which a diversity of social and cultural values are welcomed and fostered; places where significant economic prosperity is underpinned by social cohesion.

Advanced techniques and know-how for urban design and building enhance the competitiveness of the European construction industry. The construction sector is based on client- and user-driven complete life-cycle processes. Cost reduction of the overall value chain results in increased competitiveness, new business opportunities, new investments and in economically viable services to the largest possible client base. Optimal allocation of available economic resources is met.

New research focuses on how technology can address human sciences and socio-economics, and how the sector can profit from exploring the current design gap. Inclusion of diversity and the equalization of opportunities for all are overarching principles that strengthen the sector by enabling it to reach new users and make contacts in many different communities. The design and construction sector is recognized by the public as indispensable to development of the built environment.”

Corresponding research targets

Process

- Develop materials, technologies and design and production principles that will lead to improved health, comfort, accessibility, usability and safety.
- Develop ways to meet client requirements, including late revisions, by technology take-up and feedback along the whole supply chain.
- Industrialise the construction process, thereby allowing a drastic reduction in construction costs and improvement in quality control.
- Facilitate a culture of co-operation and trust.
- To provide unity and cohesion within the design + construction sector through communication between user groups, clients, architects and engineers, contractors and trades, and society in general.

Product

- Facilitate people’s knowledge of the built environment, focusing on developing and implementing an architectural knowledge base in the construction sector.
- Develop performance indicators for products, validated throughout their service life, to increase awareness of environmental impact.
- Conceive of flexible concepts for the built environment that can be developed over time.
- Develop methods for achieving attractive, comfortable, accessible, useable and healthy indoor environments in all buildings.

- Make workplaces more flexible in order to adapt to the evolution of economic activities and enterprise structures.
- Improve the communication and design of technologies and systems so that they can be used by all (including the old, the disabled and newcomers in Europe) and in changing social structures.
- Ensure that upgraded, renovated, rehabilitated and new buildings and infrastructure meet changing social needs.
- Target specific goals to achieve results.

Infrastructure

- Develop sustainable urban policies that ensure the holistic development of new areas and the regeneration of existing ones.
- Counter urban sprawl by encouraging densification and the improvement of amenities in city centres.
- Facilitate speedy and cost-effective infrastructure construction, maintenance and operation.
- Reduce vulnerability, life cycle costs and disruptions such as traffic accidents.
- Make use of technological and economic breakthroughs to increase the use of underground constructions for infrastructure, thereby liberating space above ground. Introduce the term ‘city under the city’ as a concept to maintain the economically sound backbone of our historical city centres.
- Identify, implement and integrate solutions for networks of transport and services that increase safety, provide mobility for all, reduce risks for users and citizens, and increase systems capacity and durability.

Cultural heritage & Collective Memory

- Improve the preservation, rehabilitation and integration of the cultural heritage into the urban and rural environment, leading to an appreciation of the collective memory.
- In particular, use consequence-based advanced technologies and practices to develop cities whilst respecting and building on their cultural heritage and other socio-economic and human aspects.
- Ensure that research encompasses interactions between technology, environment, societal and economic impacts, and provides further opportunity to communicate knowledge and expertise.

Hazards

- Facilitate ways to quantify and manage the impact of natural and external hazards on the stability of soils, building structures, infrastructure and civil engineering works, both safely and reliably.

Social sustainability

- Enable equal opportunities in society. Embrace diverse approaches to problem solving and community involvement.
- Develop infrastructure and living spaces to allow better integration of all members of society, including accessibility for all.
- Undertake interdisciplinary academic collaboration with social and medical sciences, environmental psychology, architecture and engineering, on the understanding that research will benefit from many perspectives.

Section 4 Becoming sustainable

Objective

“Europe combines ‘high tech’ with ‘high culture’, and is a natural leader in creating a sustainable built environment. The built environment links nature and citizens in a sustainable way. The built indoor environment enables health and comfort in living, moving and working. The negative impacts of construction’s whole life-cycle and of the built world on the environment are radically reduced, thereby substantially improving the sustainability of the construction sector in Europe, with policies such as zero-waste construction and an efficient use of all resources. Environmental life-cycle approaches are adopted for design, construction works, maintenance and operation, as well as in product development.”

Corresponding research targets

Interaction of built and natural environments

- Reduce the negative environmental impacts of construction.
- Develop urban planning, buildings, materials, infrastructure and renovation schemes to anticipate environmental and climate changes. Decrease CO₂ emissions from new and existing buildings.
- Make all new buildings cost-efficiently energy-positive.
- Drastically reduce the environmental effects of networks, services and underground construction.
- Develop mitigation and re-use of brownfield and polluted areas.

Interaction of built environment with citizens

- Improve the built environment for people.
- Develop performance-based criteria, health and safety criteria, and system-based approaches.
- Reduce environmental impact (pollution, vibration, radiation, noise) of day-to-day activities.

Production

Drastically reduce resource use in production by:

- Reducing quantities of materials and energy-use
- Lowering emissions from products in use
- Improving reparability and recycling
- Implementing zero-waste construction activities, if possible
- Finding new methods of production that lower volatile organic compounds (poisons aka VOC’s)

Existing buildings and infrastructure

- Drastically reduce the consumption of and increase the reuse of resources. Implement energy-ambitious programmes of renovation.
- Reduce greenhouse gas emissions.
- Develop the smart and sustainable management of buildings and infrastructure.
- Develop energy-positive retrofits for existing buildings.

Section 5 Strategic research themes

In order for research and development to reflect the different contexts of construction, this section provides three recommended thematic approaches to R&D: *Materials and technology*, *Industry transformation* and *Service*.

Materials and technology

The properties of materials and technologies are integral to the structures where we live, move and work: roads, railways, bridges and tunnels, networks of drinking and wastewater, and so on. Similarly, the tactile properties of materials are pivotal to our sense of mental well being in buildings, and so durability problems necessitating repairs cause major disruption, as well as large costs. Even small improvements in eco-efficiency (energy and raw material consumption) would generate big savings due to the large volumes involved. New analytical and development opportunities are evolving, for example from the application of nanotechnology, which can lead to breakthroughs in the functionality and sustainability of building materials, as well as in building energy performance improvement.

All this being the case, R&D in this context will typically involve the development of:

- Client-driven platform construction and the industrialisation of construction (including underground), allowing for drastically reduced construction costs and time, in turn giving rise to architecturally rich communities
- New materials, and construction, maintenance and demolition techniques, which reduce consumption of natural resources and allow recycling and reuse of materials
- Efficient materials and technologies for safeguarding our cultural heritage
- Methods of inspection, maintenance, repairs and renewals of infrastructure at minimal cost and with minimum disruption.
- Nano- , bio- and information technology as drivers of change in the construction industry and the built environment.



Industry transformation



This theme concerns the management of construction, with the objective of improving the competitiveness and productivity of the European construction sector and creating new business opportunities. An important task is to turn the sector around to becoming knowledge-based. Another important aim is to incorporate small and medium-sized enterprises (SMEs) into sector innovation processes, thus making use of the flexibility and creativity that is an inherent property of many SMEs.

This approach also includes refocusing from the purely technical to include the human element. Today, increasingly advanced technology is being developed but human behaviour essentially remains the same – we are not inherently interested in learning the details of the technologies available. It is important that technologies, buildings and cities are developed with human behaviour and needs constantly in mind. This approach will yield hospital designs that facilitate recovery, roads that limit the inherent risks for drivers, building plans that reduce fire evacuation times for all, etc.

R&D typically performed within this approach will:

- Link the value and supply chains in construction together, including bridging the gap between “knowledge production” and “knowledge use”
- Re-engineer construction into a safe, knowledge-based and high-tech industrialised process, producing highly customised, low environmental impact products
- Develop new sustainable models, design and building techniques, materials and ICT that increase design possibilities, efficiency and safety, and reduce risks from hazards
- Develop standards that are performance-based and inherently open to innovation
- Develop tools for transforming research into economic activity
- Develop tools for improving the general public’s and particularly young people’s perceptions of the construction sector, by dialogue and communication
- Build a more human-friendly construction work environment
- Address the mechanisms of change needed for business procedures
- Develop “human science tools” in construction, while adopting holistic approaches and integration for improving dialogue, communication and decision-making, as well as obtaining better value definitions for customer and user
- Develop the architectural knowledge-base and its implementation in construction
- Develop robust technologies that connect human behaviour and requirements for safety, energy-efficiency, etc.

Service

The cultural heritage of the existing built environment enriches the identity, the collective memory and the quality of our daily life. Cities, towns and villages, each in their unique territorial setting, represent an essential part of our universal heritage, and should be seen holistically, with structures, spaces and human factors normally in a state of continuous evolution and change. This involves all sectors of the population, and requires integrated design and planning processes across a wider range of different activities. Conservation deals with ensembles of buildings, infrastructure and open spaces and includes intangible as well as economic values.



R&D typically performed within this approach will develop:

- Methods for management, life-extension, assessment, monitoring, diagnosis, improving energy performance, shortening payback time and reducing the environmental impact of infrastructure, networks and buildings
- Specific methods and materials to preserve and rehabilitate existing buildings of various types, and transport and services infrastructure.
- Ways to integrate buildings and networks in the urban and natural environment (including social innovation and risk-sharing)
- methods for incorporating alternative energy resources into the built environment.



Section 6 Generating and implementing R&D and Innovation

The process of construction itself is one of problem solving, though traditionally, change has been local and incremental. Barriers to groundbreaking innovation in construction include:

- The number and range of interests involved in a construction project;
- The complexity of construction outputs;
- The lack of performance-based competition;
- A focus on initial costs;
- Short-term relationships;
- The high proportion of small firms;
- Lack of adequate skills and training;
- The long-term consequences of failures;
- Regulations and standards.

These are significant barriers, and efforts to reduce them piecemeal will likely fail. The framework for collaboration within R&D must therefore take as its point of origin the development of the sector as a whole, by bringing the individual project problem-solving approach to a more universal, sector-wide application. This includes the creation of a positive innovation climate and strong, coherent innovation processes (including infrastructure, education and training), radically enhancing the number and quality of new products, processes and services being introduced.

A construction sector open to innovation would have the following characteristics:

- Long-term relationships both within the supply side and between supply and client interests
- A focus on performance and costs over the life-cycle and away from initial costs
- Knowledge-based, with people at all levels able to assess and implement new concepts
- Widely accepted sets of performance indicators
- A network of information and knowledge services.

This is the innovation context in which R&D will facilitate the transformation of the construction process. This change will necessarily be driven by the sector itself and supported by authorities.

In addition, next to the influence of research, it is important to recognise the mechanisms behind other sources of innovation in construction: product supplier initiatives, the influence of parallel industry sectors, individual creativity and the actions of operators and users.

In sum, the responsibility for developing our sector lies with all stakeholders. The way that clients articulate their requirements, specify and commission their projects is pivotal to the ability of the sector to produce and implement innovation while ensuring overall quality and sustainability. Clients' focus and dialogue with the other parts of the sector will set the objectives.

Section 7 Closing remarks

The challenges that construction is facing are its opportunities. The engagement of the design + construction sector is essential to achieving a sustainable and competitive Europe. The built environment is an amalgam of environmental, economic and social issues, reflecting everyday and long-term problems and opportunities for the people of Europe. The development of the sector needs to take this cross-disciplinary character into account.

Preparing to meet the issues at hand requires a careful critical analysis of the construction process from both a builder's and a user's perspective. Changes will be, of necessity, evolutionary, incremental and gradual procedures. A new Europe is growing with the accession of many new countries; this provides a unique opportunity to introduce a new approach to construction and to develop our sector into the competitive, responsible, knowledge-based and client-driven builders of the new Europe. There are no straightforward instantaneous solutions. We must approach an understanding of clients, societies and environments. On behalf of the sector, we summon all involved in European design + construction to contribute to this new vision for the built environment.

