European Construction Research Network

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E-CORE Strategy for Construction RTD

The Construction Sector: Large, Diverse and fundamental to Environmental Economic and Social Development

Construction - defined as all the activities that contribute to the creation, maintenance and operation of the built environment – is the largest single economic activity in Europe, directly employing some 12 million people and accounting for around 10% of GDP and for over 50% of fixed capital formation. The European construction sector is therefore very large, but at the same time it is also very diverse. At one end of the spectrum are the design practices and contractors that create buildings and infrastructure works of international renown, inspiring their users and demonstrating great technical achievement. At the other end are the myriad of individual tradesmen and small firms who operate in very local markets, mostly on small domestic building and maintenance works.

Construction activities are fundamental to economic and social development, while the outputs of construction - buildings, infrastructure works and transport networks - support all other economic and social activities, public and private. The vast majority of people live, work and take their leisure in buildings, modern life depends on transport systems and urban services and public services are provided through hospitals, schools and other public buildings. In addition, the built environment provides essential protection from natural and man-made hazards and threats.

Construction also has major environmental impacts. It consumes large quantities of raw materials, typically six tonnes *per capita* annually, and produces a correspondingly large quantity of wastes. Buildings account for around 45% of Europe's energy consumption, with a further 5-10% being used in the processing and transport of construction materials. But construction also provides the means of cleaning polluted land and watercourses, and renewing urban areas through new developments and the restoration of historic buildings and structures.

Knowledge & Innovation: Key Factors in European Competitiveness

In its Communication "Working together for growth and jobs - A new start for the Lisbon Strategy" prepared for the Spring 2005 European Council, the European Commission reaffirmed the goals set out for Europe in previous Summits at Lisbon and Gothenburg and in particular stressed that the focus should be on:

- the creation of a dynamic and competitive European knowledge-based economy, with an overarching commitment to sustainable development and a high quality of life for all,
- the promotion of knowledge and innovation, and
- actions to ensure that Europe becomes a more attractive place to invest and work, encouraging European businesses to create more and better jobs.

The Communication focused on the measures needed to enhance growth and high quality employment, and highlighted investment in infrastructure as a means of promoting these objectives.

The contribution of construction to growth and competitiveness comes principally through its impact on the efficiency and competitiveness of other industrial and commercial sectors. Most of construction serves national and local markets, and is not in competition with

suppliers from outside Europe. But a transport link that is not completed on schedule, or a buildings that fails to provide acceptable conditions for their occupants, will prejudice the performance of firms and public services.

Because of the significance of construction as a source of employment, as the creator of housing, buildings and infrastructure, and as a consumer of energy and materials, any strategy for achieving the goals set for Europe must include the creation of a competitive, innovative and sustainable construction sector, with efficient, socially responsible and prosperous firms offering high quality employment. Changing the construction sector, in order to improve its performance and the conditions and the working experience of its workforce, is thus crucial to the achievement of environmental, economic and social sustainability.

A Construction Research Strategy to support European Goals

This E-CORE strategy for Construction RTD in Europe identifies the changes required in the sector, in order that it may fully support the overarching EU goals. It then sets out the principal ways in which RTD can support those changes. A strategy is not a vision of the future. Rather, it provides guidelines to actions that will shape the future. Strategies typically address needs and aspirations stretching for some years into the future, and their ultimate success may be overlaid by factors that were not foreseen, or even foreseeable, when they were prepared. An important role of a strategy is therefore to create an awareness of issues that will shape the future, so that there can be a more informed response as circumstances change.

The over-arching aim of the strategy is *to maximise the contribution of construction and the built environment to the Lisbon objective and sustainable development* in all its aspects: environmental, social and economic. This will require construction:

- To interact more effectively and more sympathetically with Society,
- To rise to the challenge of higher expectations by individuals and communities ,
- To focus on delivery of services, rather than of physical products.

T*he process of creating the built environment and maintaining the huge investment represented by existing buildings and infrastructure is one that involves indeed not just the immediate client or owner and the construction sector, but 'Society' in many guises.* The built environment is a shared asset - one person's house is part of a community's streetscape. Planning policies and procedures for controlling the use of land, administered by public authorities, have for many years reflected this shared interest.

Now, however, there are broader societal demands. S*ociety is demanding more from its buildings, infrastructure and urban areas.* Rising personal incomes and a more stable population have brought about a shift in perspective from quantity to quality. As capital and skills move around the World in the global marketplace, the ability of cities to attract investment, by providing the quality of life sought by high-performing individuals, becomes a key factor in global competitiveness. Europe's historic cities offer unique living and working environments, but maintaining and restoring them, while retaining their unique character, demands specialist skills.

And *with the demand for quality has come an increasing realisation that the built environment is a key influence on the activities and processes that take place within it, and the attitudes of people towards these activities***.** At an obvious level, the provision of a road facilitates communication between communities. Less obvious, but equally significant, are the ways in which buildings mould the processes within them, providing environments that stimulate or inhibit concentration, communication, learning, healing, producing etc.

http://www.recyhouse.be

These paradigm shifts, coupled with the drive for sustainability, are seen as the key drivers for change and improvement in construction. When products of construction are viewed as assets, not costs, and the industry that supplies them as a service industry, new business drivers are introduced into construction, new relationships are created with clients in both public and private sectors, and new supply structures evolve. The industry is challenged not just to provide a set of outputs, but to provide the most effective long-term support service to its clients while responding to Society's requirements for sustainability.

Top Level Goals for Construction

The construction sector is generally considered to be a mature and traditional sector. Its internal structures and process have evolved over centuries and are manifest the plethora of separate professional and trade interests, and the complex relationships through which construction projects are carried out. Much of construction is characterised by fragmentation of responsibilities, a lack of focus on end-users and short-term price-based

competition. But to meet future challenges of quality and sustainability it will need to move from this 'Baseline' state, to become an integrated, user-focussed and performance-driven industry. Investment in research and innovation will be essential to this process and the strategy maps the themes and objectives of the RTD required for this transformation.
Over the sector as a whole, RTD can support the achievement of four 'Top Level Goals', to create an industry that is:

1. Focussed on value, and not on price:
   Construction outputs and services will have well characterised performance, and will be delivered through lean, efficient production processes.

2. Socially responsible:
   The processes and outputs of construction will meet ever more demanding environmental standards.

3. Innovative, and continually learning:
   Integrated, experienced supply chains in long-term relationships with clients will operate as learning units, delivering services through an informed and empowered workforce.

4. Valued by its clients, its people and by Society generally:
   Through enhancing its ability to meet users' aspirations, the industry will change its image and will attract people with the skills and capabilities that it needs.

RTD to meet the Goals

To secure these changes will require innovation not only in construction firms, but also in client organisations and supporting sectors (finance, insurance etc). RTD requirements have therefore been examined from five different perspectives:

- the *environmental perspective*, as Society sets ever more demanding requirements,
- the user perspective, as users seek more value from the outputs of construction and to develop different relationships with the suppliers,
- the *process perspective*, as firms seek to improve efficiency and reliability,
- the *people perspective*, with the need to improve the conditions and quality of construction employment and to change the image of the industry, and
- the *technological perspective*, as new developments change what is possible and support the achievement of environmental and economic goals.

Market drivers and challenges

Urban redevelopment

Enlargement of the EU to 25 countries and possibly beyond will open new markets, and offer new labour sources. The income imbalance between the old EU-15 and the new members will result in a flow of labour to the EU-15 which in part will compensate for declining entrants to the labour market in those countries. At the same time, the large urban refurbishment, redevelopment and environmental clean-up requirements of the new members will stimulate markets for new systems and technologies. Huge populations still live in multi-storey blocks constructed 30-50 years ago, which have poor environmental performance and provide inadequate living conditions by modern standards. They will require replacement or up-grading. More generally, immigration and the trend for smaller family units will continue to place pressure on Europe's housing stock, leading to a requirement for affordable and flexible housing systems capable of being adapted to accommodate changing needs.

Climate change

Storms, floods and extreme temperatures have in recent years brought home the volatility of our present climate. The outputs of construction have long operating lives; buildings and infrastructure designed now may need to work under quite different conditions in the future. Construction has a major role to play (a) in reducing greenhouse gas emissions and (b) in the measures required to accommodate the changes now in progress.

Technologies and design approaches for reducing energy consumption are capable of reducing emissions from buildings dramatically, but the task of modifying or replacing the European stock of buildings is huge and more economic techniques for reducing consumption in existing buildings need to be developed. The introduction of water-saving measures will similarly require substantial investment, but could be undertaken alongside the replacement of other services, which takes place more frequently than replacement of the building fabric.

The form of our urban developments also needs to change, with more emphasis on mixed residential and business use in order to minimise transport requirements. Investment in public transport to reduce car use will require construction of new rail and tram systems, while inland water transport may also be the subject of large-scale investment.
Measures to adapt to climate change will include works to prevent large-scale flooding as a consequence of rising sea levels and intense rainfall. Existing structures will need to be adapted to reduce the probability of failure in high winds, extreme temperatures and precipitation and the general revision of design codes to anticipate future climatic conditions.

Demographic change

European populations are aging, as birth rates fall below the natural replacement rate. This will increase investment in healthcare public services, with corresponding implications for construction markets. New forms of healthcare will be developed, enabling the elderly to remain in their homes, but in turn these will place new demands on housing. The adaptation of homes to accommodate a higher proportion of elderly and infirm occupants will become a significant feature of the market.
At the same time, demographic change will reduce the flow into the workforce of the younger workers who have typically provided much construction site labour. Construction may respond by introducing greater industrialisation, both on and off-site, and by re-skilling tasks in order to overcome skill shortages. However, these approaches will only partially address the labour-intensive demands of repair and maintenance, which are growing as a proportion of construction output. Market forces may put a premium on newer property with lower maintenance needs and stimulate the development of high durability materials and components, requiring less regular maintenance. Also a change in the family structure i.e. growing number small families and single flat occupation may result in a demand for smaller housing blocks.

Meeting environmental requirements

Society's requirements for the built environment find expression in regulations and public expectations, some of the latter being manifest in planning decisions while others translate into competitive market pressures. Through research and its application, construction can meet the challenges of sustainability, so that the built environment no longer makes huge demands on natural resources.

With Society setting ever more demanding requirements, the *environmental perspective* identifies the following focus points for RTD:

- Reducing consumption of natural resources and energy,
- Maximising use of renewable energies,
- Reducing the impact of construction activities,
- Supporting the creation of environmental tools and strategies.

Key RTD goals include:

- development of cheaper and more effective ways of improving the thermal performance of existing buildings, without incurring major disruption or changes in appearance,
- development of more intelligent control systems, responsive to user requirements without intervention,
- development of localised power generation systems, enabling greater use of 'waste' heat, and independence from conventional sources,
- re-use of water in buildings without introducing health risks,
- more flexible buildings, so that new uses can be accommodated without the need for early replacement of otherwise satisfactory components and materials,
- techniques for on-site processing and re-use of construction wastes, to minimise transport movements of materials from the site, and increased use of recycled and waste materials and industrial by-products in construction products,
- cheaper and safer means of underground construction and improved techniques for removing pollutants from previously used sites.

Autonomous buildings / Positive energy buildings
One approach to the development of buildings which make lower demands on natural resources has been through the development of 'autonomous' buildings, which have no connections to central energy or water supplies. These are highly energy efficient, with renewable energy providing their residual energy requirements. In the future, new buildings could even be net energy producers, utilising their capacity for collecting ambient energy. Water requirements are met from rainwater and by recycling. Wastes are treated locally. Designed to be flexible, with life-time analyses of use and resource consumption, they will allow complete end-of-life recycling. Through refurbishment of fabric and replacement of equipment, the energy and water consumption of existing buildings will be significantly reduced. Achieving autonomy, whether of a single building or a group of buildings (e.g. a small housing community) is an aim which stimulates innovative design and associated RTD.

Fulfilling user requirements and aspirations

Construction provides a set of services that support the activities of direct users of the built environment while respecting and responding to the interests of the wider set of stakeholders that constitute Society. Thus the starting point for the creation of the built environment must be an understanding of users' needs and aspirations, and stakeholders' requirements. These need to be better understood and expressed, with interactions between clients/users, Society and supply interests facilitated though new tools and new technologies. Currently, there are few meaningful measures of performance that can be a basis for communication, while communications do not take advantage of the latest technologies.

The *user perspective* identifies the actions needed to deliver more value for users from the outputs of construction and to develop different relationships between users and suppliers, through:

- Understanding and modelling performance,
- Creating performance indicators,
- Communicating performance.

The RTD required will aim at:

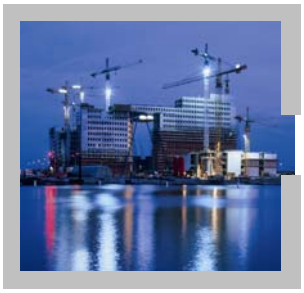
- understanding the present limitations of performance models for the principal technical attributes of buildings and structures (structural performance, thermal performance, environmental performance, fire safety etc.),
- creating performance indicators which reflect functional performance, through research into the interactions between the built environment and its users,
- developing and refining models of technical and functional performance which cover the expected lifetime of the building or structure,
- creating progressively more powerful and accessible visualisation tools, aimed at a wider range of designers and users,
- extending 'virtual' prototyping to include a wider range of experiences – sound, air movement, air quality etc – so that the user may have an 'immersive' experience of the proposed building or facility,
- linking 'virtual' tools to technical and functional performance models, so that changes made through virtual experience may immediately be reflected in performance predictions,
- creating of new information systems, to provide users with better operational information, so that buildings and infrastructure may be used more efficiently.

Continuous performance improvement

Unlike other industry sectors, construction has not developed a culture of continuous improvement through systematic analysis of performance in use of its outputs. The project-based nature of construction has led to short-term relationships between users and supply interests, and the relative expense and difficulty of securing reliable information on both technical and functional performance has inhibited feed-back from completed developments.

However, with the introduction of longer-term relationships, and developments in technology, there are now incentives and means for securing better information. Monitoring and communication technologies now allow automated collection of data and with the rapid development of 'chip' technology, the ability to install sensors that can monitor all aspects of technical performance and that can enhance functional performance (e.g. by tracking the movement and actions of people through pattern recognition techniques) is becoming reality. Just as aircraft engine manufacturers monitor performance in real time, so will construction monitor the performance of its products and services. Performance models will enable us to keep track of current requirements more effectively.

Changing the construction process



The *process perspective* is concerned with the processes through which the industry delivers assets and services, from inception to completion and operation. Currently fragmented, and with much scope for inefficiency, information deficiencies and conflicting objectives, this could be integrated with the aid of new tools and new knowledge. But there are large research challenges, notably in the understanding of human and organisational behaviour.

The *process perspective*, is thus of utmost importance as firms seek to improve the efficiency and predictability of their processes. The RTD required will support:

- Whole life thinking,
- Lean production,
- Industrialisation,
- Integrated delivery, particularly through partnering and the use of ICT.

RTD objectives include:

- the application of Information and Communications Technology to the recording of in-use performance of systems, components and whole structures,
- the development of systems and record formats for tracking changes in use, as needs change

- the refinement of methods of accelerated testing, to enable the performance of materials and components to be predicted under different environmental scenarios, and,
- the incorporation of future requirements in current cost, resource and environmental impact assessments,

- the assessment of 'constructability', ie ease and practicability of construction, through '4D' modelling systems employed during the design phase, with the aim of eliminating waste within the whole construction process,

- exploring and reducing the tensions between the improved efficiency and predictability of industrialised systems of construction, and the ability to meet the exact needs of individual customers,

- enabling systems to meet demanding requirements for structural and environmental performance, setting standards for conventional construction,

- exploring the acceptability and economics of such systems across Europe, with a view to creating Europe-wide markets for suppliers,

- providing conventions and standards for connectivity, so that different industrialised systems may be combined to suit different requirements,

- providing integrated production and erection systems, so rendering the final assembly process more efficient and predictable,

- enhancing understanding of relationships in construction projects, and how these can be optimised through managerial actions and contractual frameworks.

Mass customisation

Traditionally, most non-housing building projects have been based on designs prepared for a specific site, and the capacity for transferring lessons and experience from one project to another has been limited. The use of standard designs was perceived to lead to uniformity and an uninspiring built environment. However, with modern 'flexible manufacturing' technologies, standardisation has been overtaken by 'mass customisation'. A basic design can be modified in a multitude of ways to meet individual needs. With experience, resource usage can be optimised and performance continually improved, without the risks attached to the introduction of completely new and untried combinations of materials and components. This approach contributes to other goals. With greater standardisation, materials can be provided in immediately usable sizes and quantities. This reduces waste on site and simplifies the recycling of any residual waste since it originates from a factory rather than from a building site. Conditions of employment can be improved and exposure to site risks reduced. Transferring some construction activities to the protected factory environment reduces the impact of one other important source of inefficiency and unpredictability - the weather.

Enhancing construction employment

The people who create and maintain the built environment are the main resource within construction. They will need to adopt new ways of working and new technologies, but at the same time, the recruitment and retention of skilled workers will be a challenge for the industry unless its '3D' (dirty, dangerous, difficult) image is changed. This *people perspective* considers the contribution of research to the creation of a sustainable workforce, working in dramatically improved site conditions and with the skills and knowledge that meet new requirements.

It seeks to improve the conditions and quality of construction employment and to change the image of the industry through:

- Improving the working environment, notably through mechanisation and by improving health and safety,
- Enhancing the quality of work through individual and team development and through improved communication and training.

RTD needs include:

- Research into attitudes towards safety, learning practices and associated reward systems in order to create effective approaches to instilling safety awareness and practices. Simulators for Virtual Training sessions could be an outcome of such research.

- RTD on the application of new information and communication technologies to site communications to improve safety and technical competence.

- Research into learning processes to support the introduction of new training and qualification systems, leading to a higher status for construction employment.

The 'Vigilant' Organisation

Site-based activities, even with the highest degree of planning will have unpredictable elements because of unknown ground conditions, circumstances unconnected with the site (e.g. delivery delays) or simply the weather. They therefore require continuous reappraisal as circumstances change, to identity and address the consequent risks. All parties to the project need to be involved in this, depending on the scale of the reappraisal, but the central role should be played by the workers on site, who need to be equipped to assess and handle hazards, supported as required by other parts of the organisation. Collectively, the project team becomes the Vigilant Organisation.

Developing the skills and competences required will call to a large degree on expertise in fields of social sciences, involving studies not only of accident and near-miss incidents, but situations where organisations have developed accident-avoidance procedures in response to new circumstances.

A Vigilant Organisation will be characterized by a triple barrier against accidents: sensitivity to risks, methods and procedures, and appropriate information systems and equipment.

Mechanisation and Automation of site Processes

RTD can provide progressively more sophisticated monitoring and control systems for construction equipment. The goal should be the complete replacement of human labour in all hazardous conditions, such as the construction of tunnels, by drawing on technology developed for space and undersea exploration. Even on conventional sites, the operation of equipment may be planned and controlled by systems that utilise design data for the building or other structure under construction.

Complete automation may not be necessary, nor possible for the increasing proportion of construction concerned with repair and refurbishment, when there is imperfect knowledge of the condition of the structure and the exact tasks required may not be fully determined until the works commence. However, the application of technologies for remote operation, assisted by progressively more intelligent systems for capturing and interpreting visual data, will serve to reduce direct exposure to risk. The 'site control room', comparable to the control centre of a production plant and with similar controls and displays, should become a feature of a construction project.

Living buildings/Nanotechnology

Organic "adhesives" produced by bacteria might bind together aggregates of sand particles, earth, dust and clinker to form building materials. By selecting specific bacteria, it will be possible to vary the properties of the resulting composites: strength, density, permeability, thermal insulation etc. Air quality could be subject to bacteriological control, using biological sensors. Pollutants in ventilation circuits might be eliminated by biotechnologies. A "living" wall surface could be like a sort of lichen - purifying the air, regenerating oxygen and releasing fragrances. Similarly, surfaces utilising natural materials might control humidity and heat loss and prevent build-up of dirt and dust.

Novel construction materials could result from the application of nano-technology (e.g. through the use of nano-particles, nano-tubes and nano-fibres), offering new combinations of strength, durability and toughness. Examples are bio-mimetic materials based on structures and compounds found in nature, composites with self-adjusting interfaces, shape-memory, self-repairing and strain hardening materials. New filters for air and water will be developed, offering the potential for much improved indoor air quality in urban areas and the potential for large reductions in water consumption.

Exploiting new opportunities in materials and technologies

The strategy is founded on the view that construction is a provider of services to the users of the built environment. However, construction has still to provide a physical asset in order to deliver the service. The *technological perspective* considers how materials and construction technologies will change through research and through the adoption of new developments from other sectors in order to provide buildings and infrastructure that better meet users' and Society's needs. Its main themes are:

- The use of nanotechnologies, biotechnologies and ICT to create new products,
- Enhancing the performance of natural and traditional materials,
- Applying technologies to create new ways of achieving: separation and control, durability, flexibility and re-use, intelligence and responsiveness.

The sensitive house

Anticipating the development of new forms of sensor and communications, the home will be equipped with on-board intelligence, with the provision for sensors and extensive cabling, capable of evolution to suit new generations of devices. Linked by a single 'bus', environmental systems will sense and control lighting, heating, security, fire detection, air quality etc. In larger buildings, systems will sense structural movement and strain, while mechanical plant will be automatically monitored.

New technologies for detection of strains and cracks include those used in advanced structural systems, such as fibre optics, ultra-sonics and lasers, but "simple" approaches may also find application, such as strain-sensitive paints, with conducting or colour change properties. Coupled with self-repairing materials that respond to heat, air or moisture, these could enable designs to be more closely aligned with expected loads.

RTD is not Sufficient: Fostering Innovation

The RTD themes identified in the five perspectives address current deficiencies in the way that construction operates and the opportunities for changing both the industry and its outputs through new knowledge and new technologies. They are generic, in that they seek to transform the industry, rather than any particular form of building or other output. And the development of improved technology will not be sufficient; it will be crucial to change relationships and processes if the industry is to achieve its goals, and the social sciences will have a large contribution to make to the necessary RTD.

However, research outputs do not bring about industry transformation. This comes through the actions of managements in firms and public bodies, who innovate in their products, services and requirements. There are many barriers to innovation in construction, some caused by current fragmentation of responsibilities and others by poor systems for risk identification and management. For construction to be open to innovation, the industry and its clients need to develop long-term relationships and a focus on life-time costs and performance. This will provide the business drivers for fostering knowledge and innovation. RTD can support these aims through providing new measures of performance and asset value, analyses of the benefits derived from new processes, and tools to manage and foster relationships. Enhanced systems for providing information about new developments, and the

inclusion of innovation in construction educational courses, can further promote a culture of innovation.

Integrated RTD for an Integrated Industry

The sustainable construction sector of the future must operate through integrated processes and teams, creating lasting relationships across client and supply interests. This will enable it to provide products and services with assured and well understood levels of performance, and to be a valued and trusted partner in the development and operation of the built environment. The RTD themes identified in the strategy are similarly integrated and inter-related; each has strong interactions with others. Three broad thrusts can be identified which align with the way that the industry must develop:

- Assuring performance – the development of tools for understanding, formulating, characterising, modelling and communicating the many dimensions of performance in the built environment,
- Supporting efficient construction - the development and application of advanced process and production technologies that will deliver outputs reliably and efficiently,
- Developing people – creating the conditions that will attract and retain people with the skills required and providing the means through which they can gain skills and knowledge effectively and in a timely manner.

The Way Forward – Actions and Recommendations

The E-CORE strategy sets out how RTD can assist the transformation of construction so that it fully supports the attainment of European goals. The industry, and the clients who benefit from its outputs, must bear principal responsibility for securing this transformation and for the associated investment in RTD. However, public bodies at European and Member State levels are hugely influential through their roles as regulators, as funders of research and as clients. Their policies towards construction need therefore to promote the changes indicated in a coherent manner. ECCREDI and its members should promote the strategy to the European Parliament, the European Commission, and the governments of Member States to influence policy frameworks (eg on public procurement) and RTD programmes.

The principal industry-led focus for construction RTD and innovation at the European level is the European Construction Technology Platform (ECTP), which is tasked with developing a Vision 2030 for construction, a Strategic Research Agenda and associated Action Plans. The Platform should take the strategy as the starting point for these Plans, and in particular focus on how the processes of construction should change in order to raise the level of performance in the sector.

At Member State level, it will be the responsibility of the National Technology Platforms and of the members of European industry associations and federations to initiate debate and seek coherent action. A new level of collaboration between national and European programmes is required, to ensure that resources are used effectively.

The ECTP Challenge

Through this strategy, E-CORE has provided the foundation for a new pan-European approach to the transformation of the sector through research and innovation. The creation of the European Construction Technology Platform offers an industry-led means of translating the strategy into co-ordinated action. There is for the first time a real opportunity to develop a construction sector that fully contributes to the achievement of European economic and social goals and to sustainable development.

Recommendation 1 - Communicating the strategy
ECCREDI should actively communicate this strategy to the principal bodies that set the business framework for construction – the European Parliament, the European Commission and the governments of Member States

Recommendation 2 - Achieving change though social and market mechanisms
The European Commission should explore with ECCREDI the impact of its social, economic and environmental policies on construction and the ways in which they promote or inhibit the achievement of the changes set out in this strategy.

Recommendation 3 - Building political consensus
ECCREDI should work with appropriate groupings within the European Parliament (eg FOCOPE) to establish consensus on the role of construction in achieving European goals and the changes required to facilitate this, and mechanisms for monitoring and influencing European policy and programme development in order to achieve consistency with the strategy's objectives.

Recommendation 4 - Working at all levels
National members of the European federations represented in ECCREDI should take similar, and concerted, action in relation to Member State governments and institutions, working in conjunction with the National Platforms of the European Construction Technology Platform.

Recommendation 5 - Innovation through Standards & Technical specifications
ECCREDI and the ECTP should enter into dialogue with EOTA, on the way that technical approvals can promote innovation in construction, and with CEN and CENELEC, on how this innovation can be recognised in codes and gradually be incorporated in the state of the art documents such as product standards.

Recommendation 6 - Industry transformation as the focus for the ECTP
The ECTP should recognise its responsibilities towards stimulating industry transformation by adopting the strategies set out in this report (which has been prepared for this purpose) in the work of its Focus Areas, Vision 2030, Strategic Research Agenda and Action Plan development.

Recommendation 7 - Stimulating industry change
Members of E-CORE and ECCREDI should communicate the strategy to their own members and industry contacts and stimulate action at national and European level to see the strategy adopted as an underpinning framework for setting policy in the public funding of construction RTD.

Recommendation 8 - Understanding innovation
ECCREDI and E-CORE members should promote the use of the E-CORE innovation questionnaire in Member States, to deepen understanding of innovation issues and stimulate debate on the changes required to overcome innovation barriers.

Recommendation 9 - Monitoring change
The ECTP should promote the development and use of performance indicators that reflect the quality and effectiveness of construction processes and outputs, to aid assessment of the impact of RTD and to guide the development of future programmes.

Recommendation 10 - A living strategy
National Technology Platforms and the ECTP, assisted by ECCREDI, are encouraged to review the E-CORE Strategy tool and to update or adapt it to suit prevailing circumstances.

ECCREDI is the European Council for Construction Research, Development and Innovation. ECCREDI was established in December 1995 as a joint initiative of the construction industry and the research community. The aim of ECCREDI is to contribute to the competitiveness, quality, safety and environmental performance of the construction industry and the overall sustainability of the built environment, particularly through the promotion of research. ECCREDI took the lead in developing and managing E-CORE (see below).
www.eccredi.org

E-CORE – the European Construction Research Network - was launched in October 2001 as an EC funded Thematic Network under the FP5 Programme "Competitive and Sustainable Growth". From then until March 2005, E-CORE provided an electronic reference point for construction research at a European level, providing an 'umbrella' for individual research interests and for specialist networks related to construction to come together and share ideas and opportunities. A major objective for E-CORE was to develop a strategy for European construction research, identifying knowledge gaps and proposing priorities for future EU programmes.
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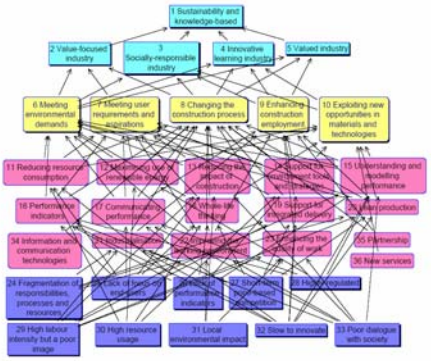
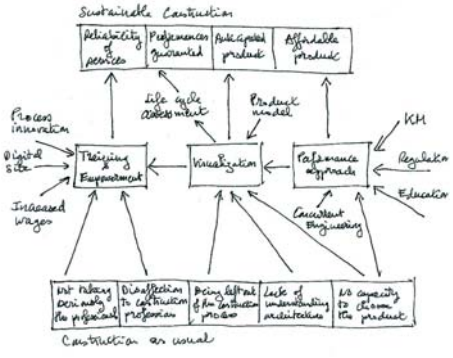
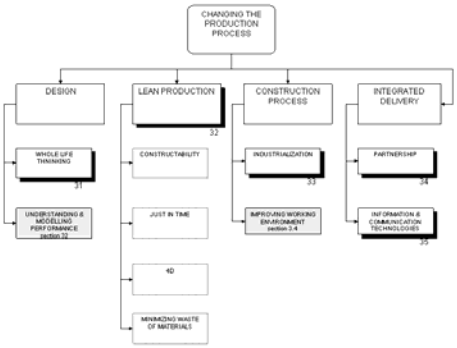
This paper is an extended summary of the E-CORE Strategy Report, the full text of which is available at http://www.e-core.org/strategy







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