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August 1999

# UK Construction 2010 – future trends and issues

## Briefing paper



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Prepared under contract to CIRIA by Technopolis

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# Summary

This report presents a series of trends that will shape the long-term future of UK construction. It is a primer for discussion rather than a statement of facts.

The document was prepared as part of CIRIA Research Project 594. The study, “Adopting Foresight in construction”, involved eight companies and more than 140 participants. Through a series of interviews and workshops, participants were given an opportunity to consider future issues in a global, industry and company context. This report was prepared as a “think piece” and circulated to all participants prior to their involvement in the various project stages.

The study and its conclusions are set out in more detail in CIRIA Funders Report CP/64, *Adopting Foresight in construction*.

## Readership

The report will be of interest to those involved in strategic planning and marketing, those responsible for human resource functions, and others across the industry who are interested in the ways in which construction is changing. The document can also be used as the basis of group discussion within organisations.

## UK construction 2010 – future trends and issues. Briefing paper

*Construction Industry Research and Information Association*

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# 1

## Introduction

This paper presents a series of trends that will shape the long-term future of UK construction. It is a primer for discussion rather than a statement of facts.

Section 2 lists anticipated trends in the economic and political realms that are likely to affect construction. These external factors are presented using a Social, Technical, Economic, Environmental and Political (STEEP) framework. The next three sections take a construction perspective. Chapter 3 covers customers and markets. Section 4 looks at projects and processes within the industry, from planning to abandonment. Section 5 deals with the inputs to the construction process, considering the kind of materials and resources that will be needed to satisfy future demands.

There is a degree of duplication between the sections, which simply reflects the interconnectedness of the issues. In a small number of cases there are contradictions between experts' views due to the subjective nature of this type of analysis.

Annex 1 provides an overview of scenario planning and draws out some conclusions about the contribution this method can make to Foresight in businesses. Annex 2, Further reading, is a list of reports and official policy documents that have been used in the compilation of this digest, which may prove stimulating to construction professionals. A list of the participating companies is set out in Annex 3.

## 2

# The changing world

### 2.1

#### SOCIAL TRENDS

There are numerous social trends anticipated including:

- dramatic population growth in the southern hemisphere, and a continuing movement of those peoples from rural areas to towns
- declining population in the UK, with an increasing age profile; the situation is similar throughout the economies of the OECD
- significant increases in the number of UK households (especially single-person households)
- increasing demand for lifetime education, skills and training
- government initiatives will drive up educational standards in UK schools over next decade, but standards look set to decline in higher education
- increasing average personal affluence, with a risk of greater inequality and social exclusion
- greater self-sufficiency amongst the working population, with limited guarantees from the state (welfare provision) or large corporations (long-term job security)
- information and communication technologies (ITC) will de-skill aspects of professionals' work; while new business processes – from partnering to supply chain management – will require additional skills.

The public will become more aggressive in its advocacy of certain green and socially desirable practices. This has been a growing trend, evident recently on several high-profile contracts where senior managers and site staff have been confronted by large numbers of demonstrators and anti-road campaigners. In some cases they have had to conduct their business and private lives under a blanket of security.

Direct action aside, people are becoming more socially empowered. Most parts of industry (outside the black economy) will be forced, over time, to become more appreciative of their customers and more thoughtful about the effects on third parties (witness the growth recently in Good Neighbour schemes). This freedom to be constructive (to innovate, to redefine social ideals and institutions) is accompanied by a requirement to accept self-discipline and the penalties of getting things wrong. In a minority of cases freedom is not associated with responsibility and there is a loss of deference to society and authority generally, which undermines our sense of community.

The level of anxiety is expected to increase among most members of the public, partly as a result of the values mentioned but also through pressures of work (spiralling performance requirements for all and job insecurity for many) and the growing polarisation between those in work and those not. The gulf in the quality of life experiences between the low skilled and the higher skilled has been muted by a variety of redistributive mechanisms. Unemployment and income differentials, however, must grow as even white-collar jobs become susceptible to automation and redesign and financial pressures on the state make cross-subsidisation more difficult.

The widely anticipated move from a situation where an individual might expect to have a job for life to one where most expect multiple jobs, even careers, will have implications

for regional development and for the housing market (both to buy and to let). In this scenario, one can envisage high-status individuals making greater demands on buildings and the built environment to do more to promote a sense of well-being and personal security.

Demographics is one of the most significant drivers of wealth, quality of life and demand for buildings. The table below shows the anticipated growth in households, which will drive demand for different types of dwelling. An important trend is the ageing population,<sup>1</sup> and especially the growth in the very old and frail, that implies more specialist housing and a wholesale rethink of the shape and feel of the built environment generally.

<b>Households</b>	<b>1991</b>	<b>1996</b>	<b>2016</b>	<b>Change 1991–2016</b>
Total number of households	19.2m	20.2m	23.6m	4.4m
Single-person households	5.1m	5.8m	8.6m	3.5m
Av household size (persons)	2.47	2.39	2.17	–0.3

Economic factors do affect household formation. Some households may not form if incomes grow more slowly than expected or if house prices rise. However, the primary determinants of household growth are demographic and social. Population growth, more elderly people, the increasing numbers of younger people delaying decisions on marriage or cohabitation, and the increased rate of divorce, are the principal determinants of the growth in the number of households.

## **2.2 TECHNOLOGICAL TRENDS**

Further dramatic developments in the performance of ITCs, and the widespread proliferation of applications based on these technologies, are universally anticipated trends, including:

- widespread use of simulation, including modelling and virtual reality, for more robust design and specification
- widespread use of sensors and communications systems will reduce further the need for a worker at the point of process or manufacture, and for precise identification of faults
- robotics and computer-controlled automation will reduce further the need for people to perform dangerous or repetitive tasks
- rapid growth in at-a-distance transactions (business-business purchasing, electronic banking, Internet-based services and retailing, etc)
- rapid growth in the volume of information and data available, both commercial data (eg flight schedules) and public records (eg government contracts on the web), and this will be allied with increased power (and precision) of search facilities.

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<sup>1</sup> Available data indicate a decline in fertility rates and an increase in mortality, which has led to proportionally fewer young people in the population. This has led to an increase in what has become known as the dependency ratio; the burden that people under 15 and over 60 place on the economically active population. The trends in the average age of the general population are expected to be reflected in the workforce, and the impact may be concentrated on mature sectors more than the newer and more dynamic areas of the economy, which will continue to be more attractive to younger people.

Significant growth in teleworking and homeworking is anticipated. In theory, teleworking can give flexibility and improve access to paid employment for that part of the population that is tied to the home in some way or can only work on a part-time basis. However, studies by companies like AT&T and Dell suggest that teleworking will spread *slowly* as part of flexible working arrangements generally; people need groups for social interaction, team work and problem solving.

The rate at which new materials are introduced will accelerate:

- we shall see a breakthrough in the price performance of advanced materials, the new substances will be more closely engineered and lighter (easier to use and work with) and will require less maintenance and repair
- genetically engineered plant (foodstuffs to timber) and animal tissues will be common
- biotechnology will extend beyond new materials to include human and animal processes (bioprocesses) including psychosomatics (eg causes of stress), genetic and environmental bases for disease and allergies.

## 2.3 ECONOMIC TRENDS

The outputs of the construction industry are predominantly *investment* goods, ie buildings, facilities and infrastructure that others use in the creation of goods and services. Trends in economic growth (eg Gross Domestic Product), inflation (eg Retail Price Index), fixed investment and unemployment have a strong influence on the industry's profit margins, liquidity and investment capacity.

European Monetary Union (EMU) moves into its third phase from January 1999 as the first member states adopt the Euro. The UK is likely to join this first wave of participants within two years and most commentators predict that this final phase will have a stabilising effect on key economic variables such as interest rates and inflation. This ought to be good for construction both in terms of levels of demand and of industrial efficiency. However, the benefits may be offset by higher levels of personal and corporate taxation (compared to those that currently prevail in the UK), which will restrict investment.

As well as the influence of the domestic economy, the industry is affected by its competitive position. In terms of wage costs, the industry appears to be very competitive. The UK has low wages for all categories of work – professionals and operatives – compared to most member states and other OECD countries.

A ready supply of unskilled and semi-skilled workers will be assured through European enlargement and industrial restructuring. This trend may be exacerbated by the expectation that blue-collar work in other sectors will continue to decline and that less-educated people will find it progressively harder to get full-time jobs on permanent contracts with good companies. We can expect a significant proportion of these people to be forced into the black economy and casual work. This situation will continue to be a disincentive to investments in capital equipment and advanced construction techniques in large parts of the industry.

## 2.4 ENVIRONMENTAL TRENDS

All commentators point to the widespread and profound changes that will be pursued during the coming decades in order to protect the environment.

Global warming is widely accepted as a fact of life. Furthermore, most scientists argue that it is too late to avoid disruption to regional agricultural patterns and water resources that will, in turn, cause widespread socio-economic problems and ecological disasters in numerous parts of the world.<sup>2</sup>

Emissions from burning fossil fuels also present a serious health risk through air pollution (eg increased incidence of asthma to lung cancer) particularly to populations in the mega-cities of the southern hemisphere.

The most obvious development in the next ten years is the growth in the number of us who will recognise and understand the threat posed by global warming; this impact will become more apparent even to people in the UK.

There are many implications for construction and civil engineering. For example, many of the engineering services that will be designed in the next say five years will still be in service in 2020. Given the marked climatic and temperature changes projected for the UK over the same period (20% reduction in heating degree days and 80% increase in cooling degree days) design criteria will need to change, and soon. A second example is the increased opportunity for the construction of renewable generating capacity in the UK, the Netherlands and farther afield.

The UK has a target to provide 10% of national electricity from renewables by 2010<sup>3</sup>. This is likely to be dominated by new and enlarged wind-power installations in remote areas rather than solar photovoltaics (for which the UK's climate and economics are unsuitable)<sup>4</sup>. However, in the next ten years major advances in solar photovoltaics (PV) can be expected, given the level of political and commercial interest (the EU has targeted 500 000 homes to have panels by 2010). Facade engineers expect that cladding with integral solar PV will be viable for commercial buildings in southern England within five to ten years. Indeed, some industrial commentators expect that within 20 years solar PV will do for electricity what PCs did for computing in the 1980s and 1990s, with local power generation supplanting central power stations to a large extent.

Environmentalism is an issue for construction today, and it is highly likely that it will become a force for radical change over the next decade. However, the targets of current legislation and prevailing market requirements suggest that the impact will be muted and gradual. This is not to say that the prospects for more stringent green legislation are remote, nor that the various authorities and major clients will not tighten their interpretation of what is environmentally acceptable. However, the idea that construction will become green overnight is a fantasy. As an example, think what would be required to bring about an inversion in the balance of material inputs from the current 90% raw materials and 10% recycled and secondary materials! In any event, environmentalism will be everywhere to some degree; translated into fiscal policy and systems of industrial control, from the Building Regulations by way of land-use planning and on to transport.

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<sup>2</sup> The greenhouse effect is increasing the temperature of the world's oceans, which has been shown to have a disproportionate effect on the location and intensity of rainfall and the frequency of cyclones. In the USA, weather-related insurance losses have increased five-fold in the past two decades (as has rebuilding work).

<sup>3</sup> At the 1997 Kyoto Conference, the developed nations agreed to bring about a 5.2% reduction on 1990 levels of CO<sub>2</sub> emissions by 2008–2012.

<sup>4</sup> While active solar power is likely to remain a specialist option in the next ten years, passive solar design (eg use of building orientation and thermal mass) may become a dominant design principle for new residential and commercial buildings. The greatest challenge is to improve the performance of the stock of existing buildings, particularly housing – with replacement rates at around 1% a year improvements through new buildings are of limited value overall.

In many cases, however, environmental gains will be achieved through developments in other spheres such as the widespread adoption of new design procedures for everything from cars to hospitals, which model the through-life costs to improve value for customers and improve economic performance. Specific environmental trends include:

- cleaner processing technologies, reduced emissions, discharges and solid wastes
- efficient, low-emission and sustainable energy technologies
- life-cycle evaluation and analysis including environmental impact, changing use and lifelong support, and disposal and decommissioning.

## **2.5 POLITICAL TRENDS**

The success or otherwise of various political processes that are under way, including European integration and European enlargement, is perhaps the single biggest challenge facing the UK and its construction industries over the next decade. If it works then stability and growth ought to follow, but the challenge is so great that the risk of a major European recession must be real.

At the level of political values, the softening of economic monetarism in the Blair/Clinton alliance's Third Way can be expected to introduce higher burdens on business and the economically active. This will aim to pay for better social welfare provision (from unemployment to pensions) and reinforce our collective ability to achieve other socially-desirable goals such as sustainability. However, this level of cross-subsidisation may still not be sufficient to prevent growing inequality and at the same time it could depress the non-government sectors' investment capacity.

## 3. Customers and markets

To understand the nature of demand for constructed facilities and services in the longer term we need to understand who the customers will be and what is likely to be the nature of their business or operating environments.

Major customers have global businesses and global reference points. They will be better informed (even than many constructors) and more demanding of construction services and products. It will be a condition of service for any “business partnership” for the relationship to add value to the client’s downstream operations and on occasion to share the risk involved in those ventures, perhaps even to take an equity stake as well. Above all customers will expect the companies that they do business with to understand and meet their objectives.

For most groups of customers in the UK and continental Europe, a “faster faster” scenario is likely to hold, with businesses having to work harder to maintain levels of growth and profitability. As part of this intensification all businesses will work their assets harder and that will include buildings and other constructed facilities; assets must deliver more value.

The insistence on better value for money and quality will characterise small occasional clients and even individual householders.

### 3.1 BUILDINGS AND FACILITIES

We may see a growth in buildings that are designed and built with a single purpose in mind and to last for a specific period (say ten years) before major refurbishment or dismantling. This may affect commercial and industrial facilities (eg retail premises, healthcare facilities, utilities) to a greater extent than public buildings or infrastructure. This implies an increased rate of renewal (facilities are used for ten years rather than 50) and will be contingent on constructors achieving improvements in the price performance of those buildings and other constructed products.

Improved price performance ought to influence all market segments – even residential – and may increase aggregate demand as people and organisations can afford to upgrade ahead of expectations or deal with maintenance problems through buying a new building or facility. However, the commercial benefits to construction – in overall terms – may be offset by an associated reduction in repair and maintenance activity. Furthermore, the UK industry will need to move to an industrial product in order to achieve this step change in output. The down side to this growth may be a fall in construction’s value added.

### 3.2 MARKETS

Most experts do not expect any long-run change in the industry’s contribution to UK GDP (although the arguments about industrialisation contradict this to some extent). However, they do expect construction’s value added to decline gradually, squeezed between the exacting demands of clients and the increasing industrialisation of most inputs, as raw materials will be supplanted by component and subsystems to be assembled rather than constructed.

All market segments have shown significant swings in demand over time. Since 1980, private housing has swung by 60 percentage points while the infrastructure projects and commercial building segment has swung across 170 points. Repair and maintenance in the housing sector (public and private) has been the most stable at plus or minus 10 per cent of peak demand.

### 3.2.1 Buildings

The greater recognition of the differentiated role of buildings and space as productive assets (as opposed to crude containers) by the business services sector may drive demand for commercial property, new and refurbished. Commentators like Frank Duffy at DEGW have been arguing for some years that the combination of technical change in IT and the growth in small companies providing business services may cause a recolonisation of large areas of post-war commercial developments (obsolescent, low-grade office space).

There are several forecasts that report periodically and, among other things, contrast demographic trends (eg number of households) with data on building stocks (numbers and condition). These forecasts estimate that around 4.5 million additional homes (comprising new and rehabilitated units) will be required in the next 20 years, the majority of which are expected to be in urban areas. This equates to around 175 000 new units a year; current production levels for new dwellings (flats and houses) are around 150 000 units a year. Since their post-war peak in the 1960s, house-building rates have been falling. During the 1950s some 230 000 new homes a year were built. This rose to 300 000 a year in the 1960s, but fell to 180 000 a year in the 1980s.

These data suggest that there will be no substantial change in aggregate demand for housing over the next decade. That is, unless the price performance of new houses improves dramatically (and thereby helps accelerate the rate of renewal of the existing stock) or future changes in planning regulations severely restrict the availability of land for development (reduce new-build and increase refurbishment). Within this picture of aggregate demand, the reorganisation of social housing provision and financing may change the balance of demand with social housing accounting for an increased proportion of all housing.

At the same time as the last household projections were published, the DETR also published a study on urbanisation in England. Based on the assumption that 50% of all new development would be on previously developed land, the study projected that the percentage of land in urban use would rise from 10.6% in 1991 to 11.9% in 2016.<sup>5</sup> Contrary to much anecdotal evidence, the majority of people will continue to live within the boundaries of our existing cities, towns and large villages.

### 3.2.2 Infrastructure

The boom in investments in the UK's infrastructure has slowed. Ten years on, the major development programmes being carried out by power and water utilities will diminish. Similarly, major new roads and structures have become an endangered species, although urban development, from bypasses to new integrated transport hubs, is expected to be a source of continuing or even increased demand. Waste incinerators are another possible growth point; however, although this is a technically attractive solution to the problems of waste management (Essex expects to run out of landfill sites within five years) it is

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<sup>5</sup> The Green Paper *Household Growth: Where Shall We Live?* was published in November 1996, and explored the issues raised by projections.

not one favoured by the general public. Within ten years, the balance between the perception of problem and the tolerability of the solution may have shifted to the point where we see a similar mini-boom to that associated with the “Dash for Gas”.

There appears to be little prospect of new investment in nuclear power in the UK. Some decommissioning may take place, but current policy dictates that dismantling the biological shield should be postponed for over 100 years, when radioactive Co60 will pose a substantially reduced risk. Decommissioning of reactors overseas may proceed using UK expertise, probably involving British workers in operational as well as advisory roles.

### 3.3

## INTERNATIONAL TRADE

Globalisation is a fact of life. Since 1990 the economic growth rates of industrial countries and those of developing countries have diverged. During the 1980s this gap in rates of growth was modest – only one to two percentage points. However, in the early 1990s the average growth rate of OECD countries plummeted while that of developing countries kept rising. The trend has reversed in the past two years with the Asian economic crisis, but the southern hemisphere looks likely to dominate in the long term. At least four trends have emerged.

1. The success of market reforms has contributed to rapid growth in Asia and to improved performance in Latin America
2. A surge of infrastructure spending has fuelled growth in many regions. In countries such as China, development has strained power generation capacity, roads, railways, airports, and water supply and treatment
3. Rising incomes have fostered large middle classes, new waves of consumer spending and increases in infrastructure spending. Together these have reduced the dependence on exports to the OECD
4. Competitiveness in export markets has contributed to growth in many countries. The increased productivity of some East Asian countries has enabled them to achieve their status as top exporters and to improve their national living standards.

The Chatham House Forum foresees that more than 80 per cent of goods and services (proportion of world GNP) will be traded across national borders by 2020 from a current level of around 30 per cent (OECD). Accurate or not, the prediction points to a widely anticipated trend that UK constructors will need to understand: economies will become increasingly open to foreign competition. The Construction Foresight Panel also anticipated domestic construction markets throughout the OECD economies being penetrated to a significant extent by non-indigenous firms.

In the past, international activity has been concentrated on a small number of very large contracting organisations and consultants: the UK’s top consulting engineers’ exports account for 30–90% of turnover. In the future, the combined pressures of standardisation and industrialisation may lead to an increase in the volume of construction services (design and engineering as opposed to materials and products) that will be traded internationally; this will be gradual but inevitable. Clearly, this will not affect all work equally; mega-projects are already international, housebuilding may become so, but the smaller end of the general contracting market, together with residential repair and maintenance, is likely to remain a local affair.

Experts do foresee major growth opportunities for UK construction businesses overseas both as a result of economic expansion in China and elsewhere in Asia, and because of

anticipated demand for more and better civil engineering works to protect populations against the effects of rising sea levels.<sup>6</sup> However, this was put as a challenge to companies. If we extrapolate from existing export statistics, the UK will lose market share as indigenous companies mature and capture more work in the developing economies.

Several commentators have highlighted the importance of European enlargement as a source of market opportunities overseas. The European Structural Funds have been a key to UK consulting engineers and contractors securing major contracts in cities like Athens. The Structural Funds are expected to become bigger and more transparent, characterised by more regularised decisions and less local bias. This will be a major sales opportunity as more of the former soviet economies are integrated into the European Union – if that process can be achieved without precipitating a political crisis and Europe-wide recession.

As an aside, international trade between member states in construction materials and products is expected to increase over the next decade through the combined effects of the Construction Products Directive and European Monetary Union (EMU).

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<sup>6</sup> Predicted rises in seawater levels due to global warming may trigger increased demand for more and better sea defences, river management schemes and other hydraulic constructions. This is a technology in which the UK excels and might be a basis for a major export campaign as much of this work will be overseas.

## 4. Projects and processes

For most of the 1990s, industry watchers have been discussing ways to bring about a dramatic improvement in the performance of the UK construction industries on all dimensions but particularly customer service, quality and latterly environmental.

The Egan Task Force is the latest in a long line of industry panels. Its vision – an adaptation of the evolutionary logic that has transformed several other UK industries – is widely shared in official circles. The report, which enjoys the status of a White Paper, offers a blueprint for construction and will shape the scale and direction of industry sponsorship by government over the next five years. To this high-level intent should be added the practical advances made by major clients such as BAA, Northumbrian Water, London Underground and the MOD, each of which has adopted new procurement models. Lean construction must become a reality within the next five years (unless there is a major economic downturn in UK and Europe) at least in those market segments where clients control large volumes of work.

The increase in the proportion of major contracts that are being let using forms of procurement – such as design-build-finance-operate (DBFO) or Private Finance (PFI) – may be another major force for change. While these contracts currently account for less than 10 per cent of total UK construction output (buildings and infrastructure), they do include many large and prestigious schemes. Typically they involve some of the industry's most progressive companies working in collaboration with clients and the future service providers. Similar forms of procurement are increasingly common internationally. The experience of this stronger connection between construction and the operation of the building or facility is expected to cause engineering professionals and contractors to elevate innovation, life-time costs and building use to the status of design parameters.

So, for many, the future of construction – the next ten years at least – will be about industrial restructuring and the re-engineering of the various processes to achieve improved quality and performance through integration of project process, management of supply chains and so on. Over the long term, this change in outlook combined with new forms of procurement (of major projects) may bring more stable demand and a more consolidated industry where the majority of practitioners use good practices most of the time.

### 4.1 PLANNING AND DEVELOPMENT

The government is expected to tighten legislative and advisory restrictions on the use of greenfield sites. This will be associated with the densification of urban and suburban areas and major programmes of urban regeneration. As a result, a greater proportion of new-build building work will be carried out in locations where conditions are difficult and compromised, from contaminants to restricted access and congested transport arrangements. Local construction factors (noise, disruption etc) will come under sharper scrutiny.

A second issue relates to the anticipation that planners will rewrite local development strategies based on a more creative manipulation of ingredients like places of work, shopping, transport and homes. These changes may increase the scarcity of

development opportunities and drive up the price of land for building in the UK. Coupled with the widely anticipated emergence of a pan-European market in property investment within five years, this may see a long-run decline in speculative development in the UK.

The RICS believes that the European property industry will grow stronger and more efficient as a result of the European single currency. By taking exchange rates out of the equation, the common currency will facilitate cross-border comparison of investment conditions. Such transparency will cause property yields and cycles to converge, and will put pressure on governments to move towards harmonising taxation. But this levelling of market conditions will be gradual because investors will continue to face local factors springing from legal and cultural differences (eg diverse approaches to valuation and a general absence of data and property indices).

## **4.2 ARCHITECTURE, DESIGN AND ENGINEERING**

The RICS anticipates a polarisation of professional organisations into a few large multi-disciplinary businesses at one end of the spectrum, with smaller specialists and works-orientated consultants at the other. Similarly, it expects a continuing rationalisation within the ranks of professional firms that will see an increase in the number of integrated design and construction companies. Throughout, the emphasis will be on adding value to the customer and taking unnecessary costs out of the process.

Briefing and concept design will need to be based on explicit calculations of the client's financial and economic situation; and will need to take a whole-life perspective as a matter of routine. Simulation – typically using IT – will become commonplace to enable clients to explore a variety of scenarios against the backdrop of accurate and assessable data on both construction and operating parameters.

This idea of what one might call responsive design is the most popular scenario. However, evidence from other industries that have followed the lean production approach suggests that while design and other professional services may become more important (to the functional performance of buildings) there is likely to be a reorganisation (and rationalisation) of the design process. The emphasis will be placed on massively increased design and engineering inputs to new products (variant of a generic type of building or facility) that will be used in a more repetitious manner. Intensive design ought thus to improve building performance dramatically across all dimensions, while the concentration of design on generic products will increase industrial efficiency. Furthermore, design and build is likely to become the dominant approach in most commercial (office, leisure, education) and industrial work (the non-flagship projects, at any rate).

Self-build is a growth point and many German and US companies offer self-build packages. Most of those with an international presence have targeted specialist niches, usually at the upper end of the price spectrum. However, the attempts to introduce self-build to the lower price bracket in the UK may be given a wholly new impetus when the international retailer IKEA begins to sell flat-packed houses through its catalogues.

The main technical trends envisaged in architecture were driven by the continued improvements in the price performance of information and communication technologies, and its widespread diffusion. All designers will use CAD in their work, and a growing proportion will use sophisticated modelling and visualisation packages whereby they can design, build and operate a building or structure as a simulation exercise – virtual reality – which is expected to improve the performance of buildings.

## CONSTRUCTION ACTIVITY

We have referred to the industrial restructuring anticipated by many commentators – more larger companies and higher barriers to entry – which may mean that the days of labour-only subcontracting (LOSC) as a dominant mode of employment are coming to an end. With stability and permanent contracts there may come a more competent workforce, trained and retrained using inherently safe systems and procedures.

Current DTI data lend support to this idea of industrial concentration. They show that the categories of construction companies with fewer than seven employees have been declining at around 10 per cent a year for the past four years, with all size categories above this experiencing annual increases.

The combination of low margins in many traditional markets and the seemingly better long-term commercial opportunities of new segments (especially those associated with PFI, DBFO etc) may encourage more constructors to form permanent alliances with utilities and service operators. This acts as a route into the operation of facilities and, in some cases, to move further downstream into the provision of the services proper, from transport to prisons. Other capital goods industries have extensive operational and maintenance capabilities – this is where franchised car dealers make their profits as do aero-engine manufacturers. For example, Rolls-Royce does not expect to see a profit on a new engine before a minimum number have been in service for seven years; the maintenance contracts are where it realises the benefits of earlier investments in manufacturing activities.

Standardisation and prefabrication will become significant across all market segments within the next ten years. The biggest economic savings will come from the ability to use standard components and systems more of the time, while retaining sufficient customisation to satisfy the clients. This is considered likely to happen now, where it failed conspicuously in the 1960s, because the industry has the knowledge, good sense and technology to use standardisation extensively without losing the ability to customise or create bespoke buildings. A gradual acceleration in the levels of investment made by constructors in their own process technologies is foreseen. The result will be more fixed assets and fewer, better-trained, better-supervised staff, leading to the long-anticipated move from a labour-intensive industry to a knowledge- and capital-intensive business.

Full-time permanent employment may end earlier for many professionals. In many jobs, the wisdom of a 50-year-old may not outweigh the lower costs and greater energy of a competent 35-year-old. For most, the only option will be low-level, part-time consultancy work making use of their previous 30 years' experiences, either as sole traders or in networks of associates. This model of employment will be a lasting one – it is likely to continue for 20 years – given the anticipated reductions in welfare provision and pensions.

There may be some mutually reinforcing trends here. Management theory predicts more companies will be repositioned as hub organisations in which a few permanent staff undertake critical strategic roles, while third parties perform other functions and specialist services on an ad hoc basis. Perhaps this will hold for construction too. Technology means that it is easier to collaborate across organisations, with people based in a variety of locations. However, economics and human factors may slow or even prohibit the emergence of these virtual companies.

Commentators expect massively increased use of ICTs and mobile communications to co-ordinate all construction activities, across tasks and across contractors. Over time,

the emphasis on improved communications will widen to include data and knowledge management systems across all project partners.

The project process will be transformed in the next ten years by ICTs. Electronic process and communication will be the norm, with supply-chain management principles in common use on larger jobs whereby the industry's margins can be assured while delivering a lower-cost, higher-quality product. The process will not be confined to capital project delivery but embrace the whole process from inception to whole-life occupation. Some blurring of organisational roles is likely to occur, with the bigger clients becoming constructors of a kind and constructors becoming clients – project delivery organisations will deliver total constructed solutions.

Other trends that may affect the industry include pressures from regulators and the public for construction to become quieter, cleaner and more neighbourly. This will reinforce the trend to prefabrication and – in time – use of anti-noise with any impact operation. Underground construction is expected to continue to be a growth point in both building (ie as a way to squeeze more lettable area out of a given footprint) and civil engineering (where a significant programme of work is under way to upgrade and extend the UK's utility infrastructures).

The main technical advances are being developed in the infrastructure segment rather than in building. Major utilities and organisations such as Transco are forcing significant advances in the technologies associated with pipe laying; and there is a significant amount of technology transfer from the offshore industries. We may therefore see advances in pipe locators, inspection and measurement, rehabilitation technologies (bursting, splitting, ramming etc).

Commentators expect the combination of new sensors, robotics and remote operation to increase the amount of trenchless tunnelling and microtunnelling that is practicable. This will have an immediate beneficial impact on local and environmental disruption, as well as on site safety associated with the collapse of underground structures.

Developments in plant and equipment will include more types of mini plant, powered access systems, powered hand-tools, electronic instrumentation and metrology, communications technology, management information systems and possibly robots. On this last point, numerous robotics prototypes exist for applications ranging from screeding to trenchless tunnelling. A more immediate prospect is wider use of semi-automated plant. A particularly fertile area for this is in underground construction, where the technology can make previously impossible solutions feasible or minimise environmental disruption. These performance aspects can outweigh the economic arguments against the high levels of investment by constructors. In most cases, it will be easier and cheaper to use a higher proportion of factory-sourced components and sub-assemblies, thereby exploiting manufacturers' investments in advanced automation. It is not clear that individual constructors or major clients will have the volume of business to encourage manufacturers to invest in computer-integrated manufacturing (CIM).

## 5. Inputs and resources

### 5.1 MATERIALS AND PRODUCTS

The pressure on profit margins is expected to increase and this will drive specifiers to seek out materials that offer improved price performance. This will be a factor across all categories of materials and components, from insulation and heat storage materials to surface engineered coatings.

The search for quicker, easier construction procedures will create increased demand for components and systems that exploit lightweight and novel jointing technologies – polymers, adhesives, sealants and engineering plastics. Developments in more advanced materials including super-critical concrete or genetically modified timber may emerge as established industrial products in the longer term (20 years).

Demand for these advanced materials may be countered by the requirements of sustainable development, whereby specifiers will take into account environmental factors (eg embodied energy) of different products and components when making their selection. Typically, more advanced materials perform less well on environmental dimensions (life-cycle energy costs, greenhouse gases, resource depletion etc) than do traditional materials like timber or brick. According to environmental authorities in some EU countries (Sweden, for example) renewables may be the only permissible technologies in the very long term.

Safety and health (particularly fire and noise) is expected to remain a major concern for regulators and to drive demand for materials to exhibit high levels of flame-retardancy. Other regulations will force a switch from VOCs to water-based treatments and preservatives.

On the subject of industry regulations designed to protect the environment, commentators expect to see more recycling of the materials and components used in buildings and structures (targets are likely to be set within both the UK Building Regulations and Planning Regulations). This is likely to increase dismantling and recovery (not performed by constructors) at the expense of demolition and disposal; and to encourage the specification of modular components and systems which can be dismantled and recovered, again reinforcing the trend away from in-situ construction.

Having said this, the changes will be gradual and may affect contracts to a limited extent over the next ten years. At present there are only small volumes of recycled and secondary materials available compared to the size of demand. Combined with weak distribution networks and underdeveloped performance standards and technical specifications, this fact will slow substitution. As an example, hundreds of millions of tonnes of primary aggregates will still be required each year in the 2010s – current consumption is around 300 million tonnes a year.

The other technology trend that is widely anticipated is the incorporation of information and communication technologies in a growing number of categories of building and civil engineering components, from intelligent windows to wholly automated building management systems to roadside sensors that will broadcast traffic information to drivers en route. This last point picks up on a more general trend. Road transport

informatics (in both the road network and in individual vehicles) might be one of the ways in which society can reconcile the tensions between environmental sustainability (less road construction and less pollution) and growth in personal mobility (increasing average miles per capita without increasing congestion) and car ownership.

## 5.2

### LAND AND OTHER NATURAL RESOURCES

Land utilisation will be an important future issue for the UK. Experts anticipate gradual improvements on all fronts from planning to construction to building management. For example, they expect local planners to demand that developers devise master plans that offer a more efficient configuration of buildings and infrastructure. Planners are also expected to insist that the majority of development occurs within urban and suburban areas and that where possible they should exploit difficult spaces (contaminated sites, air space etc). Equally, more intensive use of land can be achieved through higher densities, greater use of high-rise and underground construction and smaller internal spaces. Again, commentators expect planning regulations and planners to protect and conserve open space and green.

Water conservation is not so pressing an issue in the UK as in Southern Europe, but there are regional problems and significant indirect consequences of current distribution and management arrangements. Commentators expect to see better urban water management, perhaps including the development of closed systems without any run-off to the sewerage system. One popular idea is the separation of drinking water systems from other uses that are provided for by rainwater or greywater systems. As with most ideas, new challenges accompany such developments, including higher maintenance, reduced longevity of plant and increased biological risk. Also popular is concept of the waterless sanitation system (composting toilets), which has worked well in a variety of settings. Nevertheless, the use of this autonomous technology is likely to be hampered by public perception and the installation problems that arise with retrofitting the technology in existing dwellings. On the positive side, any UK engineers or manufacturers that can achieve a breakthrough in these areas ought to find a large number of markets overseas where water is scarce – bottled water already retails for many times the price of a similar volume of petrol or diesel.

# Annex 1 Further reading

## A1.1 RESULTS OF CIRIA STUDY

The results and conclusions of CIRIA's study "Adopting Foresight in Construction", for which this briefing document was produced, are set out in:

*Adopting Foresight in construction*  
Funders Report CP/64, CIRIA, London, 1999

## A1.2 FORESIGHT PAPERS

The largest source of data on Technology Foresight is the UK Office of Science and Technology (OST). The OST orchestrated the national Foresight Programme and maintains a comprehensive website ([www.foresight.gov.uk](http://www.foresight.gov.uk)), with links to numerous third parties actively involved in thinking about the future.

The OST has published a range of general texts and sector reports. This material can be obtained from OST, Albany House, 84–86 Petty France, London SW1H 9ST; fax: 0171-271 2015; or can be ordered from the OST's web page.

*Foresight in Business, Winning Advantage 2*, OST, 1998

*Foresight in Business, Preparing for the Future, Foresight in the Construction Industry, A Case Study*, OST, 1998

*The Future in Focus, a Summary of National Foresight Programmes*, OST, 1998

*Foresight in Business, Winning Advantage*, OST, 1997

*Progress Through Partnership, The Report of the Technology Foresight Steering Group*, OST, 1995

*Progress Through Partnership: Construction Sector Panel Report*, OST, 1995

## A1.3 FORWARD LOOKS (CONSTRUCTION)

"Solar Dawn: Challenging the Horizon", Ronald C Kirkwood, CIBSE presidential address 1998, August 1998.

This is excellent introduction to global warming is available from the Chartered Institute of Building Services Engineers (CIBSE), London; tel: 0181-675 5211, or [www.cibse.org](http://www.cibse.org) (CIBSE's 1998 Management Conference held in Bournemouth in October debated both sustainable development and the Egan Initiative).

*Thriving in a global market: Technology strategies for UK Civil Engineering Exports*. Institution of Civil Engineers, London, 1998, at <http://www.ice.org.uk>

*Creating the 21st Century through Innovation*, CERF, Washington, 1996.  
CERF publications are available to order from the American Society of Civil Engineers (ASCE) [www.asce.org](http://www.asce.org), or tel: 1-800-548-2723 or 1-703-295-6300.

*Construction Industry Research Prospectuses for the 21st Century*, CERF, 1997.  
This report describes the 38 prospectuses generated at CERF's 1997 International Research Symposium: Engineering and Construction for Sustainable Development in the 21st Century.

*CIB Coordinators' Trends Reports, An Anthology of Future Perspectives*, Conseil International du Bâtiment pour la Recherche l'Etude et la Documentation, 1997.  
Obtainable from General Secretariat, Post Box 1837, 3000 BV Rotterdam, Netherlands

*The Challenge of Change, QS Think Tank 1998, Questioning the Future of the Profession*, Royal Institute of Chartered Surveyors, London, 1998

*Whither Civil Engineering?* Institute of Civil Engineers, London 1996

*Concrete 2005*, Department of the Environment (DoE), London 1996

*A Research Strategy for the Fire and Safety Engineering Design of Buildings*, BRE and Construction Sponsorship Directorate of the DoE, London, May 1995

*Timber 2005, A Research and Innovation Strategy for Timber in Construction*, Construction Sponsorship Directorate DoE, London, 1995

*Sustainable Development and the Future of the Construction Industry: A Comparison of Visions from Various Countries*. Conseil International du Bâtiment pour la Recherche l'Etude et la Documentation, 1995

*Commerce Parks: Meeting the Needs of Modern Businesses*, Research report by DEGW for Stanhope, 1994

*Home Automation: "Private" Industry and Technology Networks*, Tidd, J, Management School, Imperial College, University of London, 1994

*Water Supplies in the UK in the 1990s and Beyond*, Institute of Civil Engineers, Thomas Telford, London, 1991

## **A1.4**

### **GENERAL TEXTS**

*Science, Technology and Industry Outlook*, OECD, Paris, 1998

*Thought Leaders, Insights on the Future of Business*, Kurtzman, J, Jossey-Bass, San-Francisco, 1998

*Planning for the Communities of the Future*, DETR, London, February 1998

*Digest of Data for the Construction Industry* (Fifth edition), Department of the Environment, Transport and the Regions (DETR), London, 1998

*Developing an Integrated Transport System*, DETR, London, August 1997

*Navigating, Uncharted Waters, The 1997 Report from the Chatham House Forum*, Royal Institute of International Affairs, 1997

*Technology Foresight, The Implication for Small and Medium-sized Enterprises*, Institute of Physics, 1996

*Changing Maps, Governing in a World of Rapid Change*, Rosell, S A, Carleton University Press, Ottawa, 1995

*Preparing for the Twenty-First Century*, Kennedy, P, Fontana, London, 1994

*Technology Foresight, The identification and Promotion of Emerging and Generic Technologies*, Advisory Council on Science and Technology, London, 1994

## Annex 2 Scenarios

Hermann Kahn defined scenarios as “hypothetical sequences of events constructed for the purpose of focusing attention on causal processes and decision points”. The emphasis is on the creation and elaboration of *alternative* futures, in recognition not only of the uncertainties that pervade the future, but also that degrees of uncertainty are themselves highly uncertain. In contrast with many predictive forecasting techniques, scenario construction is a qualitative process, leading to contrasting visions of the future and articulation of the processes by which they may come about, generally without assumptions about their relative probabilities.

The aims of scenario building concern both product and process. The product is the scenarios themselves, which are used to (i) test the desirability of certain courses of action (such as a decision about entering a new market segment), or (ii) as a focus for determining the actions necessary to facilitate or avoid a possible future event. The process outcome is the development by participants of the facility to think consistently and coherently about the future, and an improved understanding of cause-effect linkages in their areas of interest.

The events and trends used in a scenario analysis fall into one of three groups:

1. those virtually *certain* to occur, independently of any purposive action (an increase in world population is an example).
2. those under the control of others, or otherwise subject to uncertainty (such as the behaviour of overseas governments, or climate change).
3. those under the control of the decision-makers participating in the exercise (such as company policy on research and development).

The first group will apply to all scenarios. Those in the second group are used to define and differentiate the scenarios; they should be factors of key interest to participants, and generally factors whose outcome will affect decision-making. The third group will be explored *within the context* of established scenarios.

As an example, van der Heijen (1995) discusses the use of scenarios within Shell. In the late 1960s, a major issue for the company was the price of oil. Through scenarios, it considered the main factors that might lead to high prices. Demand was fairly predictable and supply appeared plentiful, but consideration of the control of those reserves meant that the participants had to accept the possibility of unilateral action by producing governments (Group 2 above). According to van der Heijen, the price hike of 1973 had been anticipated by this work within an “energy crisis scenario” and led to the implementation of contingency plans – such as a change in refining policies. These, in turn, protected the company to a greater extent than its competitors.

This case is unusual. Identification of the important single issue of the oil price may have been fortuitous, or at least represent a simple attribute peculiarly associated with that industry. Nevertheless, it does suggest the value of scenarios and illustrates important aspects of them, in particular the virtues of simplicity and of monitoring events against scenarios.

For construction, the main drivers of change are relatively obvious too. At the highest level of significance are macro-economic factors, such as national and EU economic stability, growth and inflation. At a secondary level are external factors including:

- economic trends like enlargement of the European Union
- technical and managerial trends such as just-in-time manufacturing, which caused widespread change in the configuration of manufacturing and led to growth in demand for warehousing. The Internet will have an even more profound impact on the nature and organisation of business (construction's customers)
- political factors such as the recent Transport White Paper, which may depress road-building for the next decade
- social trends, particularly demographic changes such as the rate of formation of new households or the age profile of the population.

Any construction foresight exercise will need to consider the implications of different possible outcomes on each of these dimensions. For example, people will want to explore Egan's vision of lean construction from the point of view of the following scenarios at least:

- high rates of economic growth versus low growth
- European enlargement stops at the Balkans versus the inclusion of Russia
- planning legislation will restrict land available for development except in existing urban areas versus the interpretation of planning policy will be less restrictive.

## Annex 3 Acknowledgements

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