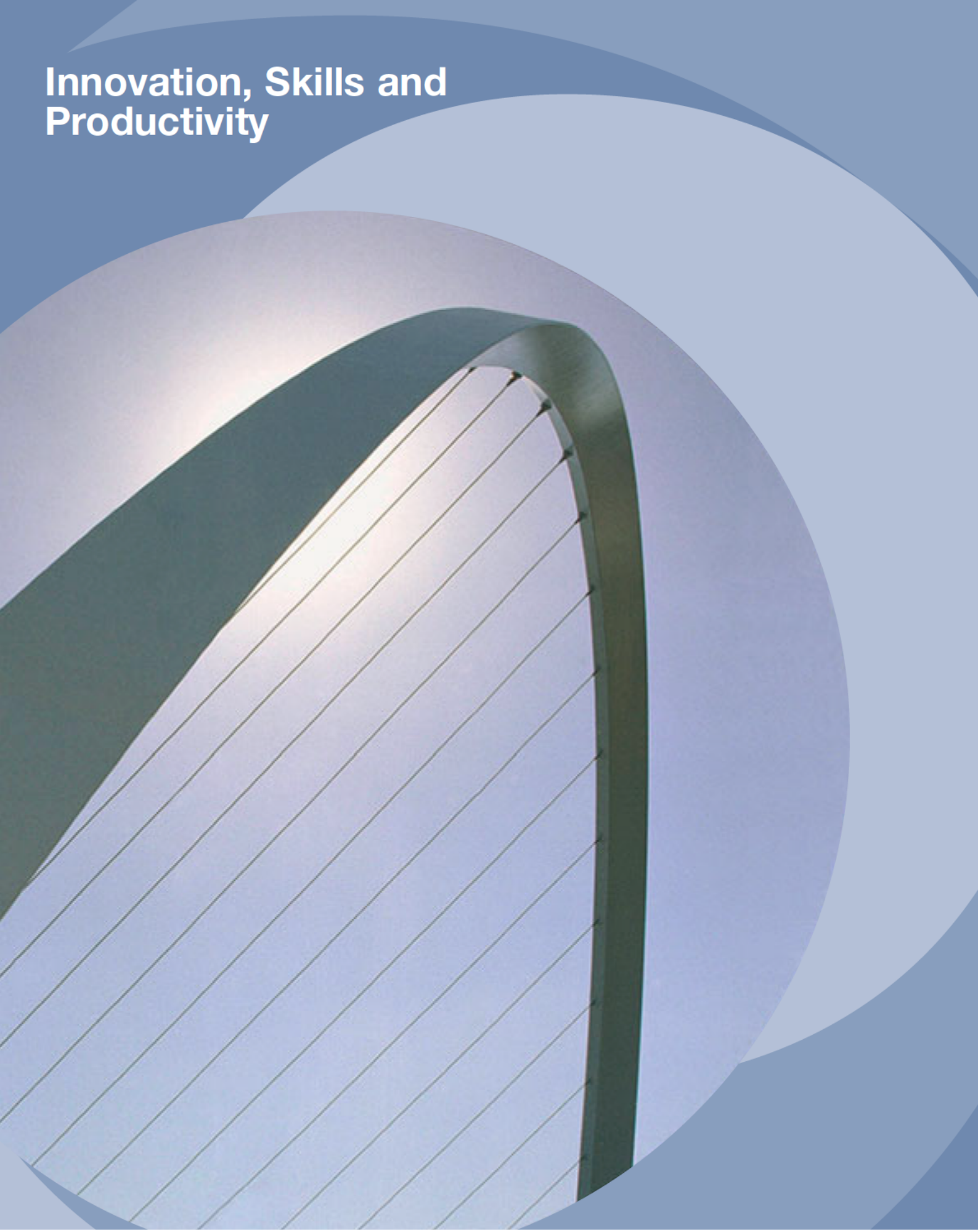
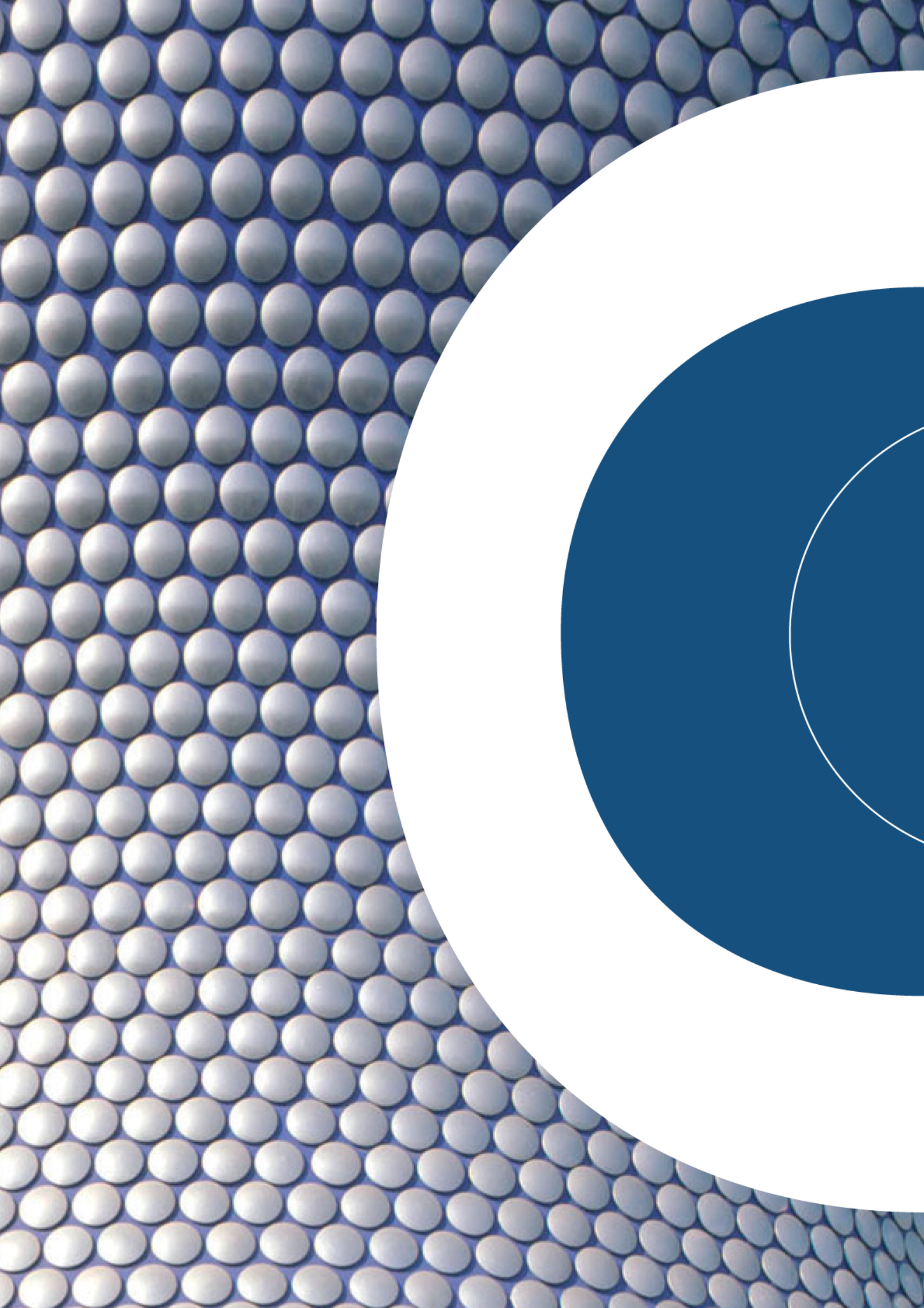
# Innovation, Skills and Productivity



CITB constructionskills



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# 1 EXECUTIVE SUMMARY

Between September 2002 and April 2003, CITB-ConstructionSkills continued its foresight dialogue, extending it to address innovations in construction techniques and their impact on productivity. This report is a reflection of the sector's opinion on innovation and as such illustrates the market conditions in which those promoting innovation operate. Working in partnership with MRM Solutions, the research took the form of a literature review followed by a consultation exercise comprising a panel of fifty employers (drawn from public and private sector clients, contractors, professionals, suppliers and subcontractors), four half-day employer workshops and ten in-depth interviews with leading practitioners.

## 1.1 THE PURPOSE OF THIS REPORT

The purpose of this report is to continue the Skills Foresight dialogue from CITB-ConstructionSkills, extending it to address innovations in construction techniques and their impact on productivity. As with the Skills Foresight project, we have consulted with the construction industry supply chain, analysed the trends emerging from the consultation and reported on them.

The report is intended for three main audiences:

- CITB-ConstructionSkills, who will use it to inform its workforce development plans
- Employers, who will use it to understand the current market opinion of innovation in the construction sector
- The Sector Skills Development Agency (SSDA), who will use it to gain an understanding of training and skill issues facing the construction sector.

The report is a reflection of the sector's opinion on innovation and, as such, illustrates the market conditions in which those promoting innovation operate.

## 1.2 THE PROJECT STRATEGY

Our strategy was to explore what employers think innovation is and how it might increase the productivity of the construction sector. With this understanding of what employers in the sector say is likely to happen, we identify some of the skill changes associated with innovation. Finally, we suggest a strategy that CITB-ConstructionSkills and the SSDA may develop to create the skills required by the industry.

## 1.3 DELIVERING THE PROJECT STRATEGY

We undertook qualitative research amongst construction practitioners who were selected because they were either recognised as experts or represented large proportions of the industry. Additionally, we selected a number of smaller companies at random. This sampling strategy was designed to provide sufficient qualitative data to produce the cross section of opinions on innovation in the construction sector. The results are therefore grounded on the views of the industry and reflect the opinions of the people charged with being innovative and delivering the increased productivity.

## 1.4 INNOVATION IN CONSTRUCTION

Our first conclusions relate to the industry view of what innovation means and how it is applied to improve productivity.

The widely accepted view that innovation is the successful commercial exploitation of new ideas translates into two strategies: doing it **better** and doing it **differently**. The construction industry has opportunities to adopt both strategies. Our consultation reveals considerable scope for innovation in the way companies and programmes are managed, as well as technical innovation in the way buildings are designed, constructed and fitted out. The report gives examples of innovation in design and build methods, construction products and construction management.

It is clear from our review of published literature on innovation in construction that much innovation is being undertaken and in the building of airports, retail and healthcare facilities, the industry is highly advanced. However, our consultation with industry suggests the adoption of this innovation is variable and even those that we spoke to who are committed to innovation, see barriers to its adoption.

We conclude there are strong arguments for increasing the level of innovation and equally strong arguments for not doing so. Section 3 further explores these arguments from the perspective of the industry practitioner and asks the question whether the construction sector has the right ingredients for innovation.

## 1.5 THE VIEW OF INDUSTRY

It is clear from our consultation that industry needs to be innovative to:

- deal with the changes demanded by clients and specifiers
- take advantage of the opportunities presented by suppliers
- deal with external pressures such as demographics and legislation.

Employers identify four reasons why innovation is required:

1. To improve the performance of the industry
2. To integrate the construction industry supply chain
3. To address external pressures on the workforce, including skill shortages, demographics and legislation
4. To introduce new management styles that deal with external pressures and accommodate the workforce of the future.

Additionally, some argue for change in the selection and procurement practices of clients.

Having identified these areas of need, the consultation reveals a number of barriers that will slow the pace of innovation. These barriers are around the market structure, the business case for change, the buying behaviour (which differs from the procurement policy) of clients, technical uncertainty and skill issues.

If industry has a collective view[1], then it is one of healthy scepticism of innovation and change. This scepticism appears, from our consultation, to decrease as the size of the company increases, suggesting it is the larger companies that will bring innovation into the industry and then take their suppliers and others with them.

## 1.6 THE IMPLICATIONS FOR SKILLS

The skills change in the industry is mapped in detail in Section 5, showing the change at each level of employment in the sector. This map is based on the consultation process and our use of the national occupational standards to profile skills in the construction industry.

It is clear from this report that employers' skill requirements are structured by their existing business strategies; this approach will equip the sector with the workforce for today but does not address the future. We found evidence of latent skill gaps in the sector. By this we mean skill gaps that are either hidden to employers or, if known, are not a priority. If the average construction company were to adopt a more innovative approach and make better use of the technologies presented, then skill gaps would become more apparent as an inhibitor to the business and the pressure on the company (and CITB-ConstructionSkills) to address them would increase.

The workforce strategy that emerges has three strands. Firstly, increase the volumes of skilled tradespeople available to the industry, helping construction managers achieve greater productivity and quality. Secondly, equip the managers (from site manager through to director), with a number of new skills necessary to deal with change and innovation. Those involved in the consultation felt that this development of management skills will provide a better climate for innovation, in both what the sector builds and how it builds. The third and final strand of the strategy is to continue, through programmes like Skills Foresight, to inform employers of the potential resulting from the acquisition of new skills.

[1] It is almost impossible to represent accurately the broad range of UK construction companies as a single entity

# 2 OUR CONSULTATION APPROACH

In this section, we set out how we collected the information from which our conclusions are drawn. This is important because it shows how the findings are grounded on the views of industry and that even when we skew our sample towards those with an interest in innovation, we still see many barriers to it.

## 2.1 THE SELECTION CRITERIA

We undertook qualitative research amongst construction practitioners who were selected because they were either recognised as experts or represented large proportions of the industry. Additionally, we selected a number of smaller companies at random. This sampling strategy was designed to provide sufficient qualitative data to produce the cross section of opinions on innovation in the construction sector.

## 2.2 THE CONSULTATION MEDIA

The consultation took three main forms:

1. *Structured interviews* – We targeted a number of people who are recognised by the sector as leaders in innovation and as a result we met with clients, research directors, construction directors, architects and suppliers. We spent time in the boardrooms with directors whose strategy is to innovate. We spent time on site with those who are charged with making innovation a reality. Everyone we spoke with has either presented a paper to a conference on innovative construction techniques, been actively involved in industry initiatives on new construction methods or is a board director with a company recognised for its work on innovation. All (bar one) are full-time industry executives.
2. *Structured workshops* – We ran four workshops as part of the project, two in-company and two with groups of companies. One in-company workshop involved the entire board of one of the top five management contractors, the other an operations team from a medium-sized contractor. The first of two group workshops was with the Major Contractors Group People's Forum and the second with a selection of construction professionals, academics and consultants.
3. *A construction panel* – We selected twenty medium-sized construction companies at random and spoke with them about innovation.

## 2.3 THE QUESTIONS WE ASKED

We asked three simple questions:

1. What changes, particularly in technology, are going to shape the future of the construction industry?
2. What trades, crafts and management positions will these changes impact upon?
3. What changes in trade, craft and management skills are needed to deal with emerging technology and future innovation?

A fourth question was added during the discussions:

4. How prepared is the sector to exploit innovation and overcome the barriers our respondents saw to the adoption of both innovative practices and new technologies?

## 2.4 THE ANALYSIS OF THE CONSULTATION

We have used the views of those we consulted to reflect attitudes towards innovation and to identify some of the barriers those promoting change have to overcome. Initially, the scope of the work was limited to the skills required to deal with innovation. Whilst we have addressed this scope, we also report other structural and commercial barriers.

From the consultation, it is possible to gain a picture of some of the innovations; this is indicative of what is happening rather than comprehensive. We draw heavily on the housing sector for such examples.

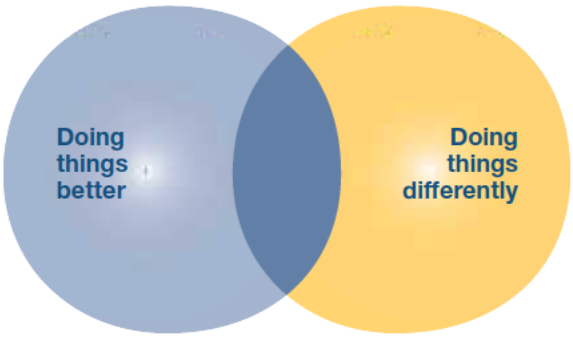
## 2.5 THE SKILLS DIMENSION

To translate the opinions of those we consulted into a framework, we took a number of innovations and set out the skills each requires. We then looked at the impact of these innovations on specific job roles.

# 3 THE SCOPE OF INNOVATION

In this section we review what innovation means to the construction sector. We include this more to scope the sections that follow rather than to rework the many texts on innovation[2]. It is therefore an overview of innovation illustrating the direction the industry is taking. The source data for this section is our survey of published information on innovation. Particular reference was made to the Construction Products Association's publications on product innovation, the Movement for Innovation (M4I) case studies for process innovation and the publication *Building Innovation* by David M Gann.

**Innovation is about**




## 3.1 INNOVATION – WHAT IS IT?

Innovation, using the DTI definition is:

> *The successful commercial exploitation of new ideas.*

The widely held view is that innovation is an approach to business, a journey and not a destination. Companies and industries are innovative in **what they do** and **how they do it**. Innovation is about doing things better, doing them differently and often both. For the construction industry, innovation is in the approach to the job and the technology used. There are four levels of innovation, as outlined below.

| Level of innovation | Example |
|---|---|
| New technology, new approach | The purchase of manufactured classroom pods delivered complete to site and purchased through an open book partnership approach that optimises value for the client |
| Old technology, new approach | A brick and block housing development supplied as part of an ongoing partnership deal between a contractor and a registered social landlord |
| New technology, old approach | A sports dome with a tension-structured covering supplied after a competitive, lowest cost wins, tender exercise |
| Old technology, old approach | Quote it, build it and leave |

[2] For further information on innovation in the construction sector, we recommend the following publications: *Building Innovation* by David M Gann, published by Thomas Telford, ISBN 0-7277-2596-3; *Homing in on Excellence* by The Housing Forum, published by Rethinking Construction, telephone 020 7837 5702; *Flexibility and Choice in Housing* by David M Gann, published by the Policy Press, ISBN 1-86134-089-3; *House from the Rising Sun*, published by TRADA Technology, ISBN 1-900510154

## 3.2 INNOVATION IN THE CONSTRUCTION SECTOR

The key areas of innovation fall into three areas:

1. Design and build methods – the way people design and construct buildings
2. Construction products – the products people use to fabricate buildings and equip them for use
3. Business management – the way people run construction companies.

### Design and build methods

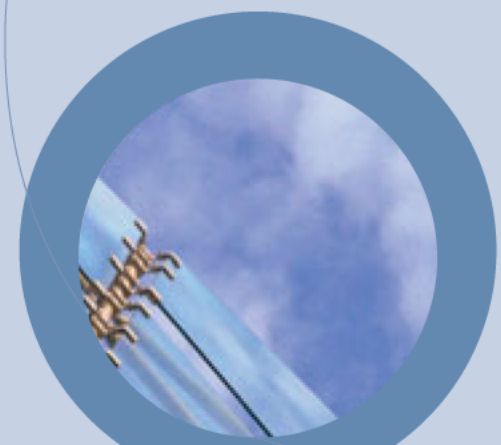
The main areas where innovation is having an impact is in:

- *Computer-aided design, modelling and costing* – the use of computer-based technology ranges from computer drafting systems to integrated design packages that will simulate the operation of the building.
- *e-building* – the use of electronic data interchange over public and private networks to share project, materials and commercial information relating to a project.
- *Plant and equipment* – the use of conveyor and handling systems to speed and ease the movement of materials onto and around a site.
- *Framed construction* – the use of timber, steel and concrete frames is not new technology but its application in lower cost, high volume markets is new.
- *Factory manufactured units* – the off-site manufacture of components for constructions, structural panels and volumetric units, for example, are now proven and applied in a number of construction sectors.

### Construction products

The types of product that dominate fall into two classes. Firstly, those that deskill and simplify such as push fit plastic plumbing, thin joint masonry and low voltage power supplies, and secondly, those that bring new features to a building such as electronic condition monitoring, air management systems and specialist materials. Many relate to the fixtures and fittings within the building, rather than the construction method. Examples of these are:

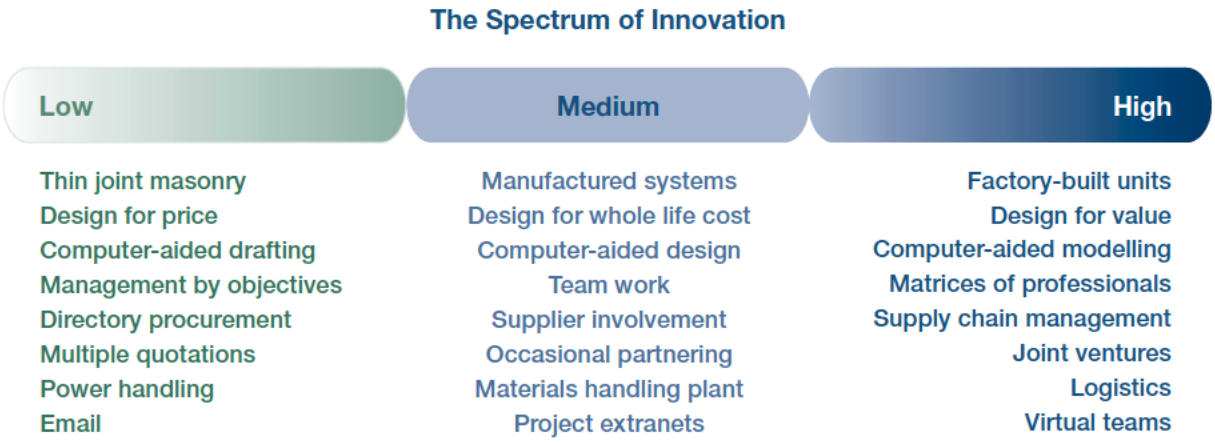
- Glazing products such as Warm Edge Technology (WET) and self-cleaning glass.
- Electronic products such as wireless networking, condition monitoring and environmental control systems.
- Lighting products such as energy saving luminaries and white light-emitting diodes (LEDs).
- Materials such as lightweight aggregates, autoclaved aerated concrete (AAC), and plastics and composites including fibre reinforced polymers (FRPs).
- Factory-made service modules or easy-fit windows, doors and other hardware.
- Cladding and structural products such as mortarless brick facings, polymer concretes and self-finish interior panels.



### Business management

The changes to business management differ with the size of company. For the small player, all of the management effort is focussed on winning and delivering contracts using traditional techniques. For the more innovative (and typically larger) company, the sort of innovation is in:

- *Procurement* – both the way clients procure construction services and the way that contractors procure specialist services. Whilst much of the talk is of value-based partnerships, there is still a great deal of price-based procurement on both client and supplier sides.
- *New forms of contract* – particularly for large contractors offering design/build/manage contracts through programmes like PFI and PPP, where risk is shared between client and contractor.
- *Design management* – the design responsibility expanding to other members of the supply chain.
- *Resource management* – managing an increasingly diverse resource and expanding the recruitment pools to ensure a consistent supply of people.
- *Supply chain management* – integrating the skills and abilities of a disparate supply chain with the needs of contractors and clients.
- *Project management* – dealing with complicated constructions in shorter times with less uncertainty and using multidisciplinary teams.




### 3.3 INNOVATION – A SPECTRUM, NOT A SINGLE POINT OF LIGHT

Reviewing much of the literature on the subject, we conclude that the spectrum of innovation available today is broad.

The diagram above illustrates the range of innovation in methods, products and management. The extremes of this spectrum are in some respects wider than the diagram suggests, with many firms operating to the left of 'low innovation' and a few operating to the right of 'high innovation'. For example, in the housing sector today it is possible to generate a three-dimensional model of a building and, using virtual reality, 'walk' the client through it. From this model, cost and performance data is created to prove the business case, a build schedule is drawn up and a programme defined. Working with the off-site manufacturer, the design can be translated into the machining instructions to fabricate the panels. A date is given for the erection on site and, using e-commerce, the components are ordered. The site manager tracks the progress of each component via an internet connection and ensures that the site is prepared for the delivery date. Once erected, the interior of the building is finished whilst bricklayers clad the exterior. The building is finished quickly and to a high specification.

Parts of the sector are highly innovative. In airports and shopping centres the technology applied to moving people and services is as sophisticated as anything found in other sectors. Flexible warehousing and distribution centres, retail and office space integrated with multi-purpose leisure and events stadia, are all types of building that have emerged in the last twenty years. Today's new buildings have environmental control, data networking and security systems that were not invented ten years ago. Houses feature highly efficient heating systems and reliable services. Civil engineering has brought substantial increases to the capacity of the transport infrastructure. On the commercial front, the types of risk sharing contract associated with the Private Finance Initiative are groundbreaking.

Yet much of the construction industry is way to the left of the low technology shown in the diagram, using building techniques that are based on traditional methods and materials that have remained fundamentally unchanged over the last 100 years. Many constructors, particularly the smaller companies operating locally on one-off construction projects, remain untouched by the innovations and changes illustrated in the diagram.

### 3.4 DISTINGUISHING THE POSSIBLE FROM THE PROBABLE

Having identified that a great deal of innovation is available, we set out to understand why the rate of innovation is perhaps less than it could be. The consultation with industry reveals the arguments for and against adopting innovative approaches.

The arguments **FOR** change are:

- An ageing workforce together with recruitment and retention issues, suggest that the people required to train the construction workforce are in short supply.
- The need for greater output from a smaller workforce.
- The need to improve standards and build quality.
- The need to create buildings with higher specifications in smaller spaces, at lower costs, with greater certainty of delivery.
- The time to train an increased workforce is longer than the time that the industry has to deliver the increased outputs.

The arguments **AGAINST** change are:

- Labour is perceived as always accessible, whether through retraining, migrant labour or simply by paying more than the competition. Although not immediately cost-effective, there are long and short-term benefits if demand can be sustained.
- Alternative methods are too expensive and often perceived as high risk.
- Construction companies are still able to compete and profit using traditional methods and materials, thus reducing the need to change (e.g. the repair, maintenance and improvement sector).
- In parts of the UK, land is the restricting factor, not labour.

For the industry as a whole, the case for change is compelling. The arguments for change hold true at an industry level and, if addressed, are good for the long-term future of the sector. This case for change is, however, not as compelling for the individual company where the immediate risks to revenue and profit, together with costs associated with innovation, outweigh the longer-term benefits. When the horizons of individual companies are short-term and motivated by self-interest, they are forced to place their own performance ahead of the industry. If they can achieve sufficient revenue and profit using existing approaches, workforce and business models, they will be unwilling to change.

To accelerate change and overcome the barriers of individual companies, a majority of the following factors is required:

- The supply of parts and assemblies must be as reliable as the current supply of 'bricks and mortar'.
- The volume of demand makes manufactured units and new construction methods as cost-effective as conventional methods.
- The local labour shortages are such that wage inflation increases the imperative to reduce labour requirement.
- The build quality required by the client cannot be achieved conventionally.
- The client specifically demands innovation.
- The shareholders and managers of construction firms take a longer-term view on issues relating to innovation and change.

Whatever route the construction industry takes, one certainty is that to continue to succeed economically, there remains a fundamental need to maintain, and wherever possible, maximise revenue and profit and minimise cost. The revenue will flow to the contractors that have methods that meet client demands for quality buildings. Profits will be made on sites that run to time and get the output right first time. Costs will be lowest in those construction companies that operate lean principles and use their labour, plant and materials to the greatest effect. In an increasingly risk-averse society, construction companies will, in the short and medium-term, strive to retain their existing business models, workforce and building methods. Only when it becomes impossible to achieve revenue, profit and cost targets with the current model, will the majority of contractors seriously consider adopting a more innovative approach to their business management, design and products.

### 3.5 THE MISSING INGREDIENTS REQUIRED FOR WIDESPREAD INNOVATION

Whilst the focus of this report is the construction industry, there is merit in looking more widely to understand the context of innovation and why the participants in the project reported the barriers they did. Our knowledge of other sectors suggests that a number of 'ingredients' are required for innovation. These are present in areas such as the automotive, information technology and pharmaceutical sectors but are of secondary importance in the construction sector.

| Ingredient | Why the construction sector lacks this ingredient | Example from other markets |
|---|---|---|
| *Differentiation by innovation*<br><br>Adding innovative product and service features gives a company advantage. | There is no 'must have' innovation that makes one construction company better than another. | Car manufacturers continually leapfrog each other by adding features. The Japanese started putting radios in cars – everyone followed. A car company could not sell cars in the UK without a radio. The same applies now to CD players, air conditioning and soon satellite navigation. |
| *Customer choice*<br><br>There is intolerance in the market of the status quo and/or an alternative approach gives the customer a choice. | Clients may not like the current performance of the construction sector but there is no real alternative. At the point of purchase, the constructors that have made the short list promise performance. There is no way for the client to know in advance whether they will deliver this. | If the rail industry 'messes up', people will turn to their cars.<br><br>If company number one does not provide the product, then customers can buy from company number two.<br><br>In other industries, the customer has some choice at the point of purchase. |
| *Major research programmes*<br><br>Research drives innovation. | Innovation needs research and trials. The research and development (R&D) spend of the construction industry is less than 0.4% of sales and it does not feature on the DTI R&D Scoreboard. | The proportion of sales spent on R&D by the pharmaceutical, IT software, IT hardware and electronics industries is 13%, 10%, 9% and 5% respectively. |

| Ingredient | Why the construction sector lacks this ingredient | Example from other markets |
|---|---|---|
| *A commercial benefit from innovating*<br><br>Nothing changes without either a threat or an opportunity. | The construction industry realises little commercial benefit from innovation; the majority of buildings are possible using brick, steel frame or some form of concrete structure.<br><br>Many clients still equate lowest price with highest value. | The electronics industry maintains commercial benefit from innovation. If it had not increased the processing speed and functionality of integrated circuits, the computing and telecommunications markets would be limited to large corporations and not include the general public. |
| *A global market*<br><br>The cost of research is so high that it requires a global market over which to spread the cost. | The construction industry has major global players but they tend to operate in national markets serving national clients. There are few clients who purchase globally. | The automotive sector is global with companies spreading the cost of a new engine across their global brands. This is one driver for the acquisition strategies of the large original equipment manufacturers (OEMs), as it helps to bring about the economies of scale required to develop new models. |
| *An innovative supply chain*<br><br>Suppliers are the source of innovation and new technology. | The construction industry's barriers to innovation make it unattractive for suppliers to innovate. | The software industry continually drives technology into its customers, providing not only products but also the training required to apply and use them. |
| *Continuity of work*<br><br>Each innovation requires a period of time before it makes a return. | The project-by-project nature of both procurement and supply in the construction industry does not allow for a stream of work over which to refine an idea. | The aerospace industry will often award twenty-year contracts with a supplier in return for commitments to research and cost reductions. |

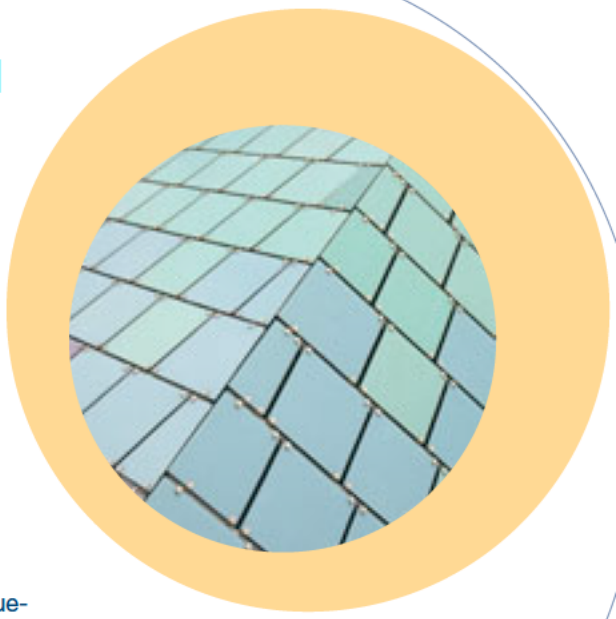
By contrasting the above factors across a range of industries, we can again see why the participants held the views that they did.

| Factor | Automotive | IT Software | IT Hardware | Pharmaceutical | Construction |
|---|---|---|---|---|---|
| Customer choice | High: There are many marques and models available | Medium: Domination by several major players limits choice | High: Wide range of system assemblers and component makers | Low: At the leading edge, companies innovate to gain a monopoly position | Low: Location is more pressing than building features |
| Major research programmes | Internationally 4% of sales are reinvested in R&D | 10.2% | 9.4% | 13% | Below 1% |
| Commercial benefit that accrues from innovation | If a car maker does not innovate it is excluded from a segment of the market | Software and hardware companies create markets by innovation | | A drug company with a new product secures a monopoly position during the lifetime of the patent | Improved construction performance and build quality |
| Global market to spread the costs | Yes | Yes | Yes | Yes | No |
| Innovative supply chain | Yes, but often only due to intense pressure from the OEM | No | Yes | No | In places |
| Continuity of market | Yes, but consumer loyalties are fickle | Yes | Yes | Yes | No |

The labour market in these other industries is fast moving as a result of the changes in consumer demand, globalisation and the application of science and technology. In the publication, *Learn to Succeed*[3], the argument for skills intensification of other industries is described; the key conclusion is that skill levels have changed substantially over the last decade and are set to continue to rise.

[3] *Learn to Succeed* by Mike Campbell, Policy Press

# 4 THE INDUSTRY VIEW OF INNOVATION



In this section, we reflect on the responses of our panel to two questions:

1. Where does the industry most need to be innovative?
2. What barriers must the industry overcome to make innovation more effective?

We conclude that whilst much change is needed, many barriers remain. Skills are only one part of the equation and the structure and inertia of the sector are more significant barriers.

## 4.1 WHY CHANGE IS NEEDED

The consultation identified four key reasons why innovation is required:

1. To improve the performance of the industry
2. To integrate the construction industry supply chain
3. To address external pressures on the workforce, including skill shortages, demographics and legislation
4. To introduce new management styles that deal with external pressures and accommodate the workforce of the future.

### 4.1.1 Improving the performance of the industry

The employers (both clients and contractors) we spoke with, repeated the well-rehearsed arguments for change that feature so heavily in the various sector initiatives born out of the Latham and Egan Reports. In summary:

- *Higher build quality* – brought about by fabricating more of the building in the controlled environment of the factory and so shifting the value adding processes away from site and into the factory.
- *Greater total value* – meaning buildings that are designed for construction (so reducing the build cost), designed for maintenance (so reducing the whole life cost), and designed for adaptability (so increasing the range of revenue-earning opportunities from the structure).
- *Greater predictability* – brought about by better planning, control and delivery of the construction process.
- *Greater focus on form* – in the housing sector the typical house plan has remained largely unchanged for most of the last 100 years and the market is driven by location rather than form and function. As locations become scarce, form may become more important.

### 4.1.2 The need to integrate better with the supply chain

The employers we spoke with regarded the way contractors work with suppliers as a key factor to improving performance. They considered innovation in this area would lead to:

- *Better integration of the design, management and realisation team* – Construction, it was argued, is one of the few industries where the design and implementation teams are not integrated and consulted throughout the design and build process. The integration of the team will, in future, encourage architects to incorporate the practical experience of site managers and tradespeople into their designs, while assisting site managers and tradespeople to better understand the rationale behind plans and help them to improve implementation. This fits with the need to make industry employees more multi-skilled, since working in an integrated team requires increased understanding of areas outside traditional demarcations. Additionally, there may be a need for a change in the way the sector qualifies and certifies its professionals, although it was argued that the professional institutes might be opposed to any dilution of content in their qualifying courses.
- *Streamlined logistics* – The twin incentives to improve logistics are environmental benefits (reduced waste) and improved predictability. Reliable logistics, enabled by new technologies for tracking materials, together with integration of contractor and supplier systems, will improve the industry's ability to deliver on time, to specification, as well as avoiding the scheduling mistakes that cause the industry to call upon containment and recovery skills associated with crisis management.

- *Standardisation of product and process* – The standardisation of both materials and processes was cited as a major potential boost to the efficiency of the building process. By not reinventing the wheel on each project, there are significant savings in design, purchasing and labour. Because tradespeople do not constantly refer to diagrams and learn to install new components, a labour saving can be made. Because the contractor has standardised on an agreed method, bulk discounts on components can be secured. Finally, if this standardisation extends into the industry as a whole, all of construction may benefit from these savings. Possible resistance to this trend may come from architects, whose role may be somewhat diminished by the use of repetitive designs and standardised components. Equally, clients seeking unique buildings may also resist standardisation.

#### 4.1.3 External pressures on and from the workforce

The workforce and availability of people to join it in the future will drive change and call for innovation. The people we spoke with suggested the following factors would lead to change:

- *The skill shortage will in part drive innovation* – The lack of skilled tradespeople is a driver for new methods. Labour-saving technologies will make the skills and knowledge of the skilled trades go further, while some of their roles are likely to be taken over by comparatively less skilled general employees, using technologies that deskill the job.
- *The skills profile may change* – Multi-skilling is likely to increase, as is a growth of niche skills. As some systems become more complex (or include new non-construction materials and technologies), there may be a trend towards some ultra specialisation in niche markets.
- *The ageing construction workforce* – The age of some of the industry's most skilled people is of concern, with fewer young entrants to the industry than there were ten or twenty years ago. The lack of skilled trades is of particular concern, with the current national focus on higher academic education rather than vocational qualification. The gradual retirement of the industry's skills base may not be a serious worry over the five-year foresight period, but over the next ten to twenty years it poses some serious questions about the future viability of the sector without new innovation.
- *Changes in occupational health/Health and Safety expectations* – Health and Safety performance has long been a major point of competition between major constructors. This trend is likely to continue, and to drive technology and processes in the sector. For example, materials that enable construction with a shorter time spent at height, or are lighter and impose less lifting stress, are likely to increase in popularity.

- *Improving external recruitment* – The industry is perceived as resistant to recruiting and developing people from other industries, yet newcomers could and do bring new ideas and improve construction. It is probable that this attitude may change over time as demographic pressures are felt.
- *Multi-skilled individuals or the integrated multidisciplinary team* – The shift from strictly demarcated trades to multi-skilling is a current and ongoing issue for construction. While traditionally the worktops in a kitchen may have been fitted by a carpenter, the plumbing installed by a plumber and the electrics by an electrician, increasingly, and particularly in refurbishment, such tasks are all performed by one individual, who has a proportion of the skills of each of these specialists. From the other side, such tasks are becoming increasingly easy for less skilled people to perform thanks to innovations like push fit connectors. In a larger project environment, the emphasis is on building a skilled multidisciplinary team with the ability to sort out any problem that confronts it.

#### 4.1.4 New management techniques

A key area for change and innovation is how the sector is managed. The consultation suggested a significant shift in the style of management.

- *Shift from 'firefighting' to planning and strategy* – A significant problem in the industry is the emphasis of cure over prevention. Managers are respected and rewarded for working around problems but not for ensuring they don't happen. For example, if a critical component is ordered late and compresses schedules at the end of a job, a manager who uses expensive overtime and drives the workforce to complete the job on time, wins kudos that a manager who placed the order on time and ran an uneventful, competent build, might not. Employers also cited that there was a certain excitement associated with retrieving jobs that have not gone to plan. Finally, there may even be a financial incentive for contractors to come up against unexpected circumstances, particularly if the costs of rectifying them fall on their clients. It was argued that the industry needs to move away from this culture, to one where delivery on time and to specification is scheduled and realised as a matter of course.
- *A higher calibre of leadership will be required* – The people we spoke with questioned if the leadership of the industry was up to the challenge of understanding, responding to, implementing and profiting from the changes that the industry will experience over the medium to long term. Better scheduling, planning and strategy are demanded by new technologies and processes, and companies that fail to grasp these chances may find themselves left behind.

### 4.2 THE BARRIERS TO INNOVATION

The consultation revealed a number of significant barriers to change and innovation. These were grounded in the commercial reality of having to maximise the current profit in the current operating climate. One could argue that this business focus is wrong, but those we spoke to in the industry are not making this argument – perhaps the culture of denial and focus on short-term profit is the biggest barrier to innovation.

#### 4.2.1 The business case

Consultation revealed the industry does not perceive that the business case for innovation and change is sufficiently well proven. Their comments included:

- Whilst many clients aspire to innovation and even pay for it in design, few will translate this aspiration into build techniques.
- Clients won't let contractors sufficiently close to the concept design and building procurement processes to allow them to bring new ideas to construction.
- The sector does not perceive that it needs innovation – those that are in business are (by definition) making a profit from what they do over the term that they are measured.
- The more profitable companies with higher value added cannot necessarily trace their success back to innovation.

- The use of lowest cost tendering forces the market to the cheapest approach; the cost of innovation both in developing and refining an idea will, in the short-term, increase costs. Whilst this cost increase may be only short-term, it could mean that the company wins no contracts in that period.
- In a project-based environment where each contract is a one-off, there is little scope for, or return on, investment in research and development.

#### 4.2.2 Market environment

The consultation revealed the perception that the market is not structured for innovation. Comments included:

- Innovation, by definition, is the flow of new ideas into commercial practice. Such a flow of ideas requires time to develop each idea, a place to test it and then opportunities to refine it. Construction is largely a project environment where the lowest cost bid wins and there is little standardisation of product. This environment does not allow sufficient margin to fund the innovation process and has few opportunities for repetition over which to refine an idea.
- The large numbers of small companies that make up the sector do not have the type of work or business model that calls for innovation. One-off projects, as stated above, are unsuitable for refining ideas. Many small and medium-sized construction companies make money from keeping their fixed workforce on site and selling-on subcontract labour at a premium.
- The clients are risk averse and do not understand either the potential or scope for innovation. Most clients do not give the contractor sufficient continuity of business over which to develop and refine innovative approaches and techniques.
- For many clients and contractors, radical approaches to both construction and construction management carry too much uncertainty – the business case is not apparent and the perceived risk too high. Whilst the current methods work for them they won't 'mend what isn't broken'.
- The construction supply chain separates design, project management, build and materials supply with little continuity of companies or people from one project to another. Hence on completion of the project the team breaks up and often loses the accrued learning.

#### 4.2.3 Market demand

The consultation revealed a belief that the market drivers for innovation are insufficient. It was inferred through their comments that:

- There is no new market for the construction industry to create by being innovative, unlike for example the electronics industry, which has not only invented a technology but also created a market for it in the last thirty years.
- The customer cannot go for an alternative approach. If the railway network fails then the consumer moves to the road, but there is no major alternative to the construction industry.
- The current level of innovation is sufficient for most to make sufficient money.
- The constraint on building land is the main driver of profit in the sector, especially in housebuilding. Any building in the correct location will sell, regardless of whether innovative features are used in its construction or not. Thus innovation brings risk, yet is not required to maintain profit margins either through reduced cost or added value, so conventional methods are likely to continue to dominate.

#### 4.2.4 Technical issues

The consultation revealed a risk-averse culture. It was inferred through their comments that:

- The conflict between innovation and predictability is not yet resolved. Although many of the technology and process innovations offered in the sector promise improved predictability, they are not perceived to compete well with current methods that offer a high degree of predictability because they have undergone numerous iterations. The introduction of unknown variables into the construction process carries a risk that challenges the sector, even if the long-term benefits may outweigh these risks.
- The industry is burdened by a heritage of bad choices. Participants in the consultation focussed on some of the projects undertaken in the 1950s and 1960s, particularly schools, hospitals and high-rise social housing. It was suggested that the era of comparative experimentalism has created a legacy of flawed,

expensive to maintain buildings because little was known about the long-term performance of the materials and methods used. One example given was the widespread use of flat-roofed designs. The failure of many 1960s technology innovations, it was suggested, is behind the need for current innovations to justify themselves far more positively and be approached with far more rigour than may have been the case previously.

- New products are typically produced on shorter production runs at higher cost. Economies of scale are likely to bring the cost down to enable the product to become widespread, but such products are unlikely to become commonplace until their price falls. Similarly, until the tradespeople who have to install and implement the product are generally versed in its use, there may be higher labour costs, which means there is another layer to this 'chicken and egg' barrier.
- Strong first-mover disadvantages exist. Because mass-market builders often do not possess the intellectual rights to the new technologies they may be using, they may effectively act as pilots for the industry, bearing all the costs of innovation. However, they are unable to capitalise on its benefits, because the technique is unpatentable or the patent is owned by a supplier, who is only too keen to sell the technology to allcomers after it has been proven.

## 4.3 THE CONSTRUCTION PANEL'S VIEW OF INNOVATION

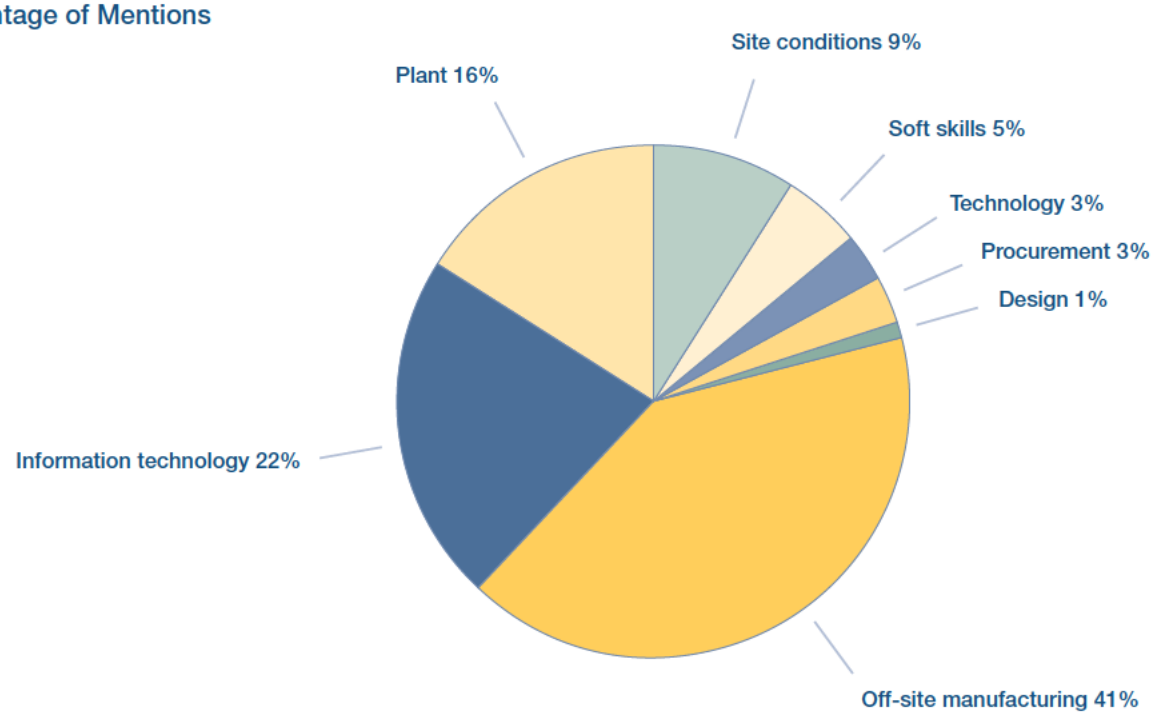
The Construction Panel comprised twenty construction companies, selected at random and of varying size. We consulted them on the impact of innovation on construction methods and the skills required to deal with that innovation. In this section of our report we outline their views.

### 4.3.1 Our panel's views on the focus of innovation

The innovation that received the most mentions was off-site manufacturing, with information technology (IT) and plant being the second and third most mentioned.

Off-site manufacturing dominates the panel's thoughts on change in the industry; IT, the second most mentioned, is referred to only half as often.

Percentage of Mentions



Breaking this down further, the list below shows their opinions on what off-site techniques will gain greatest acceptance in the next three to five years. The list was compiled by logging the number of mentions of each technology in answer to the question *'What innovations will have most impact on…'*. The list is reported in descending order of popularity:

- Easy to fit fixtures (doors, windows etc)
- Off-site manufactured kitchen and bathroom units
- Off-site manufactured structural components
- Off-site manufactured buildings
- Precast concrete structures
- Off-site manufactured finishes.

The panel's responses suggest that as the size of the manufactured unit increases, there is a drop in popularity. This suggests that off-site manufacturing will be phased in, starting with fixtures (which many already use) and progressing to complete buildings.

Interestingly, half of the companies interviewed felt that manufactured buildings will have widespread market acceptance in the next three to five years. Many were cautious over manufactured finishes, i.e. cladding and built walls, with only six of our twenty panel members considering that these will have widespread market acceptance in the same period.

Information technology, the second most influential innovation, covers three areas: computer-aided design, communication and data exchange.

With regard to the third most mentioned innovation, the panel felt that advanced plant and construction equipment would speed construction, particularly for groundwork, and so would influence building methods.

### 4.3.2 The changing roles within the industry

Our panel envisages the greatest impact on three processes:

1. Specifying and designing buildings – mainly architects and designers
2. Construction management – mainly site managers
3. Build activities – trades, mainly bricklayers, plasterers, plumbers and carpenters.

**Architects/structural designers**

Our panel suggests the following changes for those designing buildings:

- They will have to work more closely with manufacturers and look beyond their own knowledge to suppliers. They need to trust the designs of suppliers rather than designing everything themselves.
- In information technology, there will be greater use of CAD for designs and alterations, an interesting observation given that previous Skills Foresight work with architects suggests that, for many, CAD is a way of life.
- In construction methods, they will have to work more closely with the construction team, be more aware of how buildings are built and consider off-site manufacturing far more often. Their designs will have to be more complete as the scope for site-based variations reduces.
- In managing the work and their practice, architects and designers will need to be more communicative and open to suggestions.

**Site management**

The changes forecast for site managers by our panel are:

- Information technology will be more pervasive and site managers will have to incorporate computers more into the day-to-day running of projects and sites. This is likely to require more mobile IT – the digital mobile phone is a major step on the road to site-based IT.
- Construction methods will change to adopt off-site manufacturing. Site managers will have to check parts before accepting them on site, have broad and strong industry knowledge, and be better at managing projects. Their appreciation of technical advances, quality control and an ability to deal with new methods is critical. Site managers may need better and more academic training.
- Skills required for communication and improving customer service will be in greater demand.

### The panel

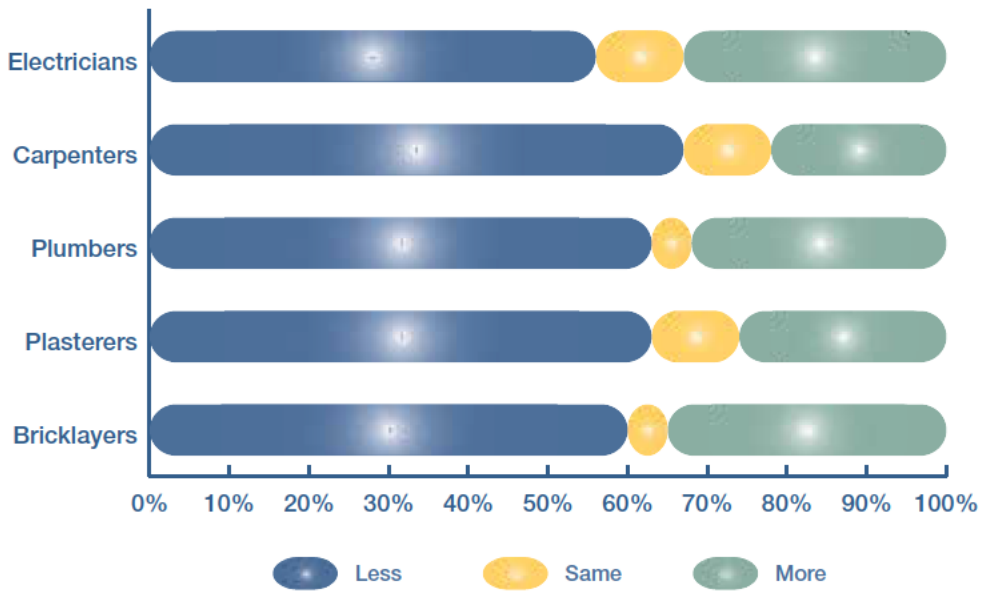
The twenty companies that made up the panel employ a total of over 30,000 people. They comprised management contractors (5), contractors (11), specialists (2) and combined companies (2). They work in housing (3), commercial (8), civil (2) or a combination of these markets (7).

**Trades**

The majority view amongst our panel was that the numbers working on site will fall. This is often qualified by comments about national skill shortages. Many of our panel qualified their comments on a shrinking workforce with concerns over the supply of trade skills, stating that although market demand may fall, the fall in numbers available for work will be faster. It is not clear what is cause and what is effect, i.e. whether new methods are reducing the demand for trade skills or whether lack of supply is increasing the use of new methods. Either way, the net effect is seen by our panel as fewer tradespeople in the UK construction sector. The few companies that predict an increase in demand for trades comment that the trades will need to adapt to new working practices, be more flexible and able to assemble different types of components to those that they are used to.

Some of our panel felt that the trades would need to move to a factory environment, a move that whilst creating good working conditions, may mean lower skill levels and lower wages.

Predictions about Numbers in each Trade



# 5 THE IMPACT OF INNOVATION ON SKILLS

In this section, against each change suggested by our consultation, we list the additional skills required by sections of the workforce.

## 5.1 THE SKILLS MAP

| Change driver | Future innovation | Impact on skills of senior managers |
|---|---|---|
| The market | *In client expectations*<br><br>The increased emphasis on whole life value and dissatisfaction with quality and delivery performance leads to innovative procurement techniques derived from PFI and Best Value and increased demand for innovative product features | Partnering<br><br>Preparation of business cases<br><br>Evaluation of business cases<br><br>Monitoring customer needs |
| | *In the structure and mode of operation of the sector*<br><br>The search for competitive advantage will see the large contractors continuing to expand their responsibility and risk. Design, build and maintenance contracts will flow down to smaller building firms, who will need to expand their operations to deal with greater legislation, particularly on the environmental impact of what they do | Risk analysis<br><br>Risk management<br><br>Managing change<br><br>Communication |
| | *Legislation*<br><br>The impact of legislation will increase, particularly in the areas of environment and employment. Planning restraints and building regulations will continue to be the government's prime method of controlling the supply of land and nature of the UK housing stock. Contractors will find themselves working within increasingly tightening regulation and having less freedom of action in what they build, how they build it and who they employ | Collating and interpreting legislation |

| Impact on skills of architects and designers | Impact on skills of construction managers | Impact on skills of site managers | Impact on skills of trades |
|---|---|---|---|
| | Understanding a client's business<br><br>Broader understanding of business and finance<br><br>Negotiation skills<br><br>Relationship development<br><br>Partnering<br><br>Option appraisal<br><br>Communication<br><br>Local political awareness<br><br>Risk management<br><br>Risk mitigation | | |
| | Problem solving<br><br>Managing the design process | Communicating with designers | |
| Interpreting and pre-empting new building regulations<br><br>Working within changing planning parameters | Designing procedures that comply with legislation | Following procedures that comply with legislation, particularly health and safety | Basic awareness of health, safety and environmental legislation |

| Change driver | Future innovation | Impact on skills of senior managers |
|---|---|---|
| Innovation in people management | *Dealing with a shrinking workforce*<br><br>The workforce will continue to shrink as the effect of UK demographics reduces new entrants and increases the level of leavers from the sector. Contractors will have to find ways of increasing the productivity of the workforce to new levels, by employing both new technology and new building methods | Evaluation of new HR strategies |
| | *Instigating respect for people management techniques*<br><br>Employing an increasingly diverse workforce will require new management approaches that reward achievement and create a performance-based culture | Managing pace of change to suit the workforce |
| Innovation in building methods | *Increasing the predictability of site*<br><br>The build time will shorten (as a result of both client drivers and the need for productivity) and schedules will become more precise | |

| Impact on skills of architects and designers | Impact on skills of construction managers | Impact on skills of site managers | Impact on skills of trades |
|---|---|---|---|
| Time management<br><br>Team management<br><br>Making use of labour-saving techniques such as off-site manufacturing | People management skills<br><br>Recruitment and selection | Better use of logistics and equipment to reduce labour | Requirement for high adaptability and multi-skilling |
| Team integration | Performance management<br><br>Proper appraisal skills<br><br>Design of incentives<br><br>Team management<br><br>Team development | Safety skills<br><br>Risk assessment | |
| Standardisation of design<br><br>Design for build<br><br>Engineering knowledge relating to large masses<br><br>Better communication of design<br><br>Understanding the construction process<br><br>Facilitate trades to extract information<br><br>Concurrent design<br><br>Handling better and more precise plans<br><br>Construction techniques | Planning and scheduling<br><br>Creating leaner schedules<br><br>Understanding critical paths<br><br>Construction knowledge<br><br>Defining and reporting a project<br><br>Project management | Sequencing<br><br>Identifying and acting on delays<br><br>Project management<br><br>Interpreting drawings<br><br>Understanding site conditions<br><br>Specifying site conditions<br><br>Quality control | Working to tighter tolerances |

| Change driver | Future innovation | Impact on skills of senior managers |
|---|---|---|
| Innovation in building methods (continued) | *Information technology*<br><br>IT will be used to manage the increased amount of data and automate the increasingly complicated calculations, simulations and design relating to buildings | Evaluating the effectiveness of information systems |
| | *Lean construction*<br><br>The continued elimination of waste, repeat work and fixing to drive up profit will force contractors to re-engineer much of the conventional approach to building and scheduling of different operations | Evaluating new approaches |
| | *New methods*<br><br>Pre-manufactured components (from push fit plumbing through to entire housing) will dominate. The focus of taking the effort away from site will continue | Integration of new methods into business development |

| Impact on skills of architects and designers | Impact on skills of construction managers | Impact on skills of site managers | Impact on skills of trades |
|---|---|---|---|
| Computer-aided design<br>Computer-aided costing<br>Computer-aided analysis<br>Document control<br>Revision management | Use of software applications<br>Knowledge management<br>Revision management<br>Time management | Use of software applications for scheduling, reporting and procurement<br>Dealing with additional information<br>Use of new surveying and setting out equipment | Data logging<br>Accessing work instructions |
| Design management<br>Knowledge of the construction site<br>Designing to a price<br>Design evaluation | Creating 'right first time' schedules<br>Sequencing work<br>Planning<br>Construction knowledge<br>Budget control | Process analysis<br>Performance recording<br>Pre-empting problems | |
| Specifying units rather than components<br>Specifying parameters<br>Construction knowledge<br>Broader knowledge of products and materials<br>Designing with larger but less flexible units | Communication of alternative methods<br>Knowledge of alternative construction techniques<br>Design of access<br>Better integration of different building operations<br>Understanding and interpreting drawings | Application of new construction techniques<br>Control of bought-in goods | Assembly of pre-manufactured units<br>Working to tighter tolerances<br>Positioning and placing large pre-built masses<br>Erecting a pre-manufactured framework |

| Change driver | Future innovation | Impact on skills of senior managers |
|---|---|---|
| Innovation in products | *Designing better buildings*<br><br>The use of new materials and fittings to increase the building specification without driving up the cost will continue. Clients will look for more flexible structures that can be put to other uses. They will specify what they want as an output contract | |
| | *Achieving better build quality*<br><br>Building regulations relating to noise, insulation and environmental impact, coupled with increased demands from clients, will lead contractors to deliver ever higher specifications with fewer defects, in shorter timescales | Training and coaching |
| | *Supply chain management*<br><br>The suppliers of pre-assembled units and components will make a greater contribution to the design, build method and final construction | Building alliances with suppliers |

| Impact on skills of architects and designers | Impact on skills of construction managers | Impact on skills of site managers | Impact on skills of trades |
|---|---|---|---|
| Design for function<br><br>Better understanding of construction to increase buildability<br><br>Better understanding of maintenance to reduce whole life cost<br><br>Knowledge management<br><br>Data interpretation | Interpreting client needs<br><br>Providing a solution<br><br>Problem solving<br><br>Knowledge management | Design appreciation<br><br>Communication | |
| Awareness of legislation<br><br>Awareness of construction techniques<br><br>Awareness of new products | Project management | Quality control | A certified workforce |
| Awareness of suppliers | Integrating the supply team<br><br>Supply chain management<br><br>Buying<br><br>Managing subcontractors | Managing procurement<br><br>Quarter master skills | |

## 5.2 THE SKILLS FOR EACH JOB

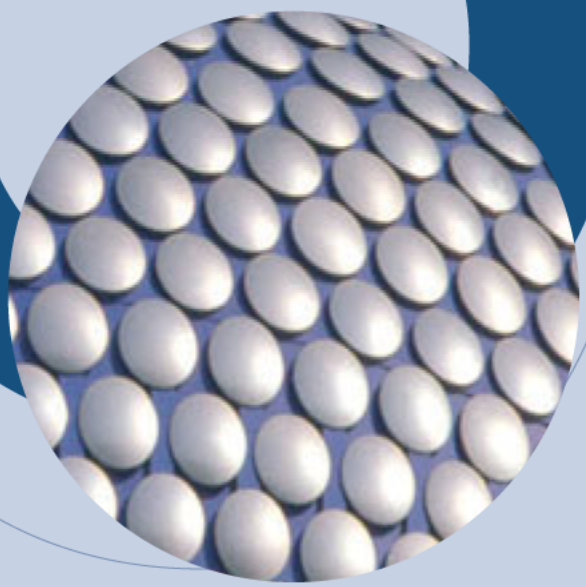
The following table translates the skills map to help define the unique skills required for those sections of the workforce that are perceived as having the greatest influence on the adoption of innovation.

| Senior managers | Architects and designers | Construction managers | Site managers |
|---|---|---|---|
| Monitoring customer needs | Design management | Broader understanding of business and finance | Application of new construction techniques |
| Partnering | Designing to a price | Budget control | Interpreting drawings |
| Evaluating new approaches | Better understanding of construction to increase buildability | Buying | Process analysis |
| Creating change | Better understanding of maintenance to reduce whole life cost | Integrating the supply team | Quality control |
| Managing pace of change to suit the workforce | Computer-aided analysis | Interpreting client needs | Risk assessment |
| Preparation of business cases | Computer-aided costing | Local political awareness | Specifying site conditions |
| Evaluation of business cases | Computer-aided design | Managing subcontractors | Understanding site conditions |
| Risk analysis | Concurrent design | Option appraisal | Design appreciation |
| Risk management | Construction knowledge | Partnering | Dealing with additional information |
| Collating and interpreting legislation | Data interpretation | Risk management | Use of software applications for scheduling, reporting and procurement |
| Communication | Design evaluation | Risk mitigation | Following procedures that comply with legislation |

| Senior managers | Architects and designers | Construction managers | Site managers |
|---|---|---|---|
| Evaluating the effectiveness of information systems | Design for build | Supply chain management | Safety skills |
| | Design for function | Understanding a client's business | Performance recording |
| | Designing with larger but less flexible units | Better integration of different building operations | Identifying and acting on delays |
| | Engineering knowledge relating to large masses | Construction knowledge | Pre-empting problems |
| | Specifying parameters | Design of access | Project management |
| | Specifying units rather than components | Knowledge of alternative construction techniques | Sequencing |
| | Standardisation of design | Providing a solution | Control of bought in goods |
| | Awareness of legislation | Understanding and interpreting drawings | Managing procurement |
| | Interpreting and pre-empting new building regulations | Use of software applications | Quarter master skills – the ability to ensure that the right materials are available yet the stock levels are minimal |
| | Handling better and more precise plans | Designing procedures that comply with legislation | Communication |

| Senior managers | Architects and designers | Construction managers | Site managers |
|---|---|---|---|
| | Awareness of new products | Design of incentives | |
| | Awareness of suppliers | Performance management | |
| | Broader knowledge of products and materials | Proper appraisal skills | |
| | Better communication of design | Team development and management | |
| | Document control | Creating 'right first time' schedules | |
| | Facilitate trades to extract information | Creating leaner schedules | |
| | Knowledge management | Defining and reporting a project | |
| | Revision management | Planning and scheduling | |
| | Team management | Project management | |
| | Time management | Sequencing work | |
| | | Understanding critical paths | |
| | | Communication | |
| | | Communication of alternative methods | |

| Senior managers | Architects and designers | Construction managers | Site managers |
|---|---|---|---|
| | | Knowledge management | |
| | | Negotiation skills | |
| | | People management skills | |
| | | Problem solving | |
| | | Recruitment and selection | |
| | | Relationship development | |
| | | Revision management | |
| | | Time management | |



# 6 A WORKFORCE DEVELOPMENT STRATEGY

Having discussed the results of our consultation on innovation and set out the skill changes needed, in this final section we draw together likely changes in the workforce and suggest an appropriate strategy for CITB-ConstructionSkills. We have based the strategy largely on the findings of the consultation but have also taken into account a limited number of statistics on demand for qualifications and the impact of this on the workforce.

Adopting the strategy could help align CITB-ConstructionSkills with the larger contractors and more innovative players, whilst still reflecting the views of the smaller contractors relating to skill shortages.

## 6.1 THE NEED TO RECOGNISE AND CLOSE LATENT SKILL GAPS

### Latent skill gaps[4]

It is clear from this report that employers' skill requirements are structured by their existing business strategies. While this approach will equip the sector with the workforce for today, it does not address the future. The evidence presented suggests that there are some latent skill gaps in the sector. By this we mean skill gaps that are either hidden to employers or, if known, are not a priority. If the average construction company were to adopt a more innovative approach and make better use of the technologies presented, then skill gaps would become more apparent as an inhibitor to the business and the pressure on the company (and CITB-ConstructionSkills) to address them, would increase.

### A low skills equilibrium

One possible risk is that the industry adopts a low skills equilibrium: the industry does not adopt the technical advances available and so requires no new skills, while its lack of new skills in turn prevents it from adopting the technical advances available. Skill gaps do not emerge (apart from those due to people leaving the industry or increased economic demand) and the sector remains in a low skills equilibrium.

### The role of CITB-ConstructionSkills

One role for CITB-ConstructionSkills is to mitigate this risk by describing to the sector the benefits of change and the role of skills in creating this change. To achieve this, CITB-ConstructionSkills should continue to make the case for change by measuring the impact of skills on business performance through continuance of its Skills Foresight work, expanding its links with Constructing Excellence[5] and better defining the link between skills, productivity and performance.

[4] For a fuller discussion on latent skill gaps and low skills equilibrium, please refer to *Learn to Succeed* by Mike Campbell, published May 2002 by Policy Press

[5] Constructing Excellence is a government-sponsored programme of activities to improve the productivity of the UK construction sector

## 6.2 THE PRIORITIES FOR THE WORKFORCE

Parts of the workforce will change, both to accommodate innovation and drive the sector further towards new methods. The research revealed priorities for all levels of professionals and these are set out below.

**Architects, engineers and designers – the people who create and realise the concepts**

Architects will change emphasis from design for form to design for function. They will specify larger and larger units (as opposed to components) and in the extreme will be selecting accommodation pods to hang off a pre-designed structure. They will need a greater understanding of engineering design and the construction process and they will liaise more with the construction team. There will be a merging of the roles of architect and construction engineer.

Designers will take in greater amounts of information and make more use of information technology to deal with document control and data interchange. They will need to work more closely with the client and the construction team and need greater communication and facilitation skills to do so. The explosion of data will call for better time management to control workload and the application of knowledge management to interpret it. They will focus on designing the job to a price, in order to maintain the profit margin available to the construction company.

**Construction managers – the people who set the company strategy, sell the work and oversee its delivery**

The professionally qualified workforce[6] requires core competencies to which construction professionals will add specialist skills according to their role. The core competencies revolve around modern management of people, the application of information technology and some technical skills relating to construction methods and risk analysis. In addition to this we will see:

- Strategic directors looking to add process analysis and change management
- Business development professionals with additional skills to understand the detailed operation of the client's business and the ability to create value
- Construction professionals with additional skills to take out cost and adopt lean construction principles
- Planning and programme managers with a good appreciation of construction methods and additional skills in defining and following programmes to greater detail.

**Site managers**

Seen by many of those we consulted as the lynchpin for construction in the future, the site manager will apply an in-depth knowledge of construction to bring order to a site that is working with no contingencies and to timing plans measured in hours, not days. He or she will have greater and earlier involvement in the design and planning stage to improve the buildability and predictability of defect-free completion.

[6] By professionally qualified, we mean the equivalent to degree or NVQ Level 4/5, plus three to five years of experience

### Trades

The demand for trades[7] will continue to increase with the demand for buildings – it will be perhaps more than five years before modern construction methods allow a noticeable reduction to the workforce. There will be increased multi-skilling and polarisation in skill levels. The trades will require higher skills and the operatives fewer skills. Much of the innovation will deskill the fabrication – whether making a plumbing joint easier or removing all wet trades. Removing the skill from joining the water pipe does not remove the need for a plumber to route the piping from supply to the sink. The skills to apply the innovations that improve the efficiency of build[8] still revolve around building to line and level and are relatively easily acquired by the existing trades.

## 6.3 WHAT THIS MEANS FOR CITB-CONSTRUCTIONSKILLS' FUTURE PLANNING AND STRATEGY

CITB-ConstructionSkills has to address two timeframes – the immediate and the future needs of employers.

### Strategy relating to trades

The conclusion from our consultation is that the rate of adoption of radical innovation on site is not sufficiently rapid to require CITB-ConstructionSkills to radically change its approach to trades training. What the consultation revealed is that employers need 'more and better' of the same trade skills. The most likely changes in the next three to five years in methods can be handled with the same core trade skills that are applied today. The requirement for greater productivity and lean construction is addressed by changes in the way that sites are managed and activity is scheduled, not by teaching faster ways of laying bricks. The trades will improve productivity if they are well managed and working to a logical sequence.

The immediate need, according to our panel and others, is to provide a core of tradespeople who can apply conventional construction methods in a more efficient way. The skills of building to line and level, following a plan and reading drawings, apply equally to conventional build as they do to the application of many of the new products and techniques.

There are employers who will need specific new skills to deal with new methods and CITB-ConstructionSkills should be sufficiently flexible to deliver these. The existing work with Space 4[9] is a good example of the sort of training CITB-ConstructionSkills will increasingly have to deliver.

In the longer term, the trades will need multiple skills centred on a core of reading drawings, understanding the principles of construction, health and safety and basic organisation and supervision. To this core of building skills they will add erection skills, site preparation, fitting (as opposed to fabricating) and how to better integrate with other trades. Above all, the requirement is that tradespeople have greater flexibility and are not confined to one discipline. Some of this approach to trades is already well established in the smaller 'jobbing builder'. The future challenge for CITB-ConstructionSkills is to establish the same 'ability to do anything' but to far higher levels of quality and tighter tolerances.

[7] By trades we mean people with specific skills such as carpenters, plumbers etc. By operatives we mean other site-based workers

[8] Efficiency based innovations are those that make it easier to assemble the kit of parts that is the conventional building

[9] CITB-ConstructionSkills provides training for companies wishing to build with the Space 4 concept. Space 4 is an off-site manufacturer of complete housing units. It takes a completed design and manufactures the panels that make up the interior shell of the house

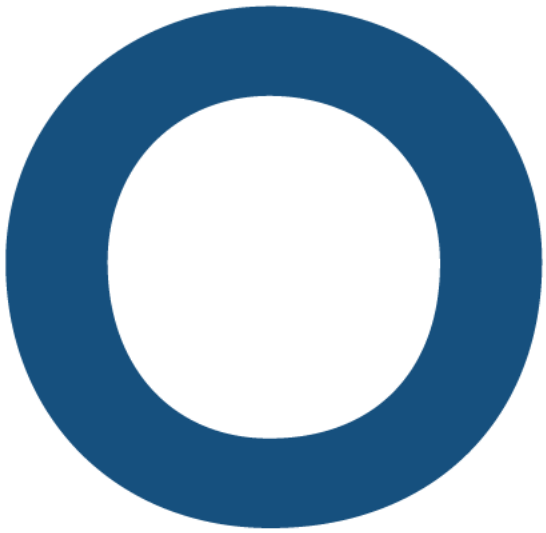
**Strategy relating to construction management**

This is an area for attention to fix both present problems and future demands. There is a need to provide a programme to upskill the existing workforce and influence the university and further education providers to deliver construction managers who increase site productivity, take out costs and who can consistently deliver.

The conclusions from this research and previous foresight studies suggest that the site manager, planner and bid manager are three roles where new skills and greater competence will deliver advantages to the industry.

The immediate need is to improve the quality with which the construction process is managed. The bid manager needs a greater understanding of the concept of value and risk; the planner needs to deliver better and more robust plans; the site manager needs a greater ability to ensure that the plans are followed. All need to better understand the construction process and use that vision to pre-empt and prevent problems.

Perhaps as this layer of middle managers becomes better at both conventional and modern methods of construction and runs projects that deliver on time, to quality and on budget, so will the rate of adoption of innovation increase.



CITB-ConstructionSkills is working in partnership with
CIC and CITB(NI) as the Sector Skills Council for Construction