2020 Vision – The Future of UK Construction

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A scenario based report by

Experian™

SAMI Consulting

St Andrews Management Institute

for ConstructionSkills

2020 Vision – The Future of UK Construction

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ConstructionSkills

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Executive Summary

Introduction and aims of the project

This report sets out the overall findings of the 2020 Vision Project, commissioned by ConstructionSkills from Experian Business Strategies and SAMI Consulting Limited, to:

- identify key issues and changes which the UK construction industry may encounter over the long-term;
- assess their potential implications for industry employment, skill and training requirements.

The ConstructionSkills 2020 Project is essentially scenario based.

The report provides an overview of construction specific trends and issues which may have a significant bearing on future UK construction activity and labour productivity, and hence on future construction industry skill and training requirements.

Drawing on this and the Foresight Futures Vision 2020 scenarios which were developed for the Department of Trade & Industry by SPRU-Science and Technology Policy Research, University of Sussex, the report develops four alternative scenarios of the UK construction industry in 2020.

Based on assumptions consistent with each of the scenarios, the ConstructionSkills Employment Forecasting Model, extended in time to 2020, is then used to explore the consequences of each of these four scenarios for the industry's long-term skill requirements. These results are also compared with a simple extrapolation to 2020 of the model's existing assumptions, the "Base Case".

Trends and issues in construction

The main underlying issues reviewed are:

- **Speed of innovation within the sector:**
  Historically, innovation in the construction sector has not been rapid. Greater internationalism, greater competition, and greater integration in the supply chain could improve this. Such changes are plausible in some scenarios of the future.

- **Demographics:**
  The UK's ageing demographic profile suggests that special measures will be needed to maintain sufficient numbers of new recruits into the industry. The provision of training at all levels in the industry will be needed to meet future skills requirements.

- **Health and Safety:**
  It is probable that the drive to improve health and safety in construction will continue to a degree in all the scenarios being considered. Additional training will be required to

maintain safety attitudes and meet new demands on safety skills in more innovative scenarios.

- **Information and Communication Technology (ICT):**
  The current trends towards greater use of integrated information systems seem likely to continue, but much more quickly in scenarios that are innovative and dynamic.

  The implications are greatest for the professionals in the construction industry, as they will need a wider skill base in ICT to integrate design, construction, logistics and manufacturing. Training will be needed at all levels, but in some scenarios will need to be focused particularly on professionals already in the industry who will need to upgrade their skills. There will also be a tendency in some scenarios for a merging of construction professions.

- **Modern Methods of Construction (MMC):**
  MMC is a generic term for a variety of construction methods that are generally new, and often have a significant off-site component. The main implications of an increase in MMC for training appear to be training for new skills on-site, more mechanical handling on-site, a reduction in demand for certain trades on-site, but a compensating increase in parallel trades off-site in factory environments, and higher levels of computer aided design (CAD). MMC is unlikely to have a great impact on trades involved in repair and maintenance (R&M), but appears likely to make inroads into new-build work for a variety of reasons. The extensive use of robotics in construction processes on-site by 2020 appears unlikely.

- **New materials:**
  There is a wide range of actual and potential new construction materials, but most of these remain within the scope of existing methods of application or installation. The implications for training and skills are therefore generally, but not entirely, secondary. In the event of a significant increase in the use of new materials, tradespeople will need to be able to read, understand and implement the instructions on the packaging. This may require changes in the basic construction training given to them. Changes in materials will be significant for both new-build and R&M. In R&M they will need to be used in conjunction with traditional skills.

- **CO2 emission reduction and energy conservation in buildings:**
  Most views of the future suggest continued pressure to reduce the energy consumption of buildings. The implications for future skills requirements could be significant. Very small imperfections in construction can have substantial implications in meeting the high levels of energy standards anticipated. There may need to be considerable changes in attitude to new construction techniques, accompanied by an understanding of the impact of actions and inactions by an individual on the final energy certificate. There is likely to be considerable scope for expansion of the skills required for assessment of energy efficiency of buildings.

  Retro-fit to improve energy conservation in existing buildings will require an understanding of the impact of new materials/systems on old buildings, and combining traditional skills with the installation instructions on the new materials.

  In some scenarios, some trades will see a reduction in demand, such as new-build wet

heating systems, as zero carbon homes obviate the need for any significant heating. The overall effects on other trades are not so clear cut.

The development of low carbon sources of energy will require enormous investment in energy infrastructure, albeit some will be replacement.

- **Other sustainability issues:**
  Increased government and cost pressures to reduce water usage and waste would generate the need for some new activities and skills.

- **General training issues:**
  Any increase in MMC will lead to greater specialism in off-site activities. On-site MMC would lead to a need for highly trained generalists capable of assembling complex components, and also possibly highly specialised employees of manufacturers installing their own products. Demand for multi-skilling would arise from the need to install more complex pieces of equipment, requiring the skills of different trades. In any innovative or progressive scenario, there would appear to be a strong case for the claim that there is a need to raise continually the standards of most people entering the industry. There is a fairly consistent view that there will remain a difference between new skill requirements in new-build and those in R&M which will continue to require traditional skills to deal with traditional buildings.

Scenarios for construction

The economic and political backdrop for each of the four construction scenarios, together with the key implications for construction, can be summarised as follows:

Scenario One – World Markets

World Markets is a world driven by aspirations of personal independence, wealth and mobility, a belief in the efficacy of integrated global markets and internationally co-ordinated policy, and a philosophy of “limited government”. Construction is characterised by:

- Rapid innovation and domination of major projects by international contractors
- Increasing use of off-site construction with more ICT-intensive buildings
- Emphasis on self-regulation, with relaxed planning controls
- Strong new housing demand, particularly private sector, but affordability issues
- Even more buoyant commercial & infrastructure construction

Scenario Two – National Enterprise

Under National Enterprise, people aspire to personal independence and material wealth, embracing liberalised markets as an effective means by which they can achieve these goals within a nationally-rooted cultural identity and with a high degree of national self-reliance and security in a more fragmented and regionally unstable world. Construction sees:

- Weak investment in other new infrastructure and public new building

- Little growth in new housing investment which remains predominantly private sector
- Limited further “internationalisation” of major contractors & projects
- Slower uptake of best practice, new technologies and off-site construction
- Proportionately stronger repair, maintenance and refurbishment than new-build

Scenario Three – Global Responsibility

In a world of Global Responsibility, people aspire to high levels of welfare with shared values, more equal distribution of opportunities and a sound environment. There is active public policy and public service provision, and international co-operation within the EU and at a global level. Competition is fostered within a regulated framework. Reconciling growth and sustainability, in a co-ordinated global context, is key under this scenario. Features of construction include:

- Heavy investment in renewable energy/resource efficiency, recycling and in new eco-efficient/low carbon and high-tech business opportunities
- Rapid innovation, with international contractors dominating major projects
- Stronger regulation and planning controls, with much greater emphasis on whole-life thinking and design
- Relatively strong public sector building and infrastructure
- Major public and private investment in both new housing and refurbishment of existing stock
- Substantial investment in new eco-efficient construction

This scenario, which reflects rapid construction growth and innovation, coupled with a robust response to climate change and other sustainability issues, is the one that leads to the greatest level of change in the industry.

Scenario Four – Local Stewardship

Under Local Stewardship, individuals seek sustainable levels of welfare within federal and networked communities. Social and other regulation ensures more equally distributed opportunities within a high quality local environment. Public policy and low economic growth combine to produce small-scale regionally based economic activity rather than large-scale business and advanced technologies.

- Construction remains fragmented, with small businesses and slow innovation
- New-build construction is relatively weak
- There is heavy emphasis on refurbishing, repairing and improving the existing residential and non-residential stock, where possible improving its eco-efficiency

Model results and the implication for skills requirements

Overall construction output growth

In recent years construction output growth has generally underperformed GDP growth and this trend continues under three of the four construction scenarios and also under the Base Case. The exception is Global Responsibility, where construction output is assumed to grow on average 0.5% a year faster than GDP.

Figure 1: Key assumptions

Assumed growth to 2020	GDP Growth	Construction Growth	New	R&M
	% p.a.	% p.a.	% of total	% of total
World Markets	3.00	2.75	57.0	43.0
National Enterprise	2.00	1.50	47.5	52.5
Global Responsibility	2.50	3.00	55.0	45.0
Local Stewardship	1.25	1.00	45.0	55.0
Base Case	2.50	2.20	59.0	41.0
Source: Foresight Futures, Experian, SAMI Consulting				

Sector variations

Not only is total real construction output assumed to increase at different percentage rates under the different scenarios, growth rates also vary across individual sectors. In particular:

- In absolute terms, compared with 2006, the real level of public sector new housebuilding is higher in 2020 in all scenarios except that of National Enterprise.
- New private housebuilding real output in 2020 is higher in absolute terms in all but the Local Stewardship scenario but declines in proportionate terms under all four scenarios.
- Public other new construction work grows in real terms under all scenarios but falls proportionately under the World Markets and National Enterprise scenarios.
- Private industrial new work output declines proportionately in all but the World Markets scenario and absolutely under Local Stewardship.
- Private commercial new work output increases proportionately under the World Markets scenario, but shows a noticeable proportionate decline under Global Responsibility and Local Stewardship.
- Infrastructure output grows noticeably in proportionate terms under the World Markets scenario, but falls under the National Enterprise and Local Stewardship scenarios. It also shows an absolute decline in output in real terms under Local Stewardship.
- R&M output shows real absolute growth between 2006 and 2020 under all four scenarios, albeit at varying rates. R&M under National Enterprise and Local Stewardship scenarios increases its share of total construction output in 2020 compared with 2006, but shows a relative decline under World Markets and Global Responsibility.

Productivity changes

An important element in employment growth is the level of productivity gains assumed for each scenario. Productivity here is defined as unit sector output divided by unit labour input. It comprises improvements in output per person but also allows for a reduction in the need for certain trades in a sector, such as a decrease in the use of plasterers in a scenario with high levels of dry lining. The net result inherent in each scenario is shown below.

Figure 2: Productivity change assumptions

	Overall productivity growth % p.a.	New-build productivity growth % p.a.	R&M productivity growth % p.a
World Markets	1.4%	2.0%	0.5%
National Enterprise	0.25%	0.5%	0.0%
Global Responsibility	0.7%	1.25%	0.0%
Local Stewardship	-0.3%	0.0%	-0.5%
Base Case	0.6%	1.0%	0.0%

Source: ONS, Experian, SAMI Consulting, ConstructionSkills.

Employment implications

In 2006 there were 2.41 million people working in the construction industry, either employed or self-employed, as defined by SIC 45 & 74.2.

Figure 3: Implications for employment

	Actual 2006	Base Case 2020	World Markets 2020	National Enterprise 2020	Global Responsibility 2020	Local Stewardship 2020
Employment, millions	2.41	3.36	3.04	3.10	3.47	3.15
% increase on 2006 base		39%	26%	29%	44%	31%
Deviation from 2020 Base Case			-9%	-8%	+3%	-6%

Source: ONS, Experian, SAMI Consulting, ConstructionSkills.

Employment rises under all scenarios (assuming that any movement from on-site to off-site after 2006 is included under the construction banner). The table above shows the net changes for each scenario based on the construction growth assumptions in Figure 1 with an allowance made for productivity changes as shown in Figure 2.

The implications for individual occupations

The implications for individual occupations are summarised below. The occupational breakdowns used below are based on the 25 occupational aggregates in standard usage by ConstructionSkills, which are in turn based on the Standard Occupational Classifications published by the Office for National Statistics and applied to Labour Force Survey data. The comments are based on the relative increases or decreases in employment compared to the overall growth of employment in each scenario. Thus a decrease does not necessarily signify an absolute decrease in the numbers employed in a trade or occupation but, rather, a relative decline.

In fact, no occupations are expected to show an absolute decline under any scenario. However, within individual trade there may be subtle changes in the mix of skills required, as detailed in the main report.

Three of the four scenarios and the Base Case show significant and different variations in the balance between the different trades by 2020. However National Enterprise retains a balance very similar to the actual distribution in 2006.

- **Managerial and administrative occupations:**
  Senior managers, business process managers and other office based staff all decline relatively in World Markets and Global Responsibility while they grow a little under Local Stewardship.

  Other Professionals/Technical Staff and IT hold or increase their proportion a little in all scenarios.

- **Construction managers and professionals:**
  The proportion of construction managers and professionals of the total employed in each scenario remains relatively constant.

- **Structural and building 'skin' trades:**
  There is some relative growth in importance of bricklayers and building envelope specialists in World Markets and Global Responsibility.

  Roofers show lower than average growth in employment under National Enterprise and Local Stewardship.

  Demand for steel erectors and other structural trades shows relatively little change under the four scenarios.

- **Building services engineering trades:**
  Electrical Trades and Plumbing & HVAC Trades show some relative growth in World Markets and Global Responsibility, little change in National Enterprise and a relatively substantial decline in Local Stewardship.

- **Plant related trades:**
  Employment levels for plant operatives and plant mechanics and fitters appear to grow roughly in line with overall growth within each of the four scenarios.

  Demand for scaffolders is predicted to grow more slowly than the average within the World Markets and Global Responsibility scenarios due to increased mechanization.

- **Other main trades:**
  Wood trades & interior fit out employment grows roughly in line with, or faster than, the overall average within each scenario. In World Markets growth is significantly higher.

  Painters and decorators and floorers show significant relative decline in World Markets and Global Responsibility.

  Conversely, plasterers and dryliners show relative growth in World Markets and Global Responsibility.

Demand for glaziers grows slower than average in all cases.

- **Other occupations:**
  Civil engineering operatives show strong relative decline in World Markets and Global Responsibility. It should be noted that this is only relative decline, due to the growth of housing and/or commercial building and is not absolute decline.

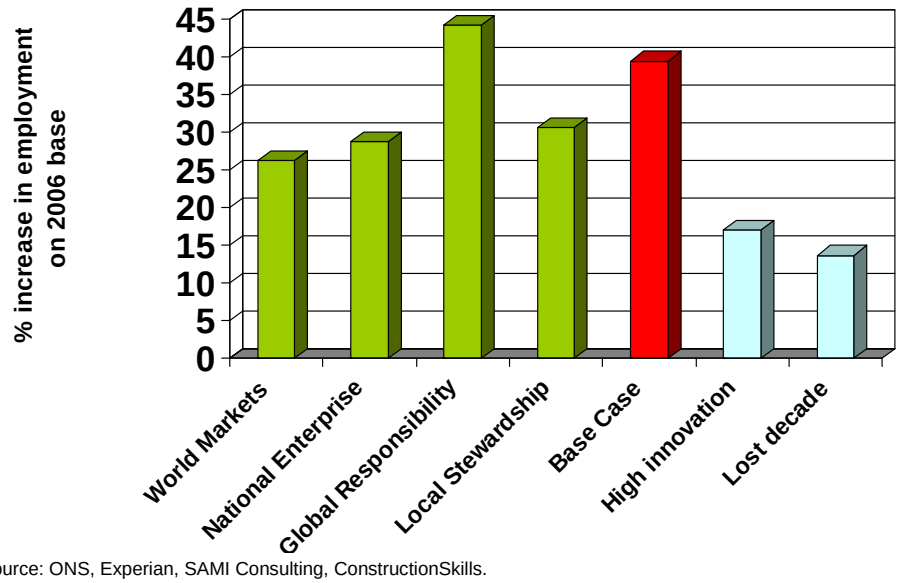
Employment sensitivities

Analysis suggests that perhaps only two factors could result in substantially reduced levels of construction industry employment in 2020, namely:

- a very serious and prolonged economic and financial downturn and/or major structural constraint on further growth (the lost decade).
- a very marked acceleration in the growth of off-site production over and above that envisaged under the selected scenarios (a high innovation outlook).

Whilst it is possible that a combination of these two factors could work together to reduce absolute future construction industry labour force requirements, this is relatively unlikely. The effect on total employment requirements of the individual sensitivities compared with those of the four scenarios and the Base Case is shown in Figure 4.

Figure 4: Changes in employment levels



Source: ONS, Experian, SAMI Consulting, ConstructionSkills.

Conclusions

Workforce requirements, recruitment, retention

- The scenarios point to significant employment growth over the period to 2020, possibly in conjunction with an increase in competition in global labour markets, particularly for skilled and professional workers. Inward migration to the UK could reverse in several scenarios, and there is consequently a significant risk of recruitment difficulties and skill shortages for the UK construction industry.

- There is therefore a need to improve the image of the UK construction industry and its attractiveness to potential employees.

- The industry needs to consider how innovation and MMC can be encouraged to enhance industry productivity and mitigate potential future labour shortages.

Energy efficiency & carbon neutrality

- Energy efficiency and carbon neutrality are likely to be a significant force for change under all scenarios, even if the drivers vary between scenarios. There is a need to improve basic skills and knowledge with respect to energy conservation and efficiency of use.

- There will be increased emphasis on air-tightness and hence on quality of construction. On new-build, this may in turn encourage greater prefabrication, panellised construction, and growth of off-site production.

- In all scenarios there will be increased emphasis – albeit to a varying degree – on improving the energy efficiency of the existing building stock, as well as that of new-build.

MMC and off-site

- The growth in use of MMC and off-site production is greatest under the World Markets and Global Responsibility scenarios.

- Obtaining critical mass and scale production is likely to be one key enabling factor for the growth of MMC, and the public sector has an important potential role here as a major client. Standardisation and greater collaboration between the various industry stakeholders are also key.

- Greater use of MMC will increase the importance of planning and logistics skills, to ensure correct timing and sequence of delivery and installation. This will increase the need for more site craneage, powered access and other mechanisation.

- Designers will increasingly need to understand how the various elements of the building inter-relate with respect to construction and performance in use. They may also have to design and engineer products that can be put together on an automated factory production line. This may be a challenge, given the historic organisation of the UK construction industry, and has implications for the individual professions.

Construction professions and management

- There is likely to be an increased focus on the whole life performance and cost of buildings and infrastructure and, as for MMC, an increasing need for the industry's professions and managers to understand how the elements of a building inter-relate and perform as a whole.

- Managers are also likely to require additional planning, logistics and commissioning skills. The need to achieve high levels of quality and performance, particularly with respect to air-tightness, is likely to require greater levels of supervision and quality control.

ICT and system interoperability

- The use of ICT will extend in quality and scope, although the pace of development and application varies across scenarios.

- The logical extension is for greater use of ICT on-site, integrating design with the manufacturing, delivery, construction, commissioning and operational processes – although this is likely to be truer of large sites and new-build than of small sites and R&M.

- Interoperability of systems (which is often currently lacking) will be key to the rate of development and application of ICT in the industry.

- In all scenarios, construction professionals and managers are likely to need a wider skill base in ICT operations.

- On-site operatives can be expected to make greater use of hand-held devices, particularly under the higher growth and innovation scenarios, and will not only need the skills to use the devices but also the ability to understand the information available and to use it accurately. This may require a higher calibre of recruit, as well as a more general education in construction, in addition to specific skills training.

Repair, maintenance and improvement

- The market for R&M increases in size in real terms between 2006 and 2020 under all four scenarios.

- Although the retro-fit/R&M market may not be a strong driver of new skills, its size and prospects nevertheless mean that there is a clear need to preserve “heritage” skills.

- This need may be reinforced as a result of the expected increase in pressure to retro-fit or upgrade existing buildings to improve their energy efficiency.

- There is increasing divergence in the skill needs of the R&M and new-build workforces in the more innovative scenarios.

Multi-skilling

- There is debate over whether there will be a trend towards more multi-skilling or towards more specialist trades. Both trends may in practice become evident, particularly in the more innovative scenarios, where new specialist and broader skills will be needed to implement MMC.

- The anticipated high levels of demand for R&M services can be expected to sustain a strong level of demand for multi-skilled tradesmen, both to ensure acceptable levels of

productivity and cost, and because growth in upgrade and retro-fit work is likely to involve tasks that cross traditional trade boundaries.

Continuous evolution of skill needs

- Change is a feature of all four scenarios, albeit at different rates and in different directions. More attention will need to be given to liaison between training organisations and industry employers to ensure that the appropriate courses are continually updated in the light of evolving site practice and methods.

- There is likely to be a greater need for retraining, re-skilling, and upskilling of those already in work, particularly as a substantial proportion of the industry's 2020 workforce is already at work in the industry.

- Training will also not just be about numbers, but also about possibly small and subtle shifts in the future skills and knowledge required by a particular trade.

Health and safety

- It is probable that the drive to improve health and safety in construction will also continue to a degree in all the scenarios being considered, driven by clients, government and enlightened contractors. Even so, the safety content of training can be expected to be higher in the socially cohesive scenarios than in the market driven scenarios.

- Safety by design will be viewed as part of the normal design process.

- Under all scenarios, it is still likely to be the larger new-build construction-sites that will have the greatest emphasis on safety, and hence on demand for safety training.

- In the high innovation scenarios, changes in products and processes will require continual reassessment of training in site safety to meet the needs of the new processes, such as heavy lifts, working at heights, and using new equipment.

Industry culture

- To a greater or lesser extent under all scenarios, a change in industry and employee culture and mindset will be essential to meet improved quality, accuracy and precision and avoid damage and waste during construction.

- This change in mindset will require training and understanding on the part of the workforce as to why the change is required, and clear leadership at all levels and among all participants in the industry, including clients. It may also necessitate a workforce with a higher level of educational achievement than in the past.

Key indicators of change

- The report identifies some early warning indicators that may help to signal the precise direction of future change within the UK construction industry and the resulting skill

requirements. In turn, these could assist the industry in achieving better forward planning and preparedness for change.

- It is recommended that changes in the environment within which the industry operates, and in its key practices, should be regularly monitored as an aid to long-term workforce planning and training.

1 Introduction and methodology

1.1 Introduction and aims of the project

This report sets out the overall findings of the 2020 Vision Project, commissioned by ConstructionSkills from Experian Business Strategies and SAMI Consulting Limited, to:

- identify key issues and changes which the UK construction industry may encounter over the long-term;
- assess their potential implications for industry employment, skill and training requirements.

The project has its origins in the discussions which took place at the ConstructionSkillls Network National Group Meeting in London in April 2007. At that meeting, it was concluded that, given the length of time required to train new entrants to the industry, particularly in the professions and a number of other high skill disciplines, it would be extremely valuable to look beyond the existing five-year horizon adopted by the current Labour Force Skills forecasting model.

The year 2020 was subsequently chosen as an appropriate time line for analysis. This was considered to be sufficiently far ahead in time to explore some potentially significant changes which could occur within the overall environment in which the UK construction industry operates and in the materials, methods and skill-base which it currently uses, yet not too far ahead to result in purely blue-sky thinking.

It is intended that the report and its conclusions will stimulate wider debate and appropriate action among all those having an interest in ensuring a successful future for the UK construction industry – including clients, consultants, contractors and sub-contractors, manufacturers, suppliers, training organisations, the unions, professional associations, regulatory authorities and other public and private sector bodies.

1.2 Structure of report

Following the Executive Summary, this introductory chapter sets out the approach and methodology adopted for the 2020 Vision Project which is essentially scenario based.

Chapter 2 then provides an overview of a number of construction-specific trends and issues which may have a significant bearing on future levels and composition of UK construction activity, on materials used and methods of working, on labour productivity and hence on future construction industry skill and training requirements.

Drawing on this analysis, and placed within a broader economic, political and social framework, Chapter 3 sets out and develops four alternative scenarios or visions of how the UK construction industry may look in 2020.

In Chapter 4, based on specific assumptions consistent with each of the preceding scenarios, the ConstructionSkills Employment Forecasting Model, extended in time to 2020, is used to explore the potential consequences of each of these four scenarios or visions of the future for the industry's long-term labour skill requirements. The varying possible outturns are compared

and contrasted. The results are also compared with those obtained from a simple extrapolation to 2020 of the model's existing assumptions, which we have called the "Base Case". Recognising the uncertainties which inevitably persist, the report also seeks to identify some key early warning indicators, or areas to be monitored, which may assist the industry in taking timely action to meet future skill requirements as they evolve.

Finally, Chapter 5 draws together the key conclusions to be drawn from the study with respect to future construction industry skill and training requirements.

1.3 Scenarios as an analytical tool

In the preceding outline of the report's structure, reference was made to the scenario-based approach which has been adopted for the project.

Professor Michael Porter of Harvard University defines a scenario as "an internally consistent view of what the future might be ... not a forecast but one possible future outcome."

Scenarios, as Porter has defined them and as we have used them in this report, are based on four underlying assumptions:

- the future is unlike the past, and is shaped by human choice and action;
- the future cannot be foreseen, but exploring the future can inform present decisions;
- there are many possible futures – each scenario maps one 'possibility space' that is in itself consistent and plausible;
- scenario development involves rational analysis and subjective judgement.

Scenarios are thus possible alternative views of the world which provide a context within which organisations can think about the future and take appropriate decisions. They can illuminate significant drivers of change, including those that may not necessarily have a high probability of occurrence. By seeing a range of possible worlds and understanding their potential drivers, decisions will be better informed, and a strategy or actions based on this knowledge and insight will be more likely to succeed.

1.4 The overall framework for the ConstructionSkills Vision 2020 scenarios

While the emphasis of this report is firmly on the future of the UK construction industry, it was felt strongly that in creating alternative visions of the industry's possible future development path, the wider political, economic and social environment could not be ignored. This is because many of the construction industry's key drivers lie within and are fashioned by the latter.

More specifically, the future of the UK construction industry will be determined by a series of variously inter-related external factors which include, but are by no means limited to:

- the future stability, rates and patterns of global and UK economic growth, trade, development and income distribution;

- whether international collaboration, competition and globalization of markets prevail, or whether national or regional protectionist forces emerge and predominate;
- demographic trends, including rates of population growth, age structure, household size and migration;
- levels of international and national security and political stability;
- future attitudes and approaches towards the role and the size of the state, both absolutely and in relation to the private sector; and towards issues of social welfare, political and corporate governance, legislation and regulation;
- economic, social and spatial development patterns;
- resource availability and security, including energy;
- environmental sustainability and climate change;
- rates and levels of innovation with respect to new technologies and materials;
- unforeseen events and shocks.

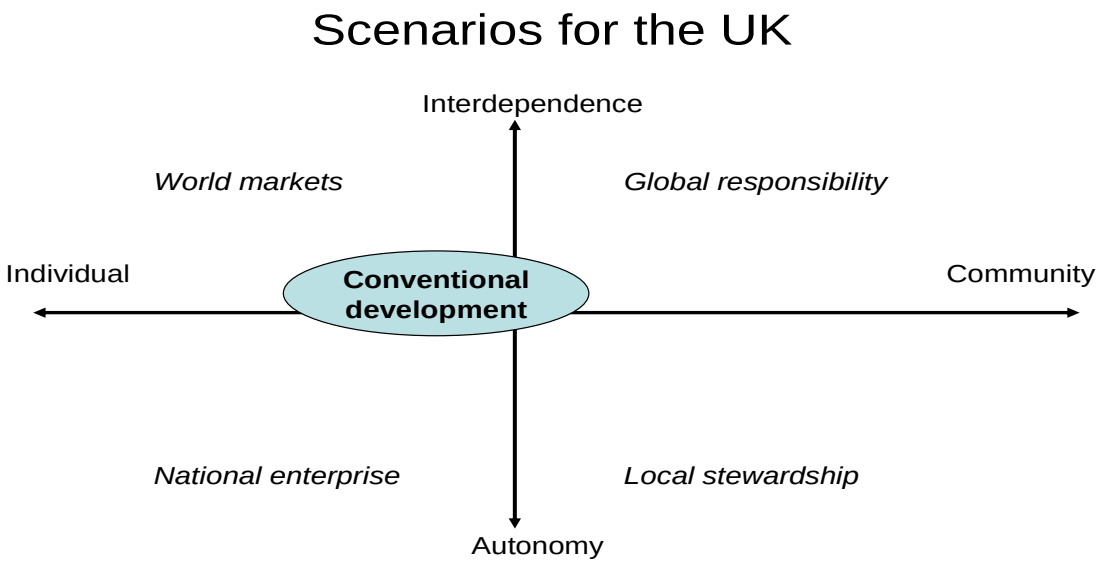
Given the scope and time-frame of the present study, it was considered neither a practicable nor sensible use of available resources to create an original set of macro economic and political scenarios from which the required UK construction scenarios could then be developed. For this reason, it was decided to adopt the Foresight Futures Vision 2020 scenarios, with a few updating amendments for which the authors of the current report take responsibility, as a base from which to develop our own UK construction scenarios. The value of the Foresight Futures Vision 2020 thinking and report is duly recognized and gratefully acknowledged.

The Foresight Futures Vision 2020 scenarios were developed for the then DTI (Department of Trade & Industry) by a team of researchers at SPRU-Science and Technology Policy Research, University of Sussex, in consultation with stakeholders from business, government and academia. They were built on an extensive review of national and global futures. They have the advantage of being widely used, and in the opinion of this project team incorporate a broad spread and combination of key, macro construction drivers. The scenario storylines draw on an analysis of socio-economic trends, but also introduce elements of novelty and change.

The four Foresight Futures scenarios thus describe what the UK could be like in 2020. The accompanying chart (Figure 5) positions each of the scenarios (named World Markets, Global Responsibility, National Enterprise and Local Stewardship) and conventional development in relation to two key drivers, the direction of both of which is uncertain yet likely to have a major impact on shaping the future course of events: social values (x axis) and systems of governance (y axis). Social values range from individualistic values to more community orientated values. Systems of governance deal with the structure of government and the decision making process, ranging from autonomy where power remains at a national level or becomes more regional, to interdependence where power increasingly moves to other institutions e.g. up to the EU, or to other international bodies, or to multi-national corporations.

The four scenarios, which provide the economic, political and social framework for this project, are presented as storylines in Chapter 3 below.

Figure 5



Source: Foresight Futures Vision 2020 report.

1.5 The approach to developing the detailed construction scenarios

Based on each of these four scenarios, a more detailed picture of how the construction industry might look in 2020 – with respect to its size, structure and shape – was then developed.

This process involved a number of steps.

The first step was to undertake a search and desk review of recently published reports and analysis on the possible future shape of the UK construction industry, highlighting key trends, issues and uncertainties with respect to factors such as levels and composition of construction, building regulations and construction methods, materials and innovation. Other relevant work on industry futures and scenario building was identified and analysed. Contact was made with several research and other organisations in order to discuss and expand on various aspects of their published work. A selected bibliography of key sources of information used in the current project is given in Appendix A.

In parallel with this research, the project has also engaged in an extensive process of consultation with industry participants and stakeholders, including clients, consultants, contractors and sub-contractors, manufacturers, distributors, training organisations, regulatory authorities, academia and other public and private sector bodies through a series of workshops as well as selected interviews and a questionnaire survey. In total, some 15 workshops were held throughout the country with the aim of engaging industry members in identifying the key issues and trends likely to shape the UK construction industry's future.

The outworkings of this programme of research and consultation have been embodied in the development of the alternative construction scenarios and in the associated assumptions and coefficients adopted for use in the accompanying forecasting model as a basis for analysing potential future skill and training requirements over the period to 2020.

1.6 Probability of alternative scenario outcomes

As already noted, scenarios are not forecasts; they may not predict the future, nor do those chosen as the basis for this project represent all possible outcomes. The probability of each of the four scenarios adopted in the current analysis may well vary. Furthermore, the eventual outturn in practice may in practice comprise a combination of events from the different scenarios.

Discussions during the various workshop sessions suggest that a number of participants consider that the Word Market and Global Responsibility scenarios may have a greater likelihood of occurrence than the National Enterprise or Local Stewardship scenarios. This may be because participants found it easier to identify with the World Market and Global Responsibility scenarios which perhaps make for a more natural and smoother extension over time of the general environment and trends which have prevailed over the past decade.

Indeed, it may be argued that the National Enterprise and Local Stewardship scenarios represent visions of a future world in which there has been serious dislocation and a step change in direction. Such a change, should it occur, might well be borne out of economic, financial, social or political crises (perhaps environmental, energy or terrorist related) or out of a popular disillusionment and backlash against the existing economic, social and political status quo. Such shocks cannot be discounted, and the industry would be well-advised to consider their potential ramifications in order to be best prepared for the future.

1.7 Acknowledgements

As will be apparent from the preceding description of the project's methodology, we have received considerable help and information from a large number of individuals, including the stakeholders of the ConstructionSkills Network. We wish to acknowledge the generosity that they have shown in giving their time despite very busy schedules, for attending our workshops, and for their enthusiastic, constructive and creative response to our many questions.

While those who participated in the project are too numerous to list here individually, we would nevertheless like to acknowledge the particular and very valuable support and information we received from the following organizations and their staff; from ConstructionSkills which provided invaluable assistance in arranging venues for and managing the invitations to, and attendance at, each of the various workshops; from the Modern Built Environment Knowledge Transfer Network and the BRE for arranging and supporting a Technical Workshop and to the BRE for arranging and providing a follow-up meeting to discuss various technical issues and trends; to Loughborough University's Department of Building and Civil Engineering for their help in providing information on innovation and off-site fabrication and from their own ESRC funded "Big Ideas" research project into future industry scenarios currently being conducted in conjunction with the Universities of Reading and Salford; and to the World Economic Forum for sharing with us the work they are doing in developing Global Construction Scenarios for the major international contractors that are members of the World Economic Forum's Engineering and Construction Community.

2 Trends and issues in construction

2.1 Introduction

This chapter provides an overview of what appear to be the key trends and issues facing the UK construction industry. These emerged from the desk research undertaken and from the subsequent workshops, meetings and interviews. There has been a deliberate focus on those aspects considered to have significant implications for future skill requirements. Thus the discussion focuses on the skills likely to be required in the future, the provision of those skills, and changes in productivity arising from other changes internal and external to the construction industry. From analysis of these changes, estimates of the future requirements for trained labour can be derived.

The probabilities of the occurrence and extent of implementation of the trends identified will vary, and where possible reference has been made to the possible forces which might affect the changes. This has been done largely within the context of the four scenarios which are developed in the next chapter.

The main underlying issues reviewed are:

- Speed of innovation within the sector
- Demographics
- Health and Safety
- Information and Communication Technology (ICT)
- Modern Methods of Construction (MMC)
- New materials
- CO2 emission reduction and energy conservation in buildings
- Other sustainability issues
- Market forces, client attitudes, other regulation
- General training issues

2.2 The speed of innovation within the sector

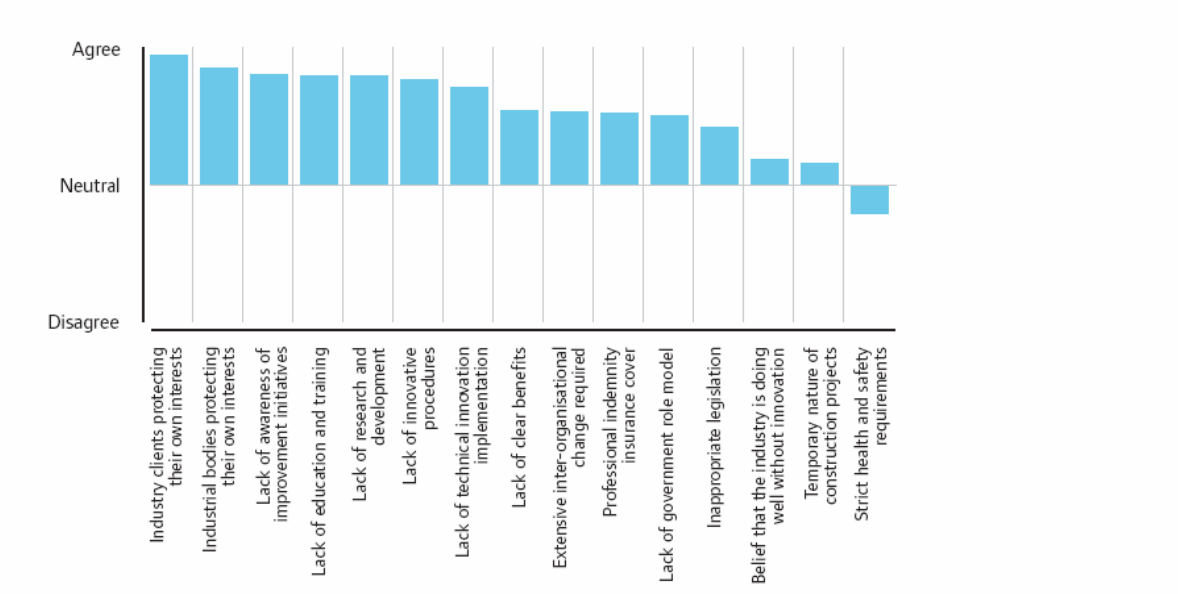
Historically, innovation in the construction sector has not been rapid. Much of the industry believes that it is inherently problematic for the British construction sector to innovate. Reasons given include:

- The vast majority of suppliers to construction, particularly for R&M work, are small to medium-sized companies whose awareness is limited, which leads to fragmentation and slower take-up of new ideas.
- Innovation tends to occur to solve specific problems which do not always recur and/or the knowledge gained is often not captured.
- The market is insular and does not import innovation from overseas.

- Much successful innovation is in methods etc. and is easily copied, reducing the incentive for individual organisations to invest in innovation.
- Clients are risk averse and do not want their capital projects, particularly the larger ones which perhaps offer most scope for innovation, to be used as "experiments".
- The fragmented supply chain, historically adversarial, and based on lowest cost competition has restricted the incentive for innovation.
- A lack of training within the industry, in particular for upgrading existing skills, hinders the adoption of new ideas, products and methods.

Similar barriers have been identified by others, including a survey by Barrett and Lee in 2004.

Figure 6: Factors inhibiting the widespread adoption of new construction practices



Source: Barrett, P. S., and Lee, A. (2004), *Revaluing Construction: International Survey Questionnaire Results*, CIB, The Netherlands.

Factors that could improve the take-up of innovation may include:

- Legislation, regulation and a tightening of control and inspection on sustainability, and possibly health and safety, which will tend to force up costs and/or require new working practices, either of which would justify changes in the traditional approach in an attempt to increase efficiency and productivity and improve profitability.
- An acceleration in labour cost increases, as a result, for instance, of an end to east European immigration, which will provide greater incentive to adopt new higher productivity methods of construction.
- The growth of larger companies, more internationalism, and a reduction in the number of small companies across the industry.
- Growth in international contracting at all levels.
- Increased participation in the industry by an innovative government or by other major clients.

- Greater integration of the supply chain, allowing collaborative design and improvements in processes.
- Greater incentive to upgrade skills within the industry, from whatever source, which could greatly help the adoption of modern methods of construction.

Even with greatly improved take-up of innovation in the industry, it still appears likely that the bulk of techniques that will be in general use in 10 to 15 years time probably already exist, albeit they may be "cutting edge" today. As evidence of this, the Home Building Federation (HBF) claims that private sector housebuilders are fully signed up to achieve the target that all new homes will be zero carbon by 2016, on the basis that it is already possible, if expensive. However it is also possible that there will be new products, "black swans" that are unknown today but which could be rapidly accepted and adopted, viz. MDF and tower cranes. Any such changes and improvements are more likely to occur in a market exposed to international competition with free markets and a free flow of ideas.

The DIY market plays a big part in the R&M sector and is frequently the first provider of new technologies and materials which might be adopted by the wider market. Changes in the DIY market should act as short term indicators of impending change.

2.3 Demographics & sources of labour

The UK population is currently ageing with an accompanying relative shortage of young people entering the workforce. The opportunities for this reducing number of young people are likely to be wide, and construction will need to become more attractive to young people as a career if it is to maintain its relatively high labour content, on-site. Two complementary forces/issues arise: to accommodate a reduction in site personnel, on-site activities could be reduced through MMC; alternatively to attract the required construction workforce in a competitive labour market, site activities will need to be well paid and working conditions improved, avoiding the worst excesses of weather, heavy labour etc.

To make construction more attractive to young entrants, contractors and other suppliers will need to integrate education, knowledge and learning throughout the construction process – design, production, building, operations and maintenance. Investing in lifelong learning, knowledge management and the welfare of people will enhance industry standards, improve profitability and attract better people to the industry.

Should modern methods of construction become more pervasive, particularly off-site, there may be opportunities for attracting recruits from a wider range of backgrounds than at present, given the better working conditions and the type of tasks required.

At the other end of the market, a bulge of older people with accumulated skills and experience will be retiring, particularly perhaps those involved in the heavier trades and labour who may be physically less able to extend their working lives, even if they wished to do so. Unless economic circumstances force later retirement, certain skills will become less available. If reliance is to be put on an ageing workforce, compensatory changes in workload on-site will be necessary.

The loss of the ageing professional workforce (designers, engineers, technicians) is likely to be less of a problem than that of the labour workforce, as professionals are able, and frequently

prefer, to continue working. Indeed the problem may be less a shortage of staff than a need to retrain a group of older professionals who do not have the skills to meet the new needs of the sector.

At present the British construction industry is being supported, at the margins, by a large influx of migrant labour from eastern Europe. This may not be sustainable, certainly not at current wage levels, and depending on economic developments across Europe, any potential labour shortage arising from a change in immigration levels may occur quickly and unexpectedly. Changes in the source of this labour pool, possibly with more immigrants coming from further east, may conceivably, but by no means certainly, compensate. Notwithstanding their availability, the skill levels and the attitudes to health and safety of these migrants will need to match any improvements in skills, heath and safety practices and knowledge that indigenous tradespeople are required to acquire.

2.4 Health and safety

It is probable that the drive to improve health and safety in construction will continue to a degree in all the scenarios being considered. Already there is more attention being paid towards health and safety on smaller sites, especially housebuilding sites. Hopefully, the accident rate will fall in all the scenarios, but there will need to be systems in place to maintain this improvement, requiring training.

Increasing client awareness of the risks and criminal liabilities that might be incurred as a result of accidents means that the safety records of contractors and others may become a bigger factor in clients' attitudes in awarding contracts. Safety by design will be viewed as part of the normal design process. There will be greater use of personal protective equipment, whilst the risks associated with construction-sites and environmental decisions, such as those concerning brownfield developments, will be controlled through better safety policies and regulations.

These trends will increase the need to improve the attitude and understanding of everyone in construction in order to enhance safety awareness and thinking throughout the construction process – design, manufacturing, build, operations and maintenance – and to improve health monitoring and screening programmes and near-miss reporting. While steps are already being made within the industry towards general certification of staff (CSCS scheme etc), there is likely to be regulation for increased certification of construction workers to ensure that they have the right safety skills, particularly in scenarios with higher levels of state intervention.

Although time and expenditure on training will be needed to improve safety and attitudes, it is not envisaged that improved behaviours will be detrimental to on-site productivity. Improved housekeeping, better attitudes, better trained and certificated staff and a reduction in lost time will compensate for any additional time spent in making sites safer. This has been the evidence over the past decade.

Nevertheless the safety content of training can be expected to be higher in the socially cohesive scenarios rather than individualistic scenarios.

In all scenarios, it will still be the larger new-build construction-sites, rather than the smaller renovation or R&M projects, that will have significantly higher emphasis on safety and hence greater demand for safety training.

In scenarios with a high rate of innovation, changes in products and processes will require continual reassessment of the level and type of training in site safety to meet the needs of the new processes, such as heavy lifts and using new equipment. This is explored further below.

2.5 Information and communications technology (ICT)

There is a generally accepted view that current use of ICT in design, notably Computer Aided Design (CAD), will be extended in quality and scope. The logical extension is for greater use of ICT on-site, integrating design with the manufacturing, delivery, construction, commissioning and operational processes, although the pace of development and application within the construction sector will vary across scenarios. The pace of development of applications is likely to be faster on larger sites and new-build than on small sites.

The main areas where change might be expected are as follows:

- There may be greater use of integrated information systems, with a need for interoperability, which will cover design, scheduling, manufacture, delivery/site logistics through CAD (3D, object based, 4D, 5D – including cost and time).
- Site drawings may be fully integrated with off-site manufacture and design.
- Components may be tracked onto site (barcodes etc.) through automated procurement and supply networks, with guidance for installation, maintenance and even to eventual recycling.
- Much of the site workforce may use hand held devices to access information. They will need to be computer literate and skilled in working collaboratively.
- Clients may demand higher levels of information, in particular for visualisation of buildings/walkthroughs and virtual prototypes, to assist design, procurement, asset management, and timely decision making.
- Design models connected to off-site factories may enable easier bespoke construction.
- Design models may be developed for training in operation, maintenance, application and use of specialist buildings (hospitals etc.).
- ICT may provide improved information for the owners and users of completed buildings.

The rate of adoption of all or any of these in each of the scenarios will be dependent on a variety of forces, including:

- The general rate and acceptance of innovation
- Better integration of supply chains
- Client attitudes
- More open and international markets
- Influences from supplying manufacturers confirming the cost advantages of the use of ICT

However, in any scenario, until there is more integration between site and designer, there will be little site advantage from much higher levels of ICT, outside the possibility of working to the latest updated drawings.

Depending upon the pace and development of take-up of ICT within the industry, the following potential training needs may be expected:

- At professional level, the main skills and training implications appear to be the continued development of CAD skills and greater effectiveness in, and attention to, detailing.
- Construction professionals may need to have a wider skill base in ICT operations to integrate design, scheduling, manufacture, delivery/site logistics. This will involve the application of a wider range of skills than currently held by most individual professionals.
- Professionals will need an appreciation and understanding of how the various elements of a building inter-relate both with respect to its construction and lifetime performance. Indeed a merging of many construction professions appears increasingly likely in scenarios that display internationalism and the breaking down of barriers within the industry.
- On-site, if ICT can change the way the supply chain works, there will be changes in skills needed to take full advantage. Higher levels of logistic skills, scheduling and site administration will be required. It is probable also that site supervisors will need to liaise more with designers and suppliers than at present.

Also on-site, by 2020, it is suggested that operatives could routinely use hand held devices giving installation, programming and safety information etc. (Super-Blackberries for builders). The hardware and software probably already exist: what is currently missing is wide application of the intellectual input and the ability to disseminate relevant material, as well as perhaps the physical robustness of the hardware. The skills required for using these devices are twofold: first, the ability to use small electronic equipment, but this is unlikely to require any training for modern youth, brought up on computer games and mobile phones; and secondly, the ability to use the information available, to understand that the information is necessary, and also that it needs to be applied accurately. This will require general education in construction rather than specific skills training.

ICT will be much more applicable to new-build projects. Application to housing development would seem to be advantageous, especially in a period of rapid innovation, high levels of housing construction and increased regulations on energy conservation with all that it entails (see below).

Apart from improving the construction process, ICT is likely to provide the potential ability, through built-in sensors/intelligence, to monitor the use and maintenance of a building component throughout its life calling for intervention if necessary, either by humans or by communicating with other components. Buildings may also contain more remotely-controlled devices: enabling users to ‘drive’ many aspects of buildings from elsewhere. The installation of these items is not considered likely to have a great impact on on-site skill requirements.

Finally, in some scenarios, the wider use of ICT in all walks of life is likely to cause faster change in the use of buildings during the course of their lives. This will need to be reflected in their design and operation. More rapid change will require greater flexibility in building structure and designs, even during the design period, imposing further demands on designers.

2.6 MMC (Modern methods of construction)

Modern methods of construction (MMC) is a generic description of methods of construction, many of which have been around for sometime, but are only slowly being used to a wider extent, where circumstances warrant and/or permit their use. MMC substantially uses off-site construction methods, bringing to site components that are relatively quick to install, although often involving specialist installation. The main advantages purported for MMC are:

- Reduced labour/capacity on-site
- Reduced waste and reworking
- Reduced skill demands on-site
- Greater speed and lower cost of construction
- Easier logistics and material handling on confined sites
- A controlled assembly environment allowing the use of new materials and methods.

The main resultant implications of MMC on training in the future appear to be:

- Greater mechanisation and automation on-site. Much of this can be achieved by wider use of existing tools and techniques (craneage etc.) but it will have implications for new skills or a wider need for skills in craneage and lifting, for handling large loads and logistics on-site etc.
- Computer integration of construction processes from design through construction to maintenance, which in turn implies a need for cross-disciplinary education for design teams.
- Different skill demands on-site, with the new skills being less traditionally trade-oriented but more multi-skilled. The new skills would appear to be along the lines of a better understanding of the composition and purpose of assemblies and how they can be moved and lifted.
- Individually manufactured components will have different installation standards and methods. In some cases installation will need to be undertaken by specifically trained personnel.
- In general however, there will be a need for site supervisors and site labour that has an understanding of modern terminology, the ability to read, understand and follow instructions on new materials and components, an understanding of the cost of damage to large components, and the ability to use tools for testing complex installations and identifying faults at an early stage.
- With a wide range of substantially different components, site workers will need a greater understanding of general building issues such as tolerances, air/water-tightness, and the interaction between components.

- There will possibly be a need for greater standardisation to facilitate familiarity and accuracy in use/installation of components while increasing the potential for economic scale production off-site. However, some would argue that increased computerisation and off site manufacture could permit more flexibility than is currently envisaged.
- Specific new trades could emerge, such previously as curtain wallers, and there will be different inspection and testing requirements. This might also apply to designers and engineers.
- MMC will require revised safety training for an environment with heavy lifting, greater heights, and more mechanised equipment.
- Off-site MMC will involve a very substantial shift of building skills from site to off-site. Depending on the level and extent of completion of finishes off-site, there might be a substantial reduction of bricklayers, plasterers, tilers, electricians, plumbers etc. on-site. Initially many of these trades will still be required in the off-site factories, but eventually, possibly rapidly, the level of skill needed will be reduced by the advantages of factory conditions and methods, in particular by having one skilled operator supervising a number of less skilled operators. Ultimately there appears to be the potential for even greater levels of automation, especially if large-scale production can be achieved through utilisation of processes and equipment developed in industries such as motor manufacturing,
- There will still be a requirement at factory level for full building technology knowhow, and an understanding of construction sites as well as new and traditional construction methods.
- There will be increased need for CAD trained building technicians to work on off-site design and application in factory conditions. An understanding of manufacturing methods will need to be combined with an understanding of construction methods.

The main methods of MMC are described below:

- Volumetric construction (also known as modular construction) involves the production of three-dimensional units in controlled factory conditions before transportation to site. Modules can be brought to site in a variety of forms ranging from a basic structure to one with all internal and external finishes and services installed, ready for assembly. A family sized dwelling might typically be manufactured in four modules plus a roof module.
- Panellised: flat panel units are produced in a factory and assembled on-site to produce a three dimensional structure. The most common approach is to use open panels, or frames, which consist of a skeletal structure only with services, insulation, external cladding and internal finishing occurring on-site. More complex panels, typically referred to as closed panels, involve more factory-based fabrication and may include lining materials and insulation. These may also include services, windows, doors, internal wall finishes and external claddings.
- Hybrid is a method, also referred to as semi-volumetric, which combines both panellised and volumetric approaches. Typically, volumetric units (sometimes referred to as ‘Pods’) are used for the highly serviced and more repeatable areas such as kitchens and bathrooms, with the remainder of the dwelling or building constructed using panels. The hybrid approach is sometimes used to provide added flexibility on complex sites

and those requiring additional communal areas. As with both volumetric and panellised approaches, the degree of factory-based fabrication is variable.

- Sub-Assemblies and Components include approaches that fall short of being classified as systematic off-site methods but which utilise several factory fabricated innovative sub-assemblies or components in an otherwise traditionally built structural fabric. Typically, schemes incorporating the use of floor or roof cassettes, precast concrete foundation assemblies, pre-formed wiring looms, mechanical engineering composites, etc. would fall into this category. Traditionally-constructed schemes utilising manufactured units – such as windows, door-sets, roof trusses etc., which might otherwise be part of the fabrication process in the other off-site categories – are not considered as sub-assemblies or components within this category.
- On-Site Modern Methods of Construction: this category is intended to encompass methods using innovative building techniques and structural systems that fall outside the off-site categories. The presence of innovation is an essential feature that might manifest itself through an innovative on-site building system, through a building technique familiar in one sector but new to another, or through traditional components being combined in innovative ways. Thin joint blockwork would fall within this category.

2.6.1 Other changes in construction methods

The use of robotics on-site is predicted, by some, as likely to increase in use for hazardous and monotonous work. However others suggest that very significant changes would be needed in on-site practice to allow much use of robotics on onshore construction-sites by 2020. There is wider agreement that there are significant opportunities for robotics in off-site manufacturing where the only constraint appears to be sufficient investment justified by sufficient volume of throughput.

On-site, new specialist tools, “intelligent” site vehicles and automated equipment have been suggested as ways of reducing the number of on-site personnel, thereby improving safety and reducing construction costs. Mechanisation could reduce the need for scaffolding and the number of people working at height.

Certainly the use of large MMC components will require much greater mechanisation on-site, but this may not necessarily lead to automation as the tasks will not necessarily be repetitive. Indeed, one of the points of MMC is to move repetitive tasks off-site.

Somewhat more futuristic, but feasible, is the use of personal mechanical aids to assist in the installation of larger components, along the lines of Robo-Cop. The training implications of such specialised equipment could be quite significant.

2.6.2 The extent and timing of off-site MMC

Off-site MMC could have a very significant impact on the requirement for site based skills on some sites over the period to 2020, but there are limits to its application.

MMC is not widely considered likely to have a very significant effect on the R&M market, which varies between 43% and 55% of total UK construction output, and in employment terms accounts for around 60-70% of the workforce under the four scenarios set out in the following chapter.

Civil engineering projects are also not likely to be greatly affected as they already use a significant proportion of pre-cast components, whether manufactured on-site or off-site (tunnel linings, pre-cast beams etc.) and the remaining components tend to be too massive to transport.

In contrast, new housing offers significant opportunities. Technically, MMC for building homes is already achievable and already occurs on a more significant scale in some overseas markets; a combination of cost, skill, inertia, required levels of investment, density and level of demand, and the attitude of home buyers and developers appear to be the main constraints on greater use in the UK at present.

Nevertheless, according to the Callcutt Review, in 2005 some 58,000 homes were built-in the UK incorporating some MMC methods. (Of these 42,000 were timber frame and another 8,800 were light metal frame). The 58,000 represented some 24% of total new-build housing in the UK. The Callcutt Review suggests that this figure could rise to nearly 70% by 2016.

In the short to medium term, MMC's impact on new-build is likely to be greater on larger building projects where repetition of components will justify the investment in off-site methods. There are estimates that up 50% of the value added to basic materials could be added off-site by 2020 on some projects in the sectors most likely to adopt MMC.

Another important impact arising from MMC is the possibility that components will not just be manufactured off-site, but manufactured offshore. Currently many of the more advanced housing packages are manufactured abroad. To keep value added within the UK, contractors and manufacturers will need to rapidly develop the right blend of skills for off-site manufacturing and ensure that there will be adequate demand to achieve the economies of scale demanded by such methods.

2.7 New construction materials

There is a wide range of actual and potential new construction materials, but most of these remain within the scope of existing methods of application or installation. The implications for training and skills are therefore generally, but not entirely, secondary.

There are a number of materials and methods used overseas that are not widely used in the UK at present, such as spray application of plaster, which could be more widely adopted in the UK given the right conditions. These and other developments in materials may allow the implementation of such labour/skill saving methods, leading to new training requirements and possibly a reduction in the number of tradespeople needed with existing skills.

However for many other improved materials, the main implication for training will be an increase in productivity as the result of using new materials, leading to a reduction in the demand for existing skills. These materials would also include those that allow labour saving design improvements, which are quicker and easier to apply, or which reduce maintenance.

These include additives to concrete to improve its properties and many theoretical or actual coatings. For example, Dulux has developed a white paint which is designed to save up on light fittings. There will be no difference in the labour content for its application, but it is claimed that

in the longer term it would reduce the number of light fittings, and therefore the number of lighting fitters, by up to 20% on a like-for-like basis on new-build.

Self compacting or high flow concrete is a “new“ material formed by using third generation additives to concrete. Its use produces a much improved surface to poured concrete and makes pouring and handling very much easier. It also reduces the need for vibrating concrete and has self levelling properties which permit easier finishing on horizontal casts. Some specific instructions in the use of the material are required, but the basic skills are largely the same as, or simpler than, traditional methods. There is labour saved in pouring and levelling, but additional requirements on the quality, water tightness and strength of the formwork. These are within the skill sets that already exist but may cause reduced productivity in formwork construction.

That said, to achieve productivity improvements using new materials, tradespeople need to be able to read, understand and implement the new instructions. Otherwise many potential improvements can be lost as tradespeople stick to old inefficient procedures that are no longer necessary or correct.

One on-site innovation, sometimes known as permanent insulated concrete formwork, is a building system made from interlocking hollow polystyrene elements that act as permanent formwork as well as permanent insulation. In situ concrete is then poured into the polystyrene framework. After installation of the formwork, the remainder of the on-site installation largely follows traditional methods with some minor enhancements and understanding of some specific issues. This dispenses with the use of traditional formwork trades. There are a few issues in design that would need particular attention.

An area of continuing development is composites, which can change the basic properties of certain components and allow more efficient installation methods and/or longer or more effective life of the component. (Glulam beams, Accoya –chemically treated wood, Parafil, honeycomb materials). Again many of the basic installation ConstructionSkills remain; the main effect of using the materials is at the design stage allowing, for example, larger spans or providing a wider choice of cost effective solutions. Designers will need to be aware of the possibilities, but the basic design skills will need little modification.

In summary, for many of the material innovations *currently foreseen* for new-build, there will be little impact on the basic type of skills required, although supplementary training may be required to familiarise trades-people in the use of specific products. They may, however, have a significant overall effect on the demand for ConstructionSkills as they will provide steady improvements in labour productivity. The rate at which such new materials are adopted is likely to be higher in scenarios in which there is international competition and transfer of knowledge than in the more insular scenarios.

Many proposed materials focus on repair or renewal. Some significant improvements in productivity could be achieved on specific tasks. These materials will occasionally require new skills in application or installation, but most material manufacturers are likely to seek to improve existing methods rather than replace them. Effective use of the new materials will require an understanding of what they do and how they improve the process and the ability to read and follow the instructions on the packet.

If new materials significantly changed the proportion of building/infrastructure faults that could be repaired rather than replaced, their use would involve a change in the balance of skill requirements.

It is noted that when new materials are used in conjunction with more traditional materials, they must not compromise the latter. Again the ability to read, understand and follow instructions on new materials will be important.

Nanotechnology is much vaunted as having potential in the construction sector. Nanotechnology can apply to the use of nano-physical effects in the manufacture of materials or components or, more futuristically, to the use of nano-machines. The use of new materials with nano-properties, such as self-cleaning glass, additives to cement etc, which are likely to be more widely used in the near future, do not appear to have very significant skill implications. Corrosion antibodies, corrosion-mending nano-bots (nano-robots), porosity modifiers and auto-modulus correctors that can be built into structures appear more futuristic, and are unlikely to be in use before 2020.

Micro “machines” such as radio-trackable tags for on-site material and components do appear to be early contenders, cost permitting, aiding the development of new logistics skills but requiring respect from site labour.

2.8 CO2 emission reduction and energy conservation in buildings

The future is almost certain to see continued pressure on builders, owner-occupiers and property clients to reduce the energy consumption of buildings under all four scenarios set out in the following chapter, although the nature, scale and speed of response is likely to vary.

Three main drivers of the development of renewable technologies are economic viability, mitigation of climate change, and energy security. These in turn are significantly affected by government policy and legislation.

The government has signed up to a number of carbon emission targets in recent years. The Kyoto Protocol and consequent Climate Change Programme set out proposals for meeting a target of a 12.5% reduction in greenhouse gas emissions in the period 2008-12 and in fact the target has been tightened further to 20% below 1990 levels by 2010. In the 2003 Energy White Paper, the government also pledged to cut current CO2 emissions in the UK by 60% by 2050.

The UK Chancellor’s 2008 Budget Speech raised the question of possibly increasing in the 2050 target from 60% to 80%. The other very significant current target is the requirement for all new housing built from 2016 onwards to be carbon neutral.

There are a number of ways in which reduced CO2 emissions from buildings can be achieved, including:

- a reduction in energy losses
- recycling energy
- reducing energy demand
- the use of low/zero carbon energy sources, namely, renewable forms of energy

- external factors such as building density, orientation of sites and buildings and local landscaping.

The implications for the construction industry are largely covered by:

- better insulation, greater airtightness and lower heat loss from buildings
- lower energy use in building services
- provision of recycling of energy (and water) in buildings
- construction of new energy sources, in particular low carbon electricity generation or solar heating systems
- possible changes in infrastructure construction as energy demand is reduced and activities such as transport suffer modified demand
- a wider understanding, on the part of designers, than simply the structural requirements of buildings

In addition there is scope for reducing the embodied energy (the amount of energy used in preparing and transporting and assembling the materials and components of a new building). As energy consumption in-use falls, conceivably towards zero, there will greater pressure on the industry to reduce the embodied energy in buildings. This could be challenging.

2.8.1 Controlling heat loss and reducing energy demands

In respect of the first three bullets above, buildings produce some 46% of CO2 emissions in the UK (excluding aircraft), and the sector is being targeted by government in the quest for reductions in CO2 emissions.

Housing emits around 26% of UK emissions of CO2. The government has set the standard that all new housing will be carbon neutral (by an as yet not fully defined measure) by 2016. The HBF claims that private sector house builders are fully signed up to achieve this target – although what build volumes will be achieved under such targets remains a matter of debate. Adequate technology is available (at a cost) either in the UK or abroad, so a relatively high level of implementation, given continuation of current government attitudes, appears fairly certain, in the Base Case and in most of the scenarios.

Nationally, Energy Performance Certificates (EPCs) – or asset ratings included in HIPs – will be required for all buildings sold, let or constructed from later this year.

There is also a growing requirement from local authorities, especially on major developments, for a full assessment of the energy demand and CO2 emissions from the proposed project, and in an energy conscious scenario this trend is likely to filter down to smaller schemes. The assessment will demonstrate the expected energy and CO2 emission savings from the energy efficiency and renewable energy measures incorporated in the development, including the feasibility of combined heat and power and community heating systems. It will form part of the sustainability statement for the development.

To achieve full carbon neutrality requires changes in occupation practices, highly efficient white goods and other equipment within the building and, it appears, some relatively expensive contribution from renewable energy associated with the building. However, whether the carbon

neutral target is achieved or not, it appears likely that the fabric of new buildings will be required to perform at near zero heat loss. The means to achieve this are generally available and understood, using high levels of insulation, excellent airtightness and efficient ventilation systems.

Indeed, to have sufficient people trained to reach the 2016 zero carbon target for housing action is probably already urgent.

However the implications of this on future skills requirements are significant. Very small imperfections in construction can have very substantial implications in meeting the energy standards. There will need to be considerable changes in attitude to construction techniques accompanied by an understanding of the impact of actions and inactions by an individual on the final energy certificate.

Increasing demand on house builders to reduce the environmental impact of homes, in particular carbon footprints, may force a move to MMC to assist in the use of better materials, and improve the quality of construction, particularly for air tightness and insulation.

There will also be demands for new ConstructionSkills on-site. These are not yet clear cut but will be driven by growth in the use of new equipment such as heat pumps, heat (and water) recycling and local micro-generation systems. A review of the expected possible net changes is given below.

2.8.2 Retro–fit for reducing energy loss

Improving new-build energy conservation alone cannot meet national targets for reducing carbon emissions. In terms of mitigation of climate change, much larger gains can be made by increasing the energy efficiency and promotion of microgeneration for existing buildings. GB residential completions totalled around 210,000 in 2007 against a residential stock of close to 26 million. The bulk of the emissions come from existing stock and will continue to do so for many decades, given the current and likely future rate of replacement.

There is likely to be pressure to increase the retro-fit of domestic insulation, installation of energy saving equipment and replacement of inefficient components such as windows and doors, especially in scenarios in which sustainability is seen as important. This will help to maintain the demand for traditional building skills, installing components and equipment into existing buildings. While the systems/materials being installed may be new, and they may require a certain amount of training to understand installation needs, the main issues will be an understanding of the building in which the new products are being installed.

In some cases, new products will be needed to enhance the U-values of existing buildings, but there are still many buildings that could be considerably improved with existing products, materials and installation skills.

Such products include:

- Improved glazing
- Replacement windows/doors to reduce draughts
- Superior loft/roof insulation
- Cavity wall insulation

- Improved energy controls, meters and instrumentation

Other products which could, with improvement, be more widely used in the future are:

- External/internal wall insulation
- Under floor insulation and draught reduction
- Energy recycling (water and air)

However owner-occupier expenditure, especially in the residential sector, is dependant on the existence of adequate funds and is a matter of choice; environmentalism will be competing with other improvement expenditure, such as the new sofa, kitchen or hot-tub. Historical evidence suggests that should there be a significant increase in expenditure on energy conservation in the existing building stock, there may be compensating reductions in other improvement expenditure.

Overall, for the retro-fit energy conservation market, apart from adapting to changes in equipment and materials, few new skills seem likely to be needed. The size of the market will depend on regulation, energy prices and general economic well-being, but may not cause a significant net increase in expenditure. However, should the market grow, even at the expense of other sectors, as is suggested in at least two of the scenarios, there will need to be a significant increase in the numbers of suitably trained tradespeople.

There could be a growing split in the type of skills required from those working on large new-build contracts and those working on small scale refurbishment and R&M.

2.8.3 Low carbon energy sources

There are two aspects to renewable energy. At a national level, as already noted, the government is currently committed to reducing carbon emissions by 20% by 2010 and by 60% by 2050, and will need to ensure that a higher percentage of UK electricity generation is produced by nuclear generation and by renewable methods (wind, tide, biomass etc.), and/or by ensuring that CO2 emissions from fossil fuels are reduced through the use of techniques such as carbon sequestration. A core element of government policy is that, by 2010, 10% of UK electricity should come from renewable sources.

This very substantial change will require enormous investment in energy infrastructure. However, some of this investment will simply be the scheduled and necessary replacement of existing power sources at the end of their life by new plant, albeit probably more expensive and demanding some different skills for its construction. The rate at which the investment occurs will depend on the level of economic growth and potential energy demand, on capacity in the construction/process industry, the will and funds to invest, and political decisions on the type and location of the new generation capacity, as discussed under the four scenarios.

The other aspect of renewable energy is the possibility of micro-generation plant attached to or close to buildings, either new or existing. The 2003 White Paper highlighted the potential contribution that micro-generation could make towards the UK government's targets and suggested that there should be much more local generation of power than is currently the case. Although the jury is still out on the effectiveness, economics and feasibility of microgeneration at the individual building level, the most likely contenders for microgeneration are reviewed below.

- Solar water heating takes energy directly from sunlight to heat water for heating or domestic supply. Currently only marginally economic, energy price increases will make solar water heating more attractive. Roof loadings, roof aspects, and connection to an existing system are, however, all issues which affect retro-fit in particular.
- Photovoltaic systems, converting sunlight directly to electricity, are also largely uneconomic for provision of electricity to buildings in the UK at present and require considerable upfront investment. Again energy price rises and a possible fall in manufacturing costs could make installation more attractive. Roof loadings and connection to the electricity system are once again practical issues.
- Cogeneration or combined heat and power, the production of hot water and electricity, on a very small-scale local level, is not widely accepted as a practical proposition. On new-build sites where an adequate level of demand for hot water and electricity can be satisfied, there can be clear efficiency gains and frequently economic advantages. However, on retro-fit where cogeneration would be displacing existing infrastructure, and on small new-build sites where total demand would be too low to provide consistent base load, the economics are very weak.
- Ground source heating/cooling, using the small temperature differences between ground level and several metres below ground level to provide low grade heating/cooling, enhanced sometimes with heat pumps, is effective in some circumstances. It requires quite substantial on-site excavation and access to a sufficient area of land, so it is often not suitable in densely built -up areas.
- Micro-wind turbines are also proposed for individual buildings, but do not appear economic for most buildings in the UK. Indeed in urban areas they can even fail to produce carbon savings if their embodied carbon is fully accounted for.
- The use of renewable/bio-fuels is being promoted by some, but is currently getting a negative press for a wide variety of reasons. For heating property in the urban context, there are views that the use of bio-fuels, such as wood chips, has a number of drawbacks, including high cost and even carbon inefficiencies, if transport is fully accounted for. Bed-Z has decommissioned the bio-fuels side of its CHP plant.
- Many of the micro-generation methods have significant planning permission implications, in spite of some major local authorities already promoting their use. Scenarios in which government is promoting sustainability are likely to see quicker take-up.
- Ultimately many domestic users of energy will base their decision to install renewable technologies on payback times. There are views that until agreements are reached with energy supply companies around minimum tariffs for power generated by microgeneration systems and sold to the national grid, some technologies may never realise the sort of payback times that will make them viable for the domestic sector.

In spite of the obstacles, individual owner occupiers may be interested in having micro-generation on their properties, either to reduce energy costs, for energy security, through altruism or self-preservation, or to meet the regulations demanding low or zero carbon buildings, such as the Merton Rule under which local authorities are permitted to require *on-site* renewables on new developments.

Micro-generation might also be a means of reducing the carbon emissions of the existing building stock when other economic methods of reducing energy consumption are exhausted.

However the economics of this are likely to require substantial increases in the cost of energy or regulations imposing low carbon emissions. Slightly perversely, it appears that a positive effect of the Merton Rule has been to persuade developers to spend more on reducing buildings' energy consumption to reduce the need to install very expensive micro-generation plant.

The overall net changes to skill requirements on new-build construction, as a result of the need to reduce CO2 emissions and other sustainability issues, are shown below. The changes are annotated with the relevant driver (CO2, water conservation, other general changes):

- Greater use of off-site manufactured components to assist in air tightness. (CO2)
- Greater use of packaged water and electrical control systems for managing energy and water usage. (Water)
- Reduction in wet plastering as a result of greater use of prefabricated components, but contrarily, wet plaster is very effective in producing airtightness. (CO2)
- Reduction in plumbing in line with a reduction in the use of wet central heating systems, (CO2) but an increase in water-based solar heating systems and in water re-use (see below) and probably growth in washing/shower facilities. (General)
- Increase in mechanical air heating/cooling systems, heat recovery and forced ventilation. (CO2)
- Little change in electrical power circuits, but an increase in electrical control systems, and growth in low voltage systems and wireless systems which can be installed by unqualified electricians. (General)

Without substantial change in current government policy, the carbon emissions requirements on new-build housing and other buildings will require the changes above to be in place by 2016.

2.9 Other sustainability issues

2.9.1 Water

Trends in the domestic and commercial use of water and problems in dealing with more aggressive patterns of rainfall, as an early result of climate change, make it likely that there will remain considerable demand for plumbing in some form, even though more may be installed off-site. Demand for items such as a third tap for filtered drinking water, hot tubs and pressure showers all add to the complexity of supply. Possible legislation for the reuse of grey water and storage and use of rain water would also increase complexities.

Predicted increases in storm frequency, compounded with more immediate issues related to building on flood plains and loss of absorption capacity in the ground, will place more pressure on drainage systems (as, paradoxically, will the reduced flow in foul water systems if too much grey water is recycled).

Designs for housing and other buildings and infrastructure will also need to consider the effect of development on the local environment with regard to "heat islands", water usage, rain run-off, the use of local resources etc.

2.9.2 Waste

Local and central government are already seeking to reduce the amount of construction waste produced. The construction industry produces 18% of total waste arising in the UK (90 mtpa), and landfill taxation is increasing. Manufacturers generally are being required to provide for recycling of their products, and this form of regulation is likely to broaden in scenarios promoting sustainability. Some local authorities are targeting large construction developments to promote recycling and the use of recycled materials, sometimes as part of planning approvals. Site operatives still need further training in avoiding waste, then segregating waste. New roles in site management of waste may develop In some scenarios.

Legislation on waste may also impact on demolition. New skills will be needed in maximising the recycling of demolished materials and in demolition methods to improve recovery.

Already there is talk by clients of construction-sites generating no off-site waste, and the Strategy for Sustainable Construction produced by the Department for Business Enterprise and Regulatory Reform has a target of zero construction waste to landfill by 2020.

There may be trends towards the use of new materials and components to allow greater use of temporary buildings, or improving the adaptability of some buildings, to reduce buildings' redundancy and subsequent demolition. These will include such measures as easily assembled/dismantled components and screwed removable pile foundations. This in turn will involve new skills in installation, dismantling and conservation.

2.10 Market forces, client attitudes, other regulation

The current government is keen to increase the number of homes being built to meet demand due to demographic changes, as may be the case in several of the scenarios. There is at present pressure to increase the number of affordable homes built.

The Housing Green paper of July 2007 talks of increasing total new housing supply in England from 175,000 completions in 2007 to 240,000 per annum by 2016. It also proposes that the number of new affordable housing units should be 70,000 p.a. by 2010/11, of which 45,000 will be social housing, a doubling since 2004/5. The need for additional housebuilding is likely to continue, but to varying degrees and levels of achievement in the four scenarios described in the following chapter.

In particular, given the government target that all housing will be carbon neutral by 2016, and given the government's own estimates that the extra cost of a zero carbon home currently stands at £35,000, future governments within the scenarios will need to be solidly convinced of both targets to provide the funding to meet them. While the cost of zero carbon housing is likely to come down in the future, there is likely to still be a significant premium for a carbon zero home, and this may be at odds with the target of 240,000 homes including a substantial amount of affordable housing.

To meet any increased demand for new housing, there is widespread belief that there is need for increased use of MMC, partly because of a shortage, perceived by some, of necessary building skills, but also because of speed and potential cost savings if sufficient volume can be

achieved. However house-buyer conservatism or even a shortage of MMC skills could slow the uptake of MMC in private housing.

The demand for new housing, coupled with the political need to re-use brown-field sites, will lead to development of increasingly difficult sites. There is likely to be continued demand for site clearance and decontamination.

There may be changes in density specifications for housing leading to more storeys and different house designs and structure. There will be new issues in relation to sunlight and noise. Neighbourhood and in-house noise in the use of buildings remains an issue with modern structures (and conversions) and may become worse if housing densities increase. Tolerance of noise is reducing as its production increases. Noise on construction sites is already being addressed by local government and controls are only likely to increase.

The constraints on space in new housing will require flexible interior areas to allow future alterations as household requirements change, ideally without structural alteration.

There is likely to be increased need for new-build or retro-fit to accommodate the disabled, the frail and the elderly, through a combination of regulation and demand.

Regulation can also stimulate demand for specific trades. There is already increasing regulation controlling what DIYers are allowed to do in their own homes, in regard to gas and electricity installation and maintenance. This sort of regulation could increase further under certain scenarios, leading to a modest increase in demand for accredited tradespeople (CORGI etc).

There is also likely to be demand for more controls, instrumentation and gadgets in housing to increase security, energy efficiency, comfort and entertainment, including remote operation. Housing Associations are already installing sensors, telemetry and warning systems in houses with vulnerable old residents to help their independence and safety. It is increasingly likely that these will be wireless devices, for communication. Power supply is still likely to require power cables (or batteries) for the foreseeable future. Nevertheless an unsuspected suitable advance in power supply, or a switch to low voltage supply with consequent significantly reduced skills levels and safety regulation for installation, could be rapidly adopted by existing homeowners.

Government is suggesting that private developers should integrate security devices and components into buildings to counter “terrorist” activities. This includes making buildings safer for occupants and the general public in the event of a bomb or other attack.

2.11 General training issues

There are diverse views on the need for specialist skills, for multi-skilling, or for de-skilling. In practice the term de-skilling is probably more accurately re-skilling. In some scenarios there may be a narrowing of the existing skill base of some trades, but all trades are likely to need training and re-training to cope with the new methods and materials that may emerge in the innovative scenarios, even if their use is apparently more simple. On balance the most probable outcome appears likely to be a blend of specialist skill, multi-skilling and re-skilling, but in any given scenario there will be a different blend.

Any increase in MMC will lead to greater specialism in off-site activities, coupled with a narrowing of skills where possible, to make the most of manufacturing methods. Work and training for most of the labour in a “construction factory” may involve supervising machines rather than operating them. However, generalists and specialists with construction experience will still be needed for supervision of less skilled labour in the factories, and technicians will be required to provide the parameters for setting up the machines.

Growth in the use of on-site MMC in the more innovative scenarios will lead to a need for highly trained generalists, capable of assembling complex components. However there is likely to be a counter balance between the generalists, probably employed by the main contractor or subcontractors, and a growing number of highly specialised employees/agents of manufacturing organisations who will come on-site with their products and install them.

Demand for multi-skilling in the more innovative scenarios will arise from the need to install more complex pieces of equipment, requiring the skills of different trades. In addition, more complex logistics would be greatly simplified with more multi-skilled staff. Apart from the need for certification under regulations for particular tasks (gas and electricity in particular), the main components of multi-skilling will be ongoing safety training, and a greater comprehension of the consequences of not following installation instructions on specialised and often large and expensive components. This is in addition to the need to understand the implications of components being imprecisely fitted. This will apply in R&M and on new-build.

In any innovative or progressive scenario, there would appear to be a strong case for the claim that there is a need to continually raise the standards of most people entering the industry at all levels – design, manufacture, building and maintenance – although at some levels, particularly in off-site manufacturing, skill levels might be reduced or at least very strongly specialised.

Calls for a universally accepted passport scheme, to which all on-site construction workers across Europe could be accredited, or an accreditation scheme for UK workers which could acknowledge health and safety awareness and skills and knowledge capability, seem plausible in most future scenarios, particularly in those that invoke greater international trade in construction.

Government is using the National School for Government to improve public purchasing skills including special skills for procuring construction work. Similar work is focused on improving the public sector’s skills in sustainable development. This should provide some impetus in improving supply side skills in meeting client needs and understanding sustainability, particularly in scenarios where there is a higher level of government involvement in the construction sector through regulation and/or high levels of government expenditure.

There is a fairly consistent view that there will remain a difference between the new skill requirements in R&M and new-build. R&M will continue to require traditional skills to deal with traditional buildings and materials even though there may be improvements in the materials available. There may be changing views as to what is achievable in R&M, particularly in the field of energy conservation, and this could lead to substantial increases in R&M work in the more sustainably conscious scenarios.

3 Scenarios for construction

3.1 Introduction

This chapter provides, for each of the four alternative scenarios, an overview of the economic and political backdrop, before setting out in more detail the envisaged level and composition of demand and *modus operandi* of the UK construction industry. As noted earlier, we have used the Foresight Futures 2020 scenarios to provide the economic and political framework for developing our construction scenarios, and for clarity and consistency, have consequently adopted for our construction scenarios, similar scenario names to those used in the Foresight Futures 2020 report. We also wish to emphasise that the summary descriptions of the Foresight Futures 2020 scenarios set out below are our own, and responsibility for any changes in emphasis, variations in detail or interpretation from the original again lie with ourselves, not with the original authors.

3.2 Scenario One – World Markets

World Markets is a world driven by aspirations of personal independence, wealth and mobility, a belief in the efficacy of integrated global markets and internationally co-ordinated policy, and a philosophy of “limited government”.

3.2.1 Economic and political framework

Under the World Markets scenario, individuals want to improve their own lives and are less concerned about equality and the effects that inequality may have on society as a whole. Economic and income growth are strong but uneven, and the gap between rich and poor countries, and between rich and poor individuals within the UK, continues to widen. Social tensions increase.

Consumerism is to the fore; business is focused on developing global markets; global competition intensifies; and fewer firms and brands, many multinational, come to dominate many sectors. Global standards emerge for many products and services.

In the UK, services are the main engine of growth, particularly healthcare, leisure and travel, financial services, media and entertainment, education and information services.

New technologies are adopted rapidly, dominated by ICT. Driven by international competitive forces and the international spread of best practice, UK productivity improves strongly and accelerates structural change. The application of biotechnology increases, transforming the health and food industries in particular, and nanotechnology starts to have an increasing effect in a number of sectors.

The labour force is highly mobile, reflecting increased globalisation, strong economic growth, a general weakening of labour market regulation and international competition for skilled workers. Tele-working and flexible employment arrangements become more commonplace. Individuals with professional and other marketable skills flourish, but the unskilled, many of whom are immigrants filling low-paid service jobs, tend to be marginalised as benefit systems are squeezed.

Government becomes more international, with various aspects of economic and financial management, commerce and trade passing to, and co-ordinated by, global institutions, while domestically there is some further devolution of power to regions.

There is popular pressure to cut taxation. Public spending and the direct role of the government in providing healthcare, education and other social services are consequently reduced. More public services are privatised or become privately managed.

Self-regulation becomes more important, with a belief that corporate social responsibility can be relied upon to deliver desirable outcomes. Planning controls are relaxed.

Progress in reaching an international accord on tackling the effects of climate change is modest, and the agreements and targets reached are relatively limited in scope and vary between countries. Minimum standards of social and environmental policy are achieved through the international legal framework and are further enhanced through using a market-based approach of pricing, traded permits and incentives, but this action proves insufficient to cut greenhouse gas emissions.

Nevertheless, energy prices, although relatively high, remain fairly stable in the absence of supply disruptions, some limited success in constraining the rate of growth in carbon consumption, and greater international collaboration to develop available oil and gas reserves. Concerns over energy efficiency, security and climate change consequently remain internationally somewhat muted.

Key features of the World Markets scenario and implications for construction, discussed in detail below, are summarised in Figure 7.

Figure 7: Key features of the World Markets scenario

World Markets
• Globalisation continues with emphasis on open markets • High level of growth, trade and investment, but with some volatility • Privatisation/private management of public services • Limited government, lower tax, constraints on public sector spending • Greater social inequality • High labour mobility, international competition for skills intensifies, continued inward net migration particularly among lower-skilled • Stable energy markets/prices • Reliance primarily on market-based mechanisms/pricing to secure energy saving with limited success in constraining demand/carbon emissions • Rapid innovation, international contractors dominate on major projects • Off-site construction/controlled environments increasingly adopted, buildings and infrastructure much more ICT intensive • Emphasis on self-regulation, relaxed planning controls • Strong new housing demand, particularly private sector, affordability issues • Manufacturing further marginalised, emphasis on high-tech and services • Commercial & infrastructure construction buoyant

3.2.2 Construction

3.2.2.1 General

UK construction demand benefits from the high level of economic growth, trade and investment.

Major projects increasingly become the preserve of international or internationally owned professional practices and construction companies which, operating in a highly competitive environment, drive rapid innovation in technologies for the built environment and the spread of international best practice.

International competition for professional and skilled construction labour increases as other overseas construction markets experience robust growth, leading to a reversal in the inward flows of skilled manual labour from eastern Europe seen during the early years of the current millennium. Professional practices experience growing international competition for staff.

Off-site fabrication and modular construction are increasingly adopted under pressure to achieve improvements in productivity and accelerate build times on-site, also against a backdrop of UK government zero-carbon new-build targets. Reflecting the nature of the products being supplied and the greater precision and/or specialist knowledge often needed for installation, more manufacturers provide a supply and fix service, using in-house labour or requiring the use of approved installers. Others also start to supply a maintenance package. ICT becomes an essential element in the planning, design, management and maintenance of new residential, commercial and public buildings, with progress in achieving common standards leading to greater interoperability of systems. There is an increased degree of integration of supply chains, particularly for major projects, including greater off-shore sourcing of materials and services.

Relaxed planning controls lead to more development on green-field sites, particularly in Greater London and the South East where economic growth and development pressures are strongest.

3.2.2.2 Housing

Rapid growth in GDP, high labour mobility, inward migration at both ends of the skill spectrum and a continued trend towards smaller households all act to support strong growth in housing demand, particularly around major centres of economic growth such as London and the South East.

Private sector housing activity continues to grow in absolute terms, particularly in the middle to upper reaches of the market. A greater prevalence of home-working, security issues, and developments in media, home-entertainment and ICT together lead to more intensive use of electronic and control systems in the home. Sustainable building codes lead to greater off-site manufacture with a variety of design solutions and construction methods being used to meet energy performance requirements, albeit at a cost due to consumer resistance to high density development.

With strong competition for available land, house prices are driven further upwards, exacerbating affordability problems for the lower-paid, many key workers and the socially disadvantaged. A belief in the efficacy of markets and pressure to reduce tax also constrain the

level of government financial support to the social housing sector, at a time when pressure of demand is increasing. RSLs and other social housing providers are consequently forced to resort to financial innovation, utilising their balance sheets effectively to generate additional sources of funding. Notwithstanding, any aspiration of decent homes for all is only partially met, segregation between the wealthy and the disadvantaged becomes more marked, deprived urban areas deteriorate, and “gated communities” grow in number.

3.2.2.3 Public non-housing

The level of public non-housing construction, as a percentage of GDP, recedes from the high levels achieved during the early years of the current millennium, as investment in renewal and upgrading of public sector health and education facilities plateaus out.

This slow-down in capital spending on public sector health facilities is reinforced by government’s policy of promoting greater private sector management and provision of health services, and by the growing importance of primary care, preventive medicine and medical rather than surgical intervention. Routine surgery is increasingly delivered through locally-based facilities supported by regional high-tech diagnostic and specialist treatment centres.

In education, ICT and distant learning assume growing significance, with private sector organisations and employers playing an increasingly proactive and important role in further and higher education and in continuing post-school training and development of the workforce in general, as the government generally withdraws from areas of activity where state provision and intervention is deemed unnecessary.

There is a steady and progressive shift towards greater use of off-site production and modularisation, with increased emphasis on energy efficiency, security and other ICT-based building management systems, on such new public sector facilities as are constructed.

3.2.2.4 Private industrial

The UK manufacturing sector is further marginalised as traditional manufacturing in primary and low-tech industries continues to experience growing competition from newly industrialised countries and other lower cost centres of production. Growth does occur in high-tech science and engineering-based manufacturing clusters, but with increased levels of international trade and competition and with the service sector forming the main driver of UK economic growth, warehousing and distribution, as against manufacturing, form the principal component of private industrial investment.

Major distribution centres see increasing levels of automation as advances in the science and application of ICT result in further significant increases in the integration of global supply chains.

To the extent that investment does occur within the manufacturing sub-sector, the focus on high-tech activities and the research, development and design end of the process results in increasingly sophisticated, service-intensive facilities incorporating high quality finishes and environmental controls.

3.2.2.5 Private commercial

Private commercial sector construction is buoyant as growth and investment is focused on the distribution and service sectors, both business and personal, and as the scale of the built environment consequently increases.

Financial and business services enjoy rapid growth. Coupled with competitive pressures for an efficient cost-effective working environment of a standard sufficient to help to attract and retain the required calibre of worker in an international marketplace, this leads to further investment in the construction of new high quality office space and the refurbishment of the existing stock.

Rising personal income levels support robust growth in retail spending as well as in leisure, entertainment and other personal services, resulting in an upgrading of many city centres as the leisure/shopping experience becomes increasingly integrated, as competition from the internet intensifies, and as work pressures lead employees to demand convenience of access to such facilities from their workplace. Demand for a higher level and quality of service provision is also accompanied by an increase in covered and conditioned environments within city centres, supporting growth in new, and upgrading of existing, malls.

Private sector investment in health and education continues to flourish as a result of higher living standards in general; a political philosophy that favours private provision; continued growth in demand for higher skills and hence training; and increased demand for health service provision from an ageing population and one that has higher health aspirations and expectations, in part due to medical advances.

The cost of energy, carbon permits, zero carbon new-build targets and a general drive to reduce costs due to overall competitive pressures have led to a steady increase in the level of awareness and attention to sustainable and energy efficient design in the new private commercial building sector as a whole, but action to tackle and upgrade the existing stock lags.

3.2.2.6 Infrastructure

Fossil fuel, particularly gas, still dominates. Electric power generation expands to meet demand with port and pipeline systems being developed to handle a greater level of fuel imports. Investment in nuclear generation proceeds, although progress with respect to current government plans has suffered some delays due to financing and planning issues including pressure from lobby groups. Investment in other fossil plant consequently occurs to plug impending shortfalls in generating capacity. Investment in renewable sources of energy remains relatively limited as tax and other price incentives – while encouraging energy efficiency and various energy saving initiatives – prove inadequate to bring about a significant increase in their commercial viability.

High levels of trade and commerce, labour mobility, housing development and tourism together create strong demand for transport services and infrastructure to serve both business and leisure needs. New investment occurs in airports and seaports, in the road network, and in the modernisation and upgrading of the rail system, although the emphasis is on private sector facilities and provision, rather than heavy investment in new facilities owned and operated by the public sector. Car ownership and usage continues to show robust growth, and the government resorts to manufacturer emission targets and to traffic pricing and management systems to control traffic levels on the main road arteries and as a gesture towards reducing carbon emissions. The secondary road system, however, becomes increasingly congested.

Rapid growth in the development, integration and application of ICT across the economy leads to continued investment in the country's communications network.

Economic growth and concern over more variable weather conditions, including rainfall regimes, spur continued investment in the water supply and sewerage system and in flood defences. Pricing, metering and efficient management of water resources and their usage becomes progressively more widespread.

3.2.2.7 R&M

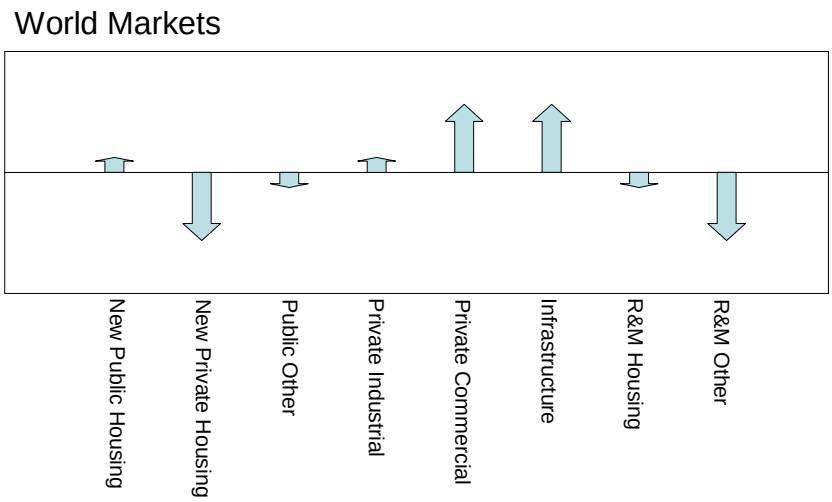
Strong economic and personal income growth in general benefits the R&M sector which continues to increase in volume.

While new buildings incorporate higher levels of energy management and efficiency, changes in building standards and targets together with increases in energy prices have been insufficient to encourage a major retro-fit programme on the existing building stock where growth in the installation of better insulation and energy efficient appliances has been steady rather than rapid.

3.2.3 Relative construction output changes under the World Markets scenario

Figure 8 schematically shows the outworking of the World Markets scenario in terms of shifts in the relative proportion of UK construction output in 2020 by principal work sector compared with the proportionate split prevailing in 2006.

Figure 8: Changes in work mix in 2020 compared with 2006



3.3 Scenario Two – National Enterprise

Under National Enterprise, people aspire to personal independence and material wealth, embracing liberalised markets as an effective means by which they can achieve these goals within a nationally-rooted cultural identity and with a high degree of national self-reliance and security. Political and cultural institutions are strengthened to buttress national autonomy in what is a more fragmented and regionally unstable world.

3.3.1 Economic and political framework

The National Enterprise scenario assumes that people value the freedom to do as they choose, but within the context of an independent United Kingdom and one which has a strong national identity. Political power consequently resides primarily at national level, and regional devolution is limited. National interests and identities within Europe have generally come more to the fore, and the UK's relationship with the EU has become arm's length. More widely, international collaboration is primarily limited to traditional areas such as security and defence, trade and immigration.

As in the World Markets scenario, market values dominate. However, issues of national interest result in government policies that provide an element of protection and support to key national industries (such as utilities, infrastructure, pharmaceuticals, aerospace, finance, media) and constrain the full force of international competition. Managerial and technical innovation and productivity growth are all consequently lower, as are long-term economic growth, per capita income and levels of international trade.

A belief in private enterprise, coupled with a relatively low level of public concern about social equality and exclusion, encourage a climate of reduced personal and corporate taxation and constrain government spending. Government consequently pulls back from provision of healthcare, education and other social services where greater private sector participation is instead encouraged. A stronger sense of national identity coupled with greater concerns over security do, however, lead to a greater level of spending on defence.

The ICT sector flourishes, but its impact is less pervasive than under the World Markets scenario and does not provide the same impetus to innovation and structural change.

Labour markets are further deregulated, but the positive effects on job creation, in terms of improved labour flexibility and cost, are insufficient to offset the impact of slower growth in the new dynamic sectors of the economy. The consequence is higher unemployment, increased wealth disparities, longer working hours, particularly for the lower-skilled, and an increase in social tensions. Government consequently moves to limit the level of immigration.

Manufacturing is less exposed to international competition, moderating the pace of decline in more traditional and lower-skilled areas of activity. However, levels of innovation and investment in the higher-tech sub-sectors are also correspondingly lower, as is foreign direct investment. SMEs serving niche domestic markets fare relatively well, but tend not to be investment-intensive.

The service sector grows moderately, particularly in the areas of finance, healthcare, tourism, retailing and personal services for the more wealthy. The informal service economy also flourishes, providing work for the increasing numbers of people excluded from the mainstream job market.

Regulation of the environment resides at national, rather than international, level with relatively little institutional or policy change. Cost and security of energy supplies is, however, a key concern, and there is consequently a drive by government to encourage energy efficiency and exploit domestic sources of energy including coal, gas, nuclear power and renewables. Market mechanisms including pricing are primarily relied upon to achieve the desired increase in security of supply.

Key features of the World Markets Scenario and Implications for Construction, discussed in detail below, are summarised in Figure 9.

Figure 9: Key features of the National Enterprise scenario

National Enterprise
• Swing from globalisation to national autonomy, market values dominate, some protectionism, inequalities of income distribution • Medium GDP, trade & investment growth; fall in foreign direct investment • Slower decline in traditional manufacturing but less growth in high-tech sector • Moderate growth in services, nationally rather than internationally focused • Constraints on tax, public finances, public spending & public services • Less intensive competition, moderate pace of innovation & application of ICT • Greater security concerns and investment in defence • Cost and security of energy a key concern: drive to encourage energy efficiency and domestic sources of power including nuclear & renewables • Limited investment in other new infrastructure • Limits imposed on inward migration of labour; slower population growth; little growth in new housing investment which remains predominantly private sector • Limited further "internationalisation" of major contractors & projects • Slower uptake of best practice, new technologies and off-site construction • Repair, maintenance, refurbishment & conversion of existing structures proportionately more significant vis-à-vis new construction

3.3.2 Construction

3.3.2.1 General

Compared with the World Markets scenario, GDP, investment and international trade all expand more slowly, and the level of labour mobility and immigration is much reduced.

The construction sector suffers in particular from lower levels of investment in new housing and infrastructure. Maintenance, refurbishment and conversion of existing structures assume proportionately more importance.

Competition within the construction sector and the "internationalisation" of major contractors and projects has not achieved the same level as under the World Markets scenario, and the rate of innovation and spread of international best practice has consequently been slower. As a result, while there has been some continued growth in off-site construction and productivity, traditional construction techniques continue to predominate. Much of the sector remains labour intensive with fragmented supply chains.

3.3.2.2 Housing

Slower GDP and personal income growth, coupled with a much reduced rate of net inward migration, lead to a lower rate of growth in demand for housing primarily among smaller households.

Methods of housing construction and innovation within the home have proceeded only slowly, although concerns over security and cost of energy supply have resulted in changes in building standards, leading to higher levels of insulation and installation of energy efficient appliances as well as some growth in the use of solar panels and photovoltaics in new housing developments.

The private sector continues to account for the major share of new housing construction, as pressure on government finances coupled with a market-oriented philosophy leads to a low level of public sector investment in social housing, and as RSLs and other social housing suppliers are slow to innovate with respect both to alternative sources of funding and types of product and service provision. Relatively modest progress is consequently achieved in increasing the stock of good quality affordable housing, although slower growth in overall demand helps to temper some of the associated pressures.

New housing development largely takes the form of additions to existing towns and villages, but some new developments are established in green-belts and the countryside as a result of weaker local planning controls designed to encourage economic development.

3.3.2.3 Public non-housing

Construction of new facilities in the public non-housing sector is constrained by the decline in social service provision, pressure on government finances and a philosophy which favours private sector provision wherever possible.

Following a high level of investment in new schools and hospitals during the first decade of the current millennium, the emphasis of public sector non-housing construction has become one of refurbishment, updating and extension of existing public buildings rather than one of construction of major new facilities. Improved energy efficiency and management has become an important element in such construction work.

As noted, a more politically volatile and uncertain world coupled with increased security concerns has resulted in an increase in overall defence spending, and this has in turn resulted in new and refurbished housing and other defence facilities for the armed forces.

3.3.2.4 Private industrial

In terms of manufacturing investment, any benefits from a reduced level of international competition and increased protection for key national industries is more than offset by the negative impact on growth of high-tech manufacturing activities and foreign direct investment. Consequently, private new manufacturing construction falls in relation to GDP.

The overall reduction in economic growth and international trade also results in an accompanying reduction in the growth of demand for construction of new distribution facilities.

Such investment as there is in the private new industrial construction sector predominately comprises small to medium-sized facilities of a relatively low-tech nature.

3.3.2.5 Private commercial

While the NHS and state school system remain the source of provision for most people, government policy and spending constraints mean that those that can afford to do so make increasing use of privately-funded services which enjoy steady growth.

Continued but unspectacular growth in the business and personal services sectors supports ongoing modest growth in demand for office accommodation, retail space and tourism and leisure facilities, resulting in a combination of new construction and refurbishment programmes as retail, leisure and other businesses seek to compete for customers and maintain a “fresh service offering”.

3.3.2.6 Infrastructure

With cost and security of energy supplies becoming a key concern of government, there is a drive to encourage energy efficiency and exploit a range of domestic sources of energy including coal, gas, nuclear power, waste-to-energy plants and renewables including, in particular, solar power and wind energy. The life of existing power stations is extended as a stop gap, and work commences on a new generation of nuclear power stations.

Investment in the transport sector is relatively limited, reflecting pressures on government finances, slower growth in the economy and international trade, and higher energy prices. Congestion increases.

3.3.2.7 R&M

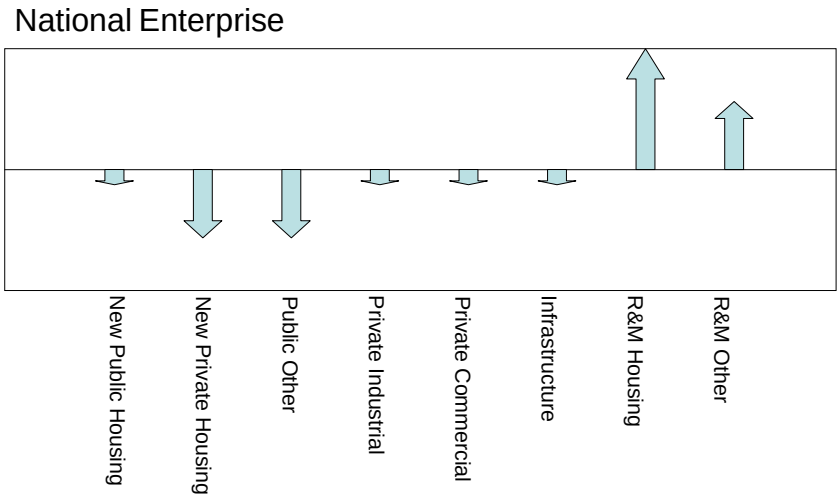
As already noted, under the National Enterprise scenario R&M grows proportionately in importance as slower economic growth and a reduced pace of competition and innovation lead to greater emphasis upon maintaining and utilising the existing building stock rather than building new.

A combination of pricing and tax incentives, however, leads to a steadily increasing focus and level of expenditure on upgrading the energy efficiency of the existing building stock, in both the public and private sectors, with particular emphasis on improving insulation.

3.3.3 Relative construction output changes under the National Enterprise scenario

Figure 10 schematically shows the outworking of the National Enterprise scenario in terms of shifts in the relative proportion of UK construction output in 2020 by principal work sector compared with the proportionate split prevailing in 2006.

Figure 10: Changes in work mix in 2020 compared with 2006



3.4 Scenario Three – Global Responsibility

In a world of Global Responsibility, people aspire to high levels of welfare within communities characterised by shared values, more equal distribution of opportunities and a sound environment. There is a belief that these goals are best secured through active public policy and provision, and by means of international co-operation within the EU and at a global level. Competition is fostered within a regulated framework. Reconciling growth and sustainability, seen from a global perspective, is a key guiding principle under this scenario.

3.4.1 Economic and political framework

Under Global Responsibility, people wish to be part of a wider national and international community. Business tries to balance the pursuit of profit with social responsibilities, working where possible in partnership with government and consumers.

Government plays a prominent role in the provision of education, healthcare and other social services, but the welfare state functions increasingly at an international level where governments co-operate to make business and the rest of society work together to achieve social improvement. The EU expands and takes on a greater co-ordinating role across many areas of policy, providing a comprehensive health, education and welfare safety net for disadvantaged groups. Regional government also gains greater power. International collaboration and co-ordination cover areas such as security, economic development, trade, resource management and environmental protection, involving networks of governmental, non-governmental and private sector organisations. Global communications systems drive cultural and political systems closer together. Equal access to high quality public education reinforces social and environmental values. There is North-South collaboration, helping a catch-up process by many developing countries.

Stable economic conditions, a commitment to innovation and broadly-based international competition enable a fairly high rate of economic growth, despite greater policy intervention in markets. Stability brings relatively low interest rates, thereby stimulating a high level of investment.

There is a high level of global mobility of labour, both nationally and internationally. Systems of education and training are increasingly internationalised, particularly at a European level, with ICT playing a prominent role and with growing international recognition of professional qualifications. UK training and labour market policies support a regulated high-skill, high wage labour force accompanied by greater income and social equality, although rapid technological development and change excludes some from mainstream employment. Resource and labour productivity show significant improvements, and unemployment and working hours decline.

Eco-efficiency is high on the agenda and progress is made internationally on agreeing carbon reduction targets and actions. Assisted by increased spending on research and innovation and by a step increase in demand which leads to economies of scale production, renewable energy sources become fully commercial and gain a large market share. Regulatory incentives spur energy suppliers to provide integrated energy services and promote energy efficiency. The need to reduce carbon emissions and a willingness to invest in new technologies supports a substantial programme of investment in nuclear power.

Modernisation and restructuring of transport infrastructure occurs with the long-term goal of building an eco-efficient integrated system. The cost of private car transport rises substantially, as does air travel, through a combination of pricing, tax and regulatory measures, and growth in usage is consequently constrained, while public transport is heavily subsidised.

In the UK, energy- and resource-intensive sectors of economic activity consequently decline; there is strong growth in services (including consultancy, finance, software and ICT support, finance, communication and media, education, leisure) and high-tech industries offering a low environmental impact. Goods are increasingly supplied as part of wider service packages aimed at ensuring “whole-life” thinking, efficient resource utilisation and recycling.

Manufacturing is transformed by high levels of investment and a drive for resource efficient goods and services, with new high-tech manufacturing sectors requiring a strong knowledge base or focused on exploiting eco-markets being built up in the UK.

Key features of the World Markets scenario and implications for construction, discussed in detail below, are summarised in Figure 11.

Figure 11: Key features of the Global Responsibility scenario

Global Responsibility
• Emphasis on public provision, international policy co-ordination & co-operation • Medium to high stable GDP growth, trade and investment • Higher tax & government spending; income redistribution & universal social service provision by government cut wealth & social inequalities • Privatisation and outsourcing of public services reduces • High labour mobility and migration, training increasingly internationalised • Major emphasis on environment & sustainability issues, with tax, pricing and regulation to achieve eco-efficiency; resource intensive activities decline. • Heavy investment in renewable energy/resource efficiency, recycling & in new eco-efficient/low carbon and high-tech business opportunities • Rapid innovation, international contractors dominate on major projects, off-site construction

increasingly adopted: planning, design, construction and management of buildings and infrastructure become much more ICT intensive
- Stronger regulation, planning controls, whole-life thinking & design
- Major public & private investment in new housing & refurbishment/retro-fit of existing stock with focus on raising quality standards & eco-efficiency
- Substantial investment in new eco-efficient non-residential buildings & transport/distribution infrastructure

3.4.2 Construction

3.4.2.1 General

The Global Responsibility scenario is a very positive one for investment in construction. Although economic growth is a little lower than under the World Markets scenario, the built-environment is transformed through investment in the rapid replacement of old, low quality buildings and infrastructure, as concerns over climate change and sustainability in general, coupled with a shared desire to create a more equitable society and open access to high quality public services, all come to the fore.

Within UK construction, there is particular emphasis on training and the acquisition of skills as UK-based contractors, many of the larger of which are part of international groups, seek to learn advanced construction techniques and attain international standards of best practice. This includes a much stronger focus on whole-life planning, design and costing as an essential element in the drive to achieve high levels of sustainability and resource conservation.

As with World Markets, off-site fabrication and modular construction are increasingly adopted in the face of competitive and regulatory pressure to achieve improvements in productivity and quality and also reduce materials wastage. This in turn requires design, engineering and construction to much finer tolerances, in turn requiring changes in workforce culture, enhanced communication and greater integration of the supply chain, different skill sets, and greater emphasis on planning, supervision and quality control. ICT becomes an essential element in the planning, design, construction, management and maintenance of buildings.

Planning controls and building standards are tightened significantly to ensure an integrated and sustainable approach to development, design and construction.

3.4.2.2 Housing

The demand for new housing is substantial. This reflects a high level of labour mobility and a continuing – albeit more controlled – level of net migration into the UK, coupled with environmental concerns and the acknowledged need to upgrade the condition of the nation's housing stock, both with respect to carbon neutrality and decent living standards for all.

The private new housing market is robust, although changes in the tax treatment of housing and land have lessened the speculative motive to buy, easing some of the adverse pressures on affordability.

In addition, under an accepted regime of higher taxation and more public spending and investment, public sector financial support for affordable housing for key workers and socially disadvantaged groups has increased. This, coupled with a more proactive and innovative

stance towards funding and service provision on the part of RSLs and other social housing providers, has significantly increased the level of construction of modern new, high quality social housing, which grows relative to private new housing activity.

Most new housing demand is met through low-rise development, mainly on existing urban land, but there is also some conversion of land to urban use on the fringes of smaller towns and villages. There is also far greater focus on mixed use development to create integrated sustainable communities rather than segregated dormitory areas.

New homes in general are far more technology and electronics intensive, accommodating and exploiting advances in ICT, the greater prevalence of home-working and tele-working, and the imperative of resource efficiency, particularly with respect to energy. Incorporation of photovoltaics, passive heating and ventilation, heat pumps, grey water recycling, rainwater catchment and the like are now relatively commonplace in new developments. Where possible, development and renewal is configured in such a way as to facilitate inclusion of local district heating, combined heat and power and renewable energy sources. Regulatory incentives designed to spur energy utilities to provide integrated energy services and promote energy efficiency have encouraged such suppliers to invest in and operate such schemes. Off-site fabrication has made significant inroads into methods and systems of housing construction, as has life-cycle costing and design.

3.4.2.3 Public non-housing

Under the Global Responsibility scenario, there is a marked softening in the push to privatise health, education and other social services, while steps are taken by the public sector to ensure a comprehensive and affordable health, education and welfare safety net for disadvantaged groups, where appropriate in partnership with private sector organisations.

Driven by an increasing pace of technological innovation and an overall rise across the economy in the demand for skilled labour, public sector investment in education and training facilities remains strong. This helps to sustain a buoyant level of construction in the state schools, colleges and universities sector. Individuals and employers alike also assume much greater responsibility for the continued and growing need for life-long learning and development, albeit with a strong bias towards ICT and workplace-based learning environments. This augments demand for construction of both public and private colleges and other training facilities.

Within the health sector, demographic trends, a greater sense of social responsibility, rising living standards and new technology all support substantial continued investment in the renewal and upgrading of public sector hospital and other health facilities, with a clear shift towards high-technology health promotion and preventative care.

As with housing, there is a strong push by government to achieve significant advances in the sustainability and energy efficiency of the public sector building stock, resulting in a strong focus on whole life cost, resource efficiency and performance, with accompanying changes in building methods and skill requirements.

3.4.2.4 Private industrial

Although the service sector is the key economic driver under the Global Responsibility scenario, manufacturing is nevertheless transformed by high levels of investment and a drive for

resource-efficient goods and services. New high-tech manufacturing activities develop, particularly those requiring a strong knowledge base, having a low eco-impact and/or focused on exploiting the growth in eco-markets both in the UK and overseas. This in turn creates a demand for construction of new state-of-the-art laboratories and production facilities.

Levels of trade and distribution remain strong, but much greater emphasis is placed upon ensuring eco-efficient distribution of goods. This leads to changes in the configuration of supply chains, to shifts between alternative transport modes, and to changes in the size, location and configuration of distribution centres. These factors together support a continued robust level of investment in replacing outmoded distribution properties and in ensuring that a modern, eco-efficient set of distribution facilities is put in place.

3.4.2.5 Private commercial

In the UK, while energy and resource intensive sectors of economic activity decline, there is strong growth in services (such as consultancy, finance, software and ICT-support, communication and media, education, leisure). This has a positive impact on the commercial construction sector in terms of the building of new eco-efficient office and retail accommodation as well as facilities for the private health, education and leisure sectors.

Increased transport costs, particularly with respect to car usage, encourage regeneration and redevelopment of a number of urban areas, with high quality housing in mixed developments incorporating office, retail and leisure facilities, thereby providing attractive living environments closer to centres of employment and around key public transport nodes.

Significant refurbishment of the existing stock of buildings occurs, one of the key areas of which is to enhance the level of energy efficiency, environmental control systems and advanced communication facilities.

3.4.2.6 Infrastructure

The Global Responsibility scenario brings a high level of investment in public transport, energy, water and advanced information infrastructures.

Substantial investment is seen in renewable energy sources, including onshore and offshore wind, tidal and solar energy as well as energy generation from waste and biomass. Advances are made in carbon capture technology and equipment and in the production and commercialisation of hydrogen as a fuel, and investment commences in supporting infrastructure. Work proceeds on the construction of a barrage across the Severn estuary, while construction continues apace on a major programme of investment in a new generation of nuclear power stations. Investment also occurs in technologies and construction of facilities to capture, store and subsequently utilise electricity generated off-peak from nuclear, wind and tidal power installations.

Modernisation and restructuring of transport infrastructure occurs with the long-term goal of building an eco-efficient integrated system resulting in a heightened level of investment in rail (including further electrification of major routes) and in other public transport, accompanied by a much reduced level of growth in air transport and car usage. Redevelopment of infrastructure to provide better integration of public transport nodes and interchanges brings in its wake associated private commercial development.

3.4.2.7 R&M

Repair, maintenance and upgrading of the existing building stock, both residential and non-residential, also assumes major policy importance, not least as a result of the drive to improve eco-efficiency and cut carbon emissions, which is supported by a combination of energy pricing, government regulation and targets and energy efficiency improvement subsidies.

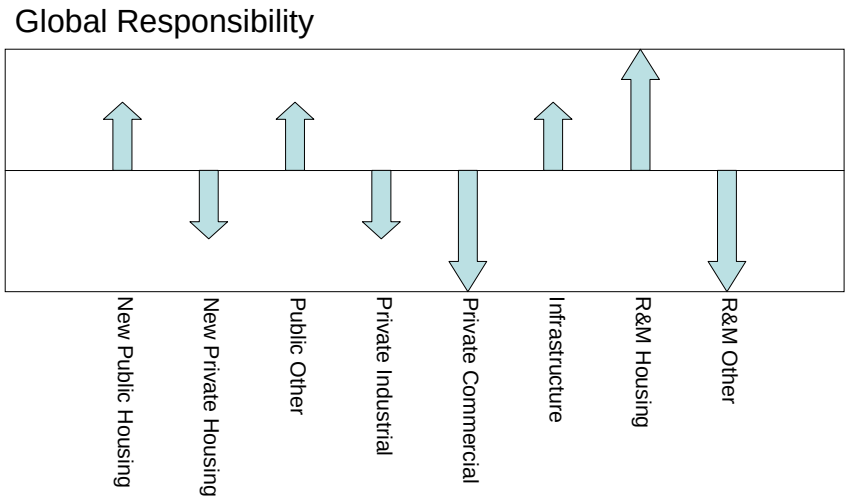
In particular, a major drive is made to improve the energy efficiency of the existing housing stock with the focus primarily upon improved roof and wall insulation and draught-proofing supported by incentives to encourage a higher rate of installation of energy efficient boilers and single-glazed window replacement.

This drive is supplemented by an ongoing programme of phased demolition and rebuild in cases where upgrading the eco-efficiency of the existing stock is uneconomic or impractical.

3.4.3 Relative construction output changes under the Global Responsibility scenario

Figure 12 schematically shows the outworking of the Global Responsibility scenario in terms of shifts in the relative proportion of UK construction output in 2020 by principal work sector compared with the proportionate split prevailing in 2006.

Figure 12: Changes in work mix in 2020 compared with 2006



This scenario, which reflects rapid construction growth and innovation, coupled with a robust response to climate change and other sustainability issues, is the one that leads to the greatest level of change in the industry.

3.5 Scenario Four – Local Stewardship

Under Local Stewardship, individuals seek sustainable levels of welfare within federal and networked communities. Social and other regulation ensures more equally distributed opportunities within a high quality local environment. Public policy promotes small-scale regionally based economic activity rather than large-scale business and technologies.

3.5.1 Economic and political framework

Decision-making powers within the UK are further devolved to regional government, people identify strongly with their local community, and this encourages development of business infrastructure and services focused primarily upon serving local and regional needs and, where possible, utilising local resources. This in turn leads to fragmentation in many business sectors. Being small, local and agile becomes a competitive asset, but in general companies face less competitive pressures than in the other three scenarios. Reflecting differing local priorities and characteristics, regional outcomes across the UK vary significantly.

Protection of the environment and resource conservation are key political and popular objectives, reinforced by strict regulation. Economic growth is relatively low but stable, and in certain respects quality of life is improved. However, environmental and ethical issues constrain the growth of international commerce. There is emphasis on the eco-efficiency, quality and durability of consumer and other manufactured goods, with long-term service support and locally-based maintenance and recycling systems. High-tech sectors and international services decline, becoming increasingly located in limited regional clusters; there is a corresponding relative decline in the number of very large multinational companies. International co-operation occurs primarily between “city states” or regions with mutual agendas. The EU evolves into a loose association of European regions.

Despite low income growth, the relative increase in labour-intensive activities, coupled with an increase in informal employment and publicly-funded employment schemes, limits the level of unemployment. Working hours stabilise but do not fall due to low levels of productivity growth. Income differentials narrow. There is strong emphasis on education and training to preserve heritage and other traditional skills. International migration of labour becomes limited primarily to those with specialist professional skills.

Health, education and social services are publicly funded through high levels of taxation, with emphasis on fairness and access for all, again with more regionalised control and provision. However, expansion of public services is limited and uneven, constrained by lower economic growth, a consequently reduced potential tax base and pressure on public sector finances. This is partially compensated for by families, members of local communities and charities who all take a more active role in providing mutual social self-support in their area.

Economic and technological developments are constrained by limitations on available levels of local resources (knowledge, capital and materials) as well as the size of local markets, density of demand and level of transportation costs which together inhibit capital investment in large-scale production facilities. Overall levels of private investment consequently decrease, and rates of innovation and technical change decline.

Services are the most important sector of economic activity, but with relatively low household incomes and a less materialistic society, demand is primarily for services which meet basic needs. Services targeted towards high income earners and businesses tend to suffer, while personal services such as healthcare, retailing, catering, leisure and tourism become increasingly localised.

Energy supply becomes diverse, restructured around local energy resources. A wide range of energy efficient and small-scale renewable energy technologies are exploited, in many cases

subsidised through funds raised by substantial energy taxes. Coupled with low growth, the latter constrain overall demand for energy.

Demand for transport is adversely affected by the major slowdown in growth of trade, reduced labour mobility and the effect of environmental taxes and high energy prices on the cost of transport. Passenger transport is still dominated by the private car, but public road and rail systems are extended. Alternatives such as car sharing, cycling and walking also increase in popularity.

Key features of the Local Stewardship scenario and implications for construction, discussed in detail below, are summarised in Figure 13.

Figure 13: Key features of the Local Stewardship scenario

Local Stewardship
• Society based around regional/local federal/networked communities • Low GDP growth, international/inter-regional trade & investment • Emphasis on social welfare & equality, higher tax rates & public provision • But level of state provision is limited by constraints on overall government finances; community self-support/charity consequently plays a major role • Economic activity, resourcing & trade are increasingly locally-based; fewer large-scale, multinational companies, competitive pressures less • Low inward migration & population growth coupled with low income growth limit new housing construction, both public & private • Low pace of innovation and take-up of new technologies, including ICT, but substantial investment in small-scale/local renewable energy sources • Strong local planning controls & environmental regulations & taxes • Construction sector remains fragmented with many small businesses; pace of innovation slow, with continued emphasis on traditional construction methods • Relatively low levels of new non-housing building & infrastructure construction • Heavy emphasis on refurbishing, repairing & improving the existing residential & non-residential stock, where possible improving its eco-efficiency

3.5.2 Construction

3.5.2.1 General

Under the Local Stewardship scenario, relatively low GDP growth, constraints on public finances, and a swing towards small-scale regionally-based activity utilising local resources all act to limit the level of investment in new construction, both in the public and private sectors. However, together with strong emphasis on protection of the environment and resource conservation, this does result in a boost to levels of refurbishment and repair, maintenance and improvement as communities seek to make the best possible use of existing facilities and also improve the eco-efficiency of the built-environment.

This world inhibits the spread and growth of the international contractor. The UK construction industry continues to be dominated by small firms, and as a result, the pace of innovation in the industry is much lower, with a continued emphasis on more traditional methods of construction

and only a gradual increase in off-site production. The traditional skill base is significantly enhanced through training programmes, leading to efficiency gains, a higher quality of workmanship and more multi-skilling. The greater focus placed on conservation and efficiency of resource utilisation leads to a corresponding increase in whole life thinking and design.

New buildings are located in existing towns and cities, leading to denser urban development. There is migration away from the larger cities as major centres of internationally-orientated business services, such as international trade and finance, decline in relative importance. There is a corresponding growth of small and medium-sized towns more suited to a smaller-scale local development path. Planning and environmental regulations favour sustainable mixed residential and commercial development. New projects are generally relatively small in scale.

3.5.2.2 Housing

The demand for new housing declines as lower incomes and the revival of more collective social values lead to larger household sizes, and as overall population growth slows due to a much reduced level of net migration into the UK. The urbanisation of the countryside comes to a halt as planning controls are tightened. This too constrains the level of new private sector housing construction.

Pressure on public finances also limit the level of public sector financial support for social housing, leading to relatively modest programmes of new-build.

A conservationist ethic and lower demand for new development contributes to the continued dominance of traditional housing construction methods, but higher levels of insulation, solar panels, heat pumps and energy efficient appliances and control systems are incorporated together with some renewable district micro-generation schemes.

3.5.2.3 Public non-housing

Investment in health and education facilities is predominantly publicly funded, but again constraints on public finances limit the overall level of new investment and construction. Projects are predominantly designed to serve local needs and tend consequently to be limited in scale. There is a relatively heavy emphasis on refurbishment incorporating improved eco-efficiency wherever possible.

3.5.2.4 Private industrial

The lower pace of research, innovation and international trade and competition lead to a decline in high-tech manufacturing which becomes increasingly confined to a few limited regional clusters. There are consequently fewer multinationals and major industrial construction projects, and the majority of new industrial construction is undertaken for SMEs, again on small-scale schemes serving predominantly regional markets.

The shift towards regionally focused patterns of resource utilisation, production and trade dampen demand for major new distribution facilities leading to an accompanying fall in levels of construction in this sub-sector.

3.5.2.5 Private commercial

Services are the most important sector of economic activity, but as already noted, demand is primarily for services which meet basic needs such as healthcare, retailing, catering, and leisure. The latter become increasingly localised as do business services.

New office, retail and leisure construction activity gravitates away from the major urban centres towards smaller and medium-sized towns as business expands there to meet needs and source its own inputs locally. Major cities see a shift in composition of commercial construction activity towards greater refurbishment and conversion of existing properties, such as offices, and to mixed-use schemes including residential. As with public housing and non-housing construction activity, eco-efficiency measures become an increasingly important element.

3.5.2.6 Infrastructure

The principal focus of infrastructure investment is on projects which promote efficiency in energy and water usage and exploit local resources.

Energy supply becomes much more diverse. A wide range of small-scale renewable energy technologies are exploited, particularly wind, biogas, biomass and photovoltaics. Local combined heat and power systems flourish.

Investment in new and expanded transport facilities is limited as a result of the major slowdown in economic growth and trade, reduced mobility, environmental taxes and high energy prices. In particular, there is little investment in additional airport capacity as long-haul travel reduces. Passenger transport is still dominated by the private car, but growth is constrained by cost. There is limited investment in improving public bus and rail systems.

3.5.2.7 R&M

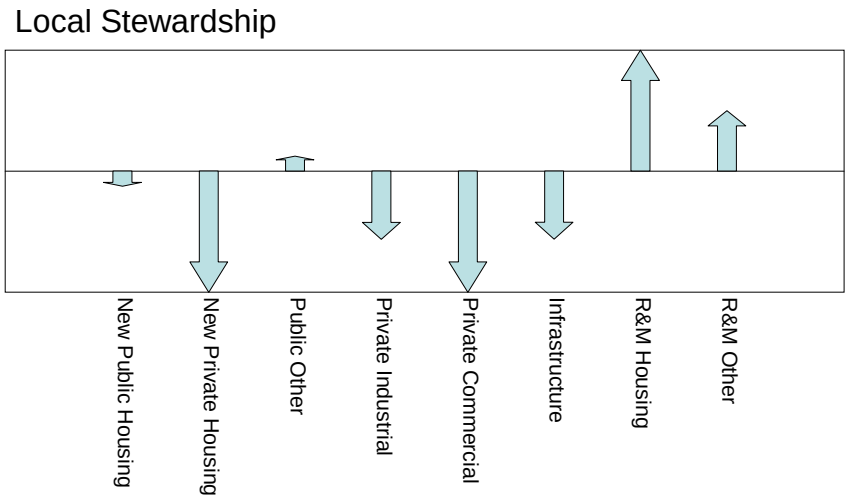
Financial imperatives result in major emphasis being placed on making the best possible use of the existing stock of buildings and infrastructure Consequently, repair maintenance and improvements, including housing refurbishment, account for a significantly increased proportion of the UK construction market.

Traditional methods and skills prevail. Once again there is emphasis on use of low cost measures such as greater insulation to improve the energy efficiency of the existing stock.

3.5.3 Relative construction output changes under the Local Stewardship scenario

Figure 14 schematically shows the outworking of the Local Stewardship scenario in terms of shifts in the relative proportion of UK construction output in 2020 by principal work sector compared with the proportionate split prevailing in 2006.

Figure 14: Changes in work mix in 2020 compared with 2006



3.6 Comparisons between scenarios and relative output shifts between sectors

As will be seen in Chapter 4, where the quantitative model assumptions for the various scenario storylines are discussed, real construction output is assumed to grow in absolute terms between 2006 and 2020 under all four scenarios, albeit at different percentage rates of growth.

However, there are different relative changes in the proportion of construction output in each of the principal work sectors in 2020 compared with the proportionate split prevailing in 2006.

The following differences are to be noted.

- In absolute terms, compared with 2006, the real level of *public sector new housebuilding* is higher in 2020 in all scenarios except that of National Enterprise. There is also a large proportionate increase under the Global Responsibility scenario.
- *New private housebuilding* real output in 2020 is higher in absolute terms in all but the Local Stewardship scenario where economic and demographic factors combine to result in a decline. However, the level of new private housebuilding output declines in proportionate terms relative to other work sectors under all four scenarios, reflecting the absolute decline under Local Stewardship; lesser but significant affordability constraints and reduced inward migration under the National Enterprise scenario; the pronounced shift towards public sector housebuilding under the Global Responsibility scenario; and affordability and land supply constraints under World Markets.
- *Public other new construction* work grows in absolute real terms between 2006 and 2020 under all scenarios, falls proportionately under the World Markets and National Enterprise scenarios, and increases under the Global Responsibility and Local Stewardship scenarios reflecting the greater emphasis under the latter two scenarios on social welfare and public sector provision.
- *Private industrial new work* output declines proportionately in all but the World Markets scenario and absolutely under Local Stewardship.
- *Private commercial new work* output increases proportionately under the World Markets scenario and shows a noticeable proportionate decline under Global Responsibility and under Local Stewardship, reflecting in part the shift back towards public sector provision of public services under these two scenarios.
- *Infrastructure* construction output grows noticeably in proportionate terms under the high growth World Markets scenario, but falls proportionately under the National Enterprise and Local Stewardship scenarios. It also shows an absolute decline in output in real terms under Local Stewardship.
- *Repair and maintenance* construction output shows real absolute growth between 2006 and 2020 under all four scenarios, albeit at varying rates. National Enterprise and Local Stewardship scenarios both show a significant proportionate increase in their share of total construction output in 2020 compared with 2006, while World Markets and Global Responsibility both show a decline, most noticeably in the case of Global Responsibility where there is proportionately greater emphasis on major refurbishment and replacement of the built environment.

4 Model results and the implication for skills requirements

4.1 Introduction

The following section takes the four scenarios discussed in Chapter 3 and sets out the possible quantitative implications for employment and skill requirements in the construction industry by 2020. We also examine a “Base Case” (which represents a continuation of existing trends) as well as considering the boundaries of the possible and providing some discussion on what construction might look like in 2020 if all the current drivers of change were pushed to their furthest possible limit over this time period.

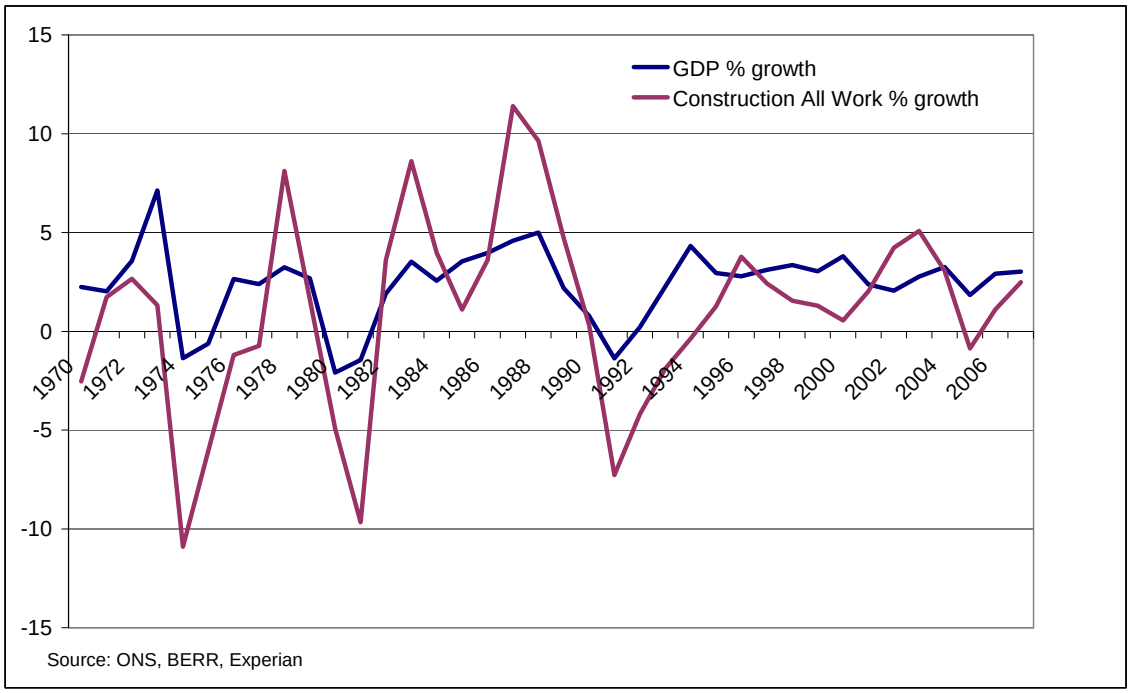
A point to be noted is that ConstructionSkills’ remit, as the sector skills council for construction, covers the construction industry as defined by Standard Industrial Classification (SIC) 45 and SIC 74.2 and thus may not cover construction workers employed in an off-site facility unless such a facility is being run by a contracting company. While we have used as our baseline 2006 employment figures those for SIC 45 and 74.2, the scenarios presented include the element of the workforce that may move from on-site to off-site work over the period between 2006 and 2020, even though they will officially move out of scope to become part of the manufacturing SICs. The definition of the construction industry may be one that will require discussion in the future if a significant proportion of its production moves from an on-site to an off-site environment.

Furthermore, it is possible that a significant proportion of new off-site production may move offshore, which would have significant implications for construction employment within the UK. In looking at the possible quantitative implications of the scenarios for future skills requirements we have assumed that this is not the case.

4.2 Key assumptions

The key drivers of the assumptions underlying GDP growth across the various scenarios are discussed at length in Chapter 3, and thus do not require further elaboration here. Historically there has been a fairly clear cut relationship between GDP and construction output growth, and in the past, events in the construction industry have often been seen as an early indicator of the health or otherwise of the economy as a whole. In recent years construction output growth has generally underperformed GDP growth, as the chart below indicates.

Figure 15: GDP and construction output growth, 1970-2007



We are expecting this trend to continue under the Base Case and three out of the four construction scenarios. The exception is Global Responsibility, where construction output is assumed to grow at an average 0.5% a year faster than GDP. The reason behind this stronger construction growth is that, under this scenario, environmental concerns very much take centre stage with international agreements and co-operation in place, which significantly mitigates climate change. Thus there is a heavy emphasis on the retro-fitting of the existing stock to increase energy efficiency and provide micro-generation, and where this is not feasible, to accelerate the replacement of old, low quality buildings with new, carbon neutral ones.

An important consideration when scoping out future employment requirements in the construction industry is the relative rates of growth of new work and R&M. The R&M sectors are much more labour intensive than the new work ones, so while the current output proportions are around 43% for R&M and 57% for new work, for employment they are 62% and 38% respectively.

Our Base Case assumes a slightly falling share of R&M work predicated on recent trends and serious attempts to fulfil current targets for new housebuilding, education facilities and public utilities. World Markets and Global Responsibilities also assume that the new work sectors continue to represent the larger share of output. The shares under World Markets remain much the same as at present, while under Global Responsibility there is a slight move towards repair & maintenance with a relatively high level of retro-fitting of energy efficiency measures and micro-generation technologies.

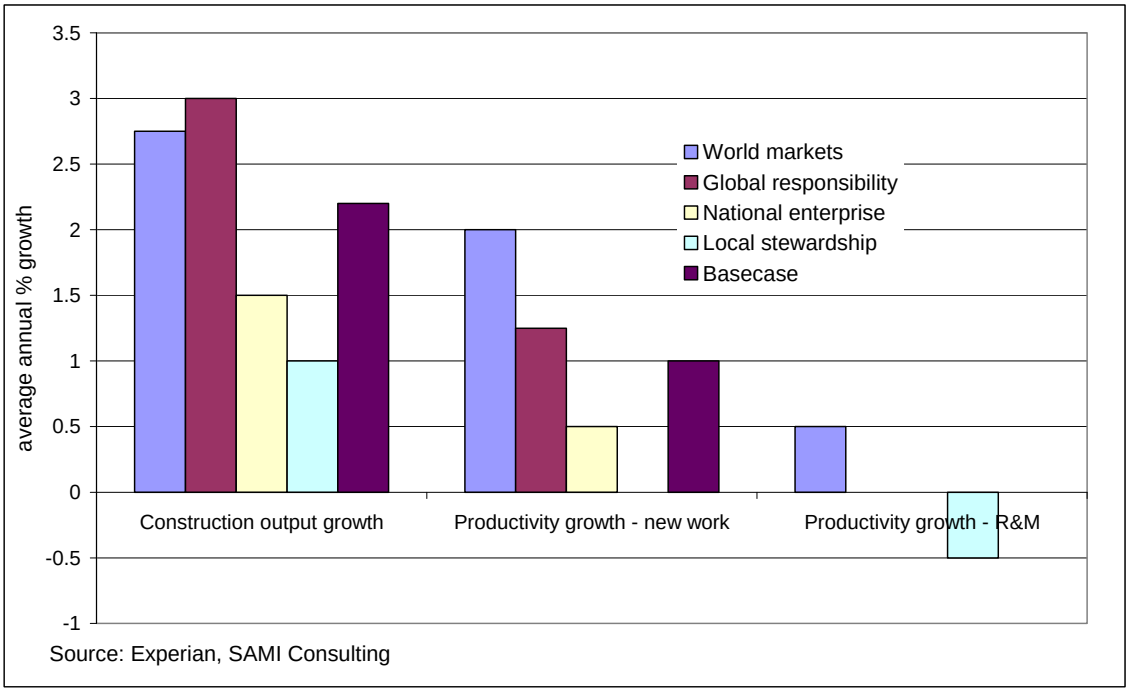
In contrast, National Enterprise and Local Stewardship assume a significant shift away from new work towards R&M, under more constrained outlooks for investment in the industry and a more ‘make do and mend’ attitude.

Figure 16: Key assumptions

Assumed growth to 2020	GDP Growth % p.a.	Construction Growth % p.a.	New % of total	R&M % of total
World Markets	3.00	2.75	57.0	43.0
National Enterprise	2.00	1.50	47.5	52.5
Global Responsibility	2.50	3.00	55.0	45.0
Local Stewardship	1.25	1.00	45.0	55.0
Base Case	2.50	2.20	59.0	41.0
Source: Foresight Futures, Experian, SAMI Consulting				

The third element driving relative levels of employment growth across the four scenarios and the Base Case is the level of productivity gains assumed for each. In the Base Case we have assumed no change in the rate of productivity growth from that used for the ConstructionSkills Network in its five-year forecasts of employment in the industry, nationally and regionally, namely a 1% a year gain for new work and zero gain for R&M, giving a total annual productivity growth figure of 0.6%. These productivity growth figures were based on simple analysis of construction employment and gross output figures over the period 1994-2004, with some adjustment after industry consultation.

Figure 17: Construction output growth and productivity assumptions



The productivity assumptions for the four scenarios have taken the Base Case as a starting point, looked at the factors that might affect productivity in the industry going forward, and extrapolated a best case outlook within which each of the scenarios must sit. The factors deemed likely to have most effect on the rate of productivity growth are project management, innovation drivers, adoption of modern methods of construction and in particular off-site manufacturing processes, and the development of innovative materials and methods.

It is important to note that the definition of productivity used here is unit value of sector output per unit of SIC labour input. There are two aspects to this. First, there is the more classical concept of improved rates of working or increased output per unit of labour input, derived through better methods or materials etc. The second aspect is the simple reduction in certain types of labour in the building process. Therefore in a scenario with greatly reduced use of wet trades and hence a reduction of the number of plasterers employed, even though the number of units of construction remains the same, the "productivity" of plasterers will be greatly increased in spite of there being no improvement in the rate of application of plaster. Both parts of these "productivity" changes are implicit in the productivity rates adopted for each scenario.

A study by Alan Mossman indicated that 10-18% of time on-site was wasted through poor project management and logistics problems. Better site management could bring this down to 5-6%, and if this level were to be achieved by 2020, an up to 1% a year efficiency gain would result.

Modern methods of construction accounted for an estimated 4%-6% of construction in 2006. Leaving aside the problem of defining what is meant by MMC, our best case assumption of growth is around 10% year-on-year, which would mean that the sector would account for about 12% of total construction output by 2020. Indications are that the productivity differential between on-site and off-site is around 1:2.5. This would imply a top-end growth in productivity for construction as a whole driven by MMC of around 0.5% a year. We have assumed a further 0.5% a year could be realised from a significant up take of innovative materials and methods.

In contrast, the drive to more sustainable construction, energy efficiency and micro-generation is likely to lead to an increase in both output and employment in the industry, and thus have little effect on productivity levels.

This all suggests a best case outlook for productivity growth of 2% across the industry as a whole over the period to 2020. As the move towards MMC is thought to benefit the new work sectors rather the R&M ones, this provides a best case outlook for the former of 2.5% a year and 1.5% for the latter.

The likely speed of adoption of the above processes then provides us with an implied productivity growth rate under each of the four scenarios. Under all four scenarios and the Base Case, the combination of forces is such that we consider that the "best case" outcome is unlikely to be achieved by 2020. In fact the specific assumptions adopted for new and R&M work, shown graphically in Figure 16, imply overall productivity growth rates ranging from a small annual decline under Local Stewardship up to a growth of just under 1.5% per year under the World Markets scenario.

4.3 Employment implications

According to analysis of Labour Force Survey (LFS) data, there were 2.41 million people working in the construction industry, either employed or self-employed, as defined by SIC 45 & 74.2 in 2006.

Figure 18: Implications for employment

	Actual 2006	Base Case 2020	World Markets 2020	National Enterprise 2020	Global Responsibility 2020	Local Stewardship 2020
Employment, millions	2.41	3.36	3.04	3.10	3.47	3.15
% increase on 2006 base		39%	26%	29%	44%	31%
Deviation from 2020 Base Case			-9%	-8%	+3%	-6%

Source: ONS, Experian, SAMI Consulting, ConstructionSkills.

Employment grows under all scenarios if we continue to count under the construction banner any labour which moves from on-site to off-site after 2006. The Base Case extrapolation leads to a 39% increase in overall employment between 2006 and 2020, based on 2.2% annual average growth in construction output, and productivity gains of 0.6% a year – 1% for new work and no gain for R&M. This assumes no significant change in current trends in the industry. Thus the mix of occupations in any sector remains broadly the same, although there is some movement towards a greater proportion of new work to meet new house build targets, for example.

World Markets has the lowest rate of employment growth, 26% to 2020, because, while construction output growth is higher than the Base Case at 2.75%, productivity gains average 1.4% over the period – 2% for new work and 0.5% for R&M. This much higher rate of productivity gain is in part driven by a more rapid adoption of new technologies, industry consolidation in a global market, and significant growth in off-site manufacture and the automation of some construction processes.

Global Responsibility has the highest rate of employment growth on the back of the fastest annual increase in construction output of any of the scenarios (3%), and a lower rate of productivity gain at 0.7% than World Markets – 1.25% for new work (reflecting a higher element of refurbishment and upgrading of existing stock than under World Markets) and zero for R&M. Under the Global Responsibility scenario, R&M also takes a higher share of work than in both the Base Case and World Markets, thus giving a slightly more labour intensive slant to the industry. This scenario also assumes significant growth in the uptake of technologies required to mitigate climate change, both on the micro-generation and macro-generation side, which in particular indicates a faster expansion of the mechanical & electrical sector of the industry.

Under the National Enterprise scenario, employment increases by 29% by 2020, a 10% smaller rise than under the Base Case. Construction output growth only averages 1.5% a year under a more protectionist global scenario, which leads to lower levels of investment funds available to the industry. However, productivity gains are also low at a mere 0.25% a year – 0.5% for new work and zero for R&M, as a less competitive environment means there is less of an imperative to generate more work from the same workforce. A shift from new work to R&M also adds to the lower likelihood of the industry being able to generate significant productivity gains overall.

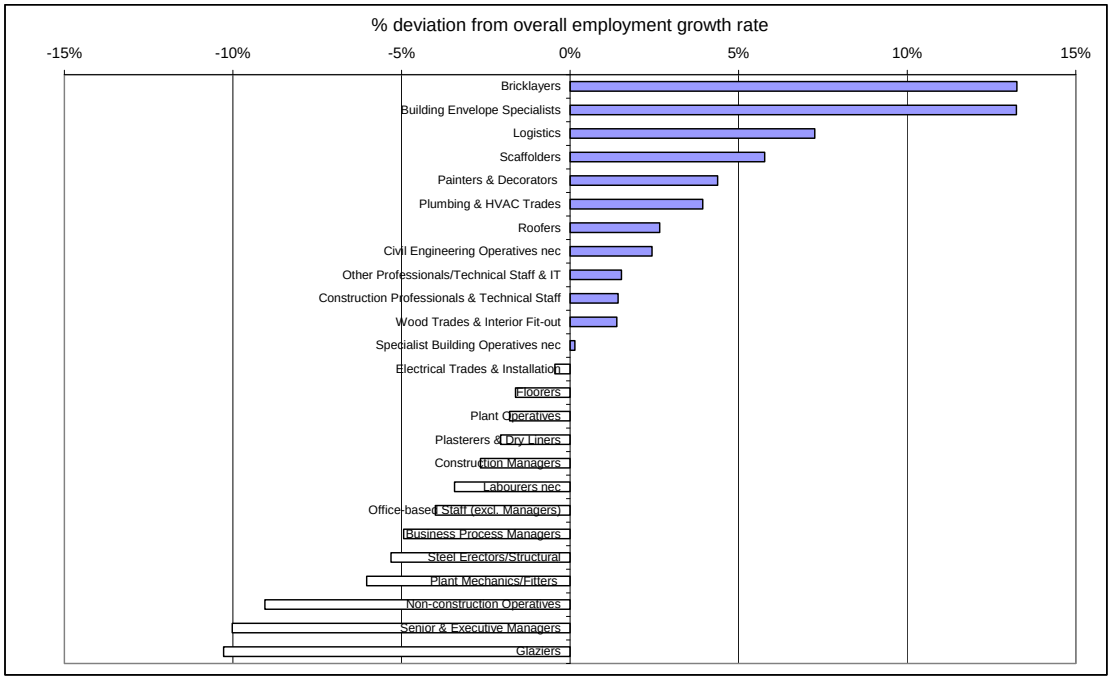
Local Stewardship sees slightly higher employment growth than under both National Enterprise and World Markets as, despite its low construction output growth rate of 1% a year, this scenario produces the highest proportion of R&M work (55%) and a productivity decline of 0.3% a year – zero for new work and -0.5% for R&M. Under this scenario, the industry retreats to a much more localised structure where resource conservation is the order of the day.

Possibilities for economies of scale are fewer and investment funds for the industry, both public and private, are limited.

Under both the World Markets and Global Responsibility scenarios all three categories of manager plus office staff increase proportionately less than total employment as a result of larger projects, better productivity, increasing moves to consolidation in the industry, and faster build times than under the other two scenarios.

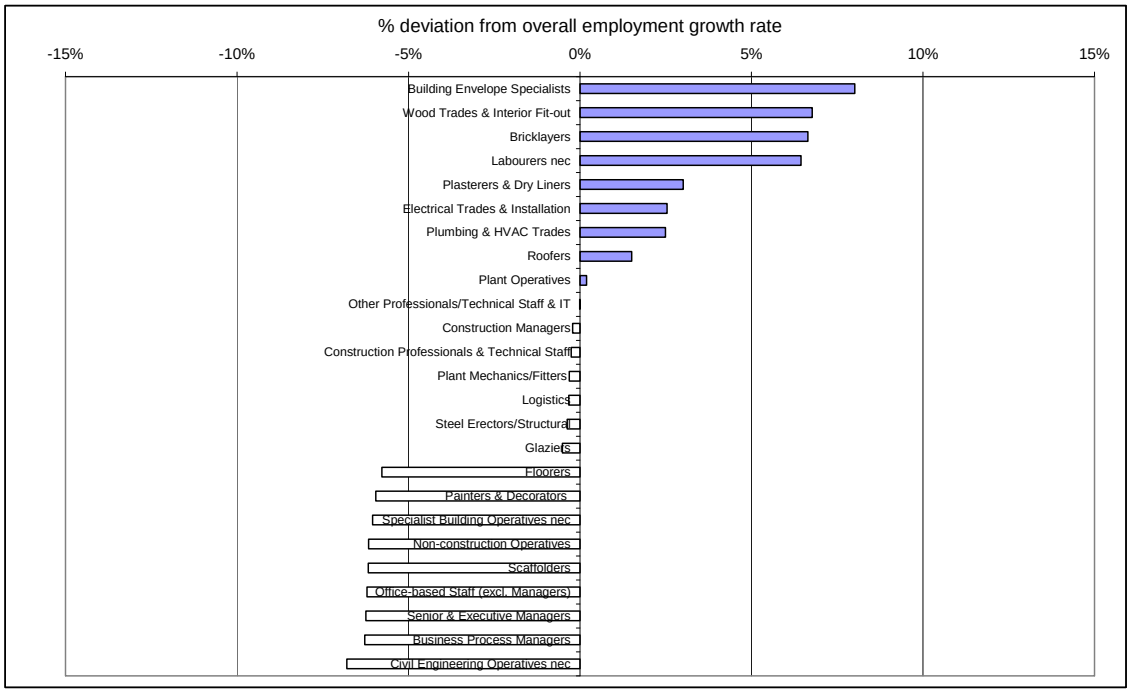
In the Base Case, those occupations that have seen faster employment growth in the recent past continue to expand at an above average rate and vice versa. Thus bricklayers and building envelope specialists experience above average growth to 2020, while glaziers and senior managers show relative, but not absolute, declines.

Figure 19: 2020 Base Case – differences in employment growth by occupation



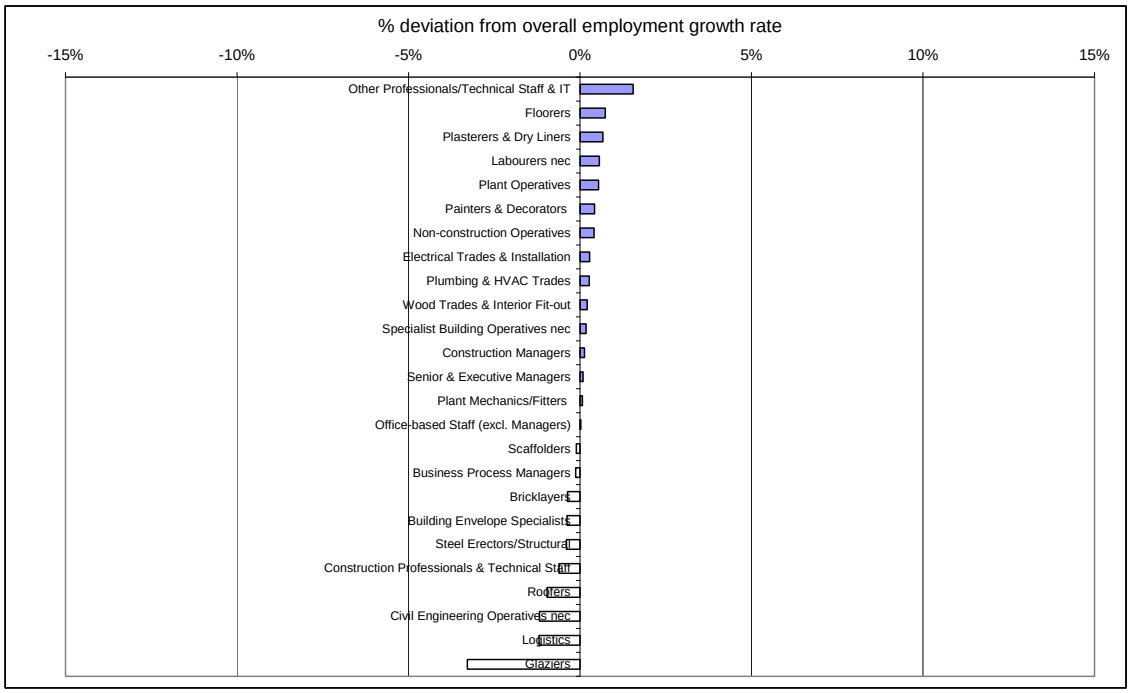
Under World Markets above-average percentage employment growth in wood trades & interior fit-out, bricklayers, building envelope specialists, plasterers & dryliners, labourers, and to a lesser extent electrical & plumbing & HVAC trades is combined with below average growth in civil engineers, floorers, scaffolders, and specialist building operatives. This is this partly due to a change in the work mix with a lower percentage of R&M and a shift towards greater energy efficiency and new methods of construction.

Figure 20: 2020 World Markets – differences in employment growth by occupation



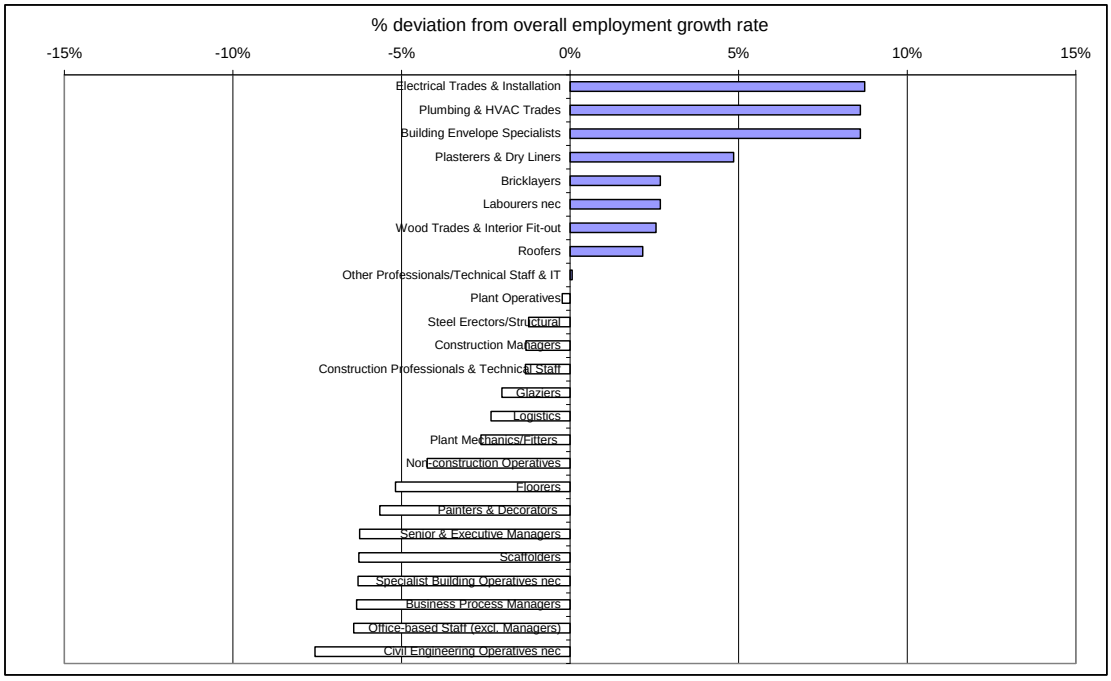
National Enterprise shows a little over 10% less employment growth over the period 2006-2020 compared with the Base Case. Most skill categories increase proportionately broadly in line with the total employment increase of 28.7%, the exception being glaziers, who show a slightly more marked deviation, although it was still relatively small at a little over 3%.

Figure 21: 2020 National Enterprise – differences in employment growth by occupation



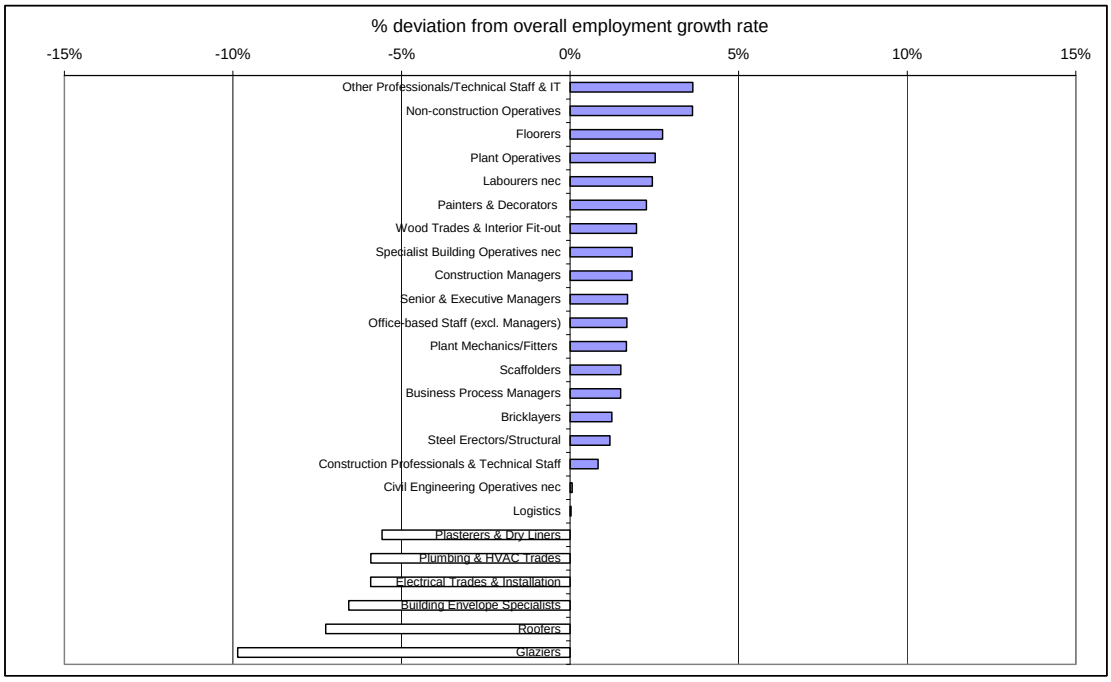
Global Responsibility shows the highest rate of growth in employment between 2006 and 2020, at 44% overall, and some trades, such as electrical, plumbing and HVAC trades could see a significantly higher increase to cope with the faster take-up of renewable technologies under this scenario to mitigate climate change. In contrast, some types of civil engineering operatives may see lower than average increases in employment as some infrastructure work, in particular on roads, declines relatively for much the same reason

Figure 22: 2020 Global Responsibility – differences in employment growth by occupation



Between 2006 and 2020, Local Stewardship gives a similar total employment increase to National Enterprise, but has some more marked differences between percentage changes in employment in particular occupations compared with that of employment as a whole. There is slower employment growth in building envelope specialists, plasterers & dryliners, roofers, glaziers, electrical, and plumbing & HVAC trades, reflecting the lower level of new-build, smaller projects, more localised activity and a greater emphasis on “making do with the existing stock” through economic and financial necessity.

Figure 23: 2020 Local Stewardship – differences in employment growth by occupation



4.3.1 The implications for individual occupations

The following figures should be interpreted as differences against the overall employment increase under each scenario, since, as noted above, all four scenarios and the Base Case produce growth in employment over the period 2006 to 2020, varying from a low of 26% for World Markets to 44% for Global Responsibility. At an occupational level, no trades or professions are expected to show an absolute decline under any scenario. Thus negatives in the figures below are demonstrating not absolute falls, but relative differences in relation to overall UK construction employment growth. For example, in the Base Case, total employment grows by 39% between 2006-2020, but for senior managers the increase is only 29%, representing a deviation from overall growth of minus ten percentage points.

4.3.1.1 Managerial and administrative occupations

These groupings cover for the most part what could be considered ‘back office’ occupations and those with generic rather than construction-related skills. For example, the grouping of business process managers includes roles such as that of finance managers and marketing managers. The exception is the senior and executive managers grouping, as this may consist of people with both construction-related and more generic skills.

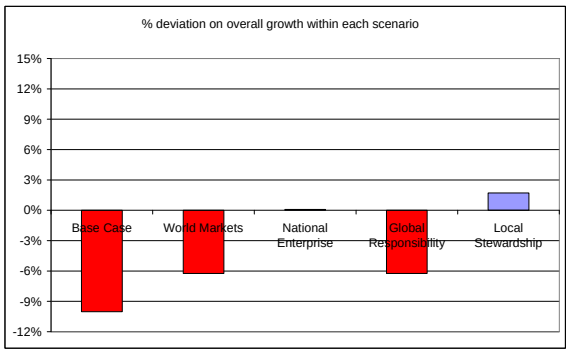
Under the Base Case, World Markets and Global Responsibility, there is an assumption of further consolidation into bigger units within the industry to a greater or lesser extent; thus expansion in three out of the four managerial and administrative groupings is likely to be lower than for construction employment overall.

The exceptions are under National Enterprise and Local Stewardship. Under the former scenario growth in senior managers, business process managers and other office based staff is roughly in line with the overall increase, while for the latter these groupings increase faster. This is because under these two scenarios there is much less “internationalisation” of the

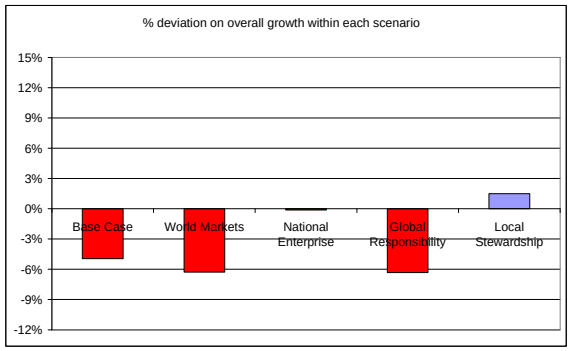
construction market than under World Markets and Global Responsibility and supply chains are more fragmented.

Figure 24: Managerial and administrative occupations

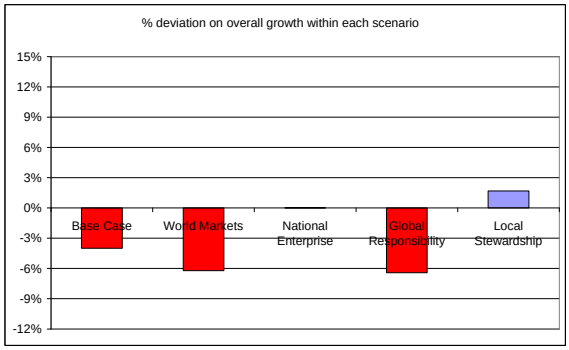
Senior managers



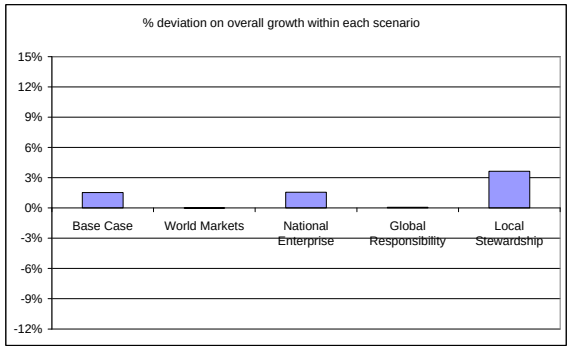
Business process managers



Office-based staff (excl. managers)



Other professionals/technical staff & IT



However, for the fourth occupational grouping, other professionals/technical staff & IT, the growth of information communication technology (ICT), both on-site and off-site, and the need to ensure inter-operability of software systems, is likely, albeit to varying degrees, to lead to a greater future demand for IT-skills including IT-literate managers and professional staff. Thus employment growth for this grouping is likely to be either in line with, or higher than, the overall employment increase within each scenario and the Base Case.

4.3.1.2 Construction managers and professionals

Construction managers and construction professionals & technical staff have been grouped together, because, although many construction managers may have started their careers as tradespeople, many also will have originally worked as construction professionals – architects, surveyors, consulting engineers etc. It is assumed that project managers are included under these two occupational groupings.

Figure 25: Construction managers and professionals

Construction managers **Construction professionals & technical staff**

There is little difference in the growth of these two occupational groupings compared with overall employment increases, with a deviation of not more than ±3% across all scenarios and the Base Case. This is not surprising as the growth in requirement for these type of occupations is likely rise in line with the overall rise in construction activity.

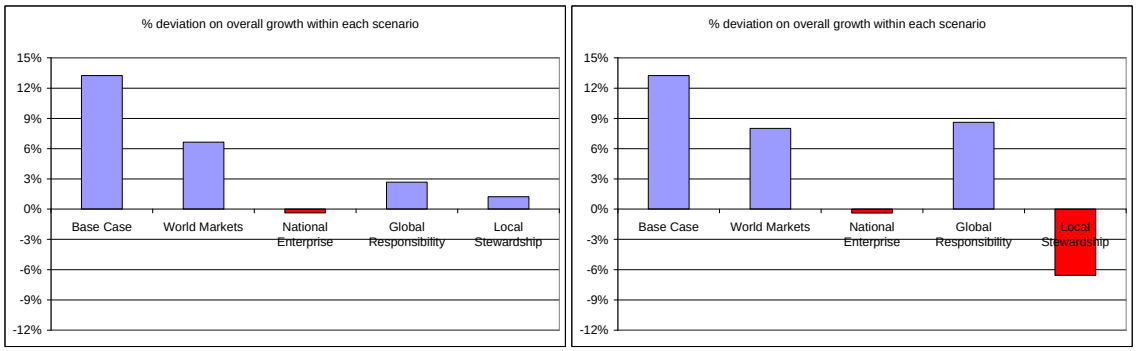
However, the way construction managers and professionals will work is likely to change significantly over time, particularly under the higher growth/higher innovation secnarios. The rise in off-site manufacturing will require greater integration between off-site and on-site teams, and construction professionals are probably going to need to gain a knowledge of manufacturing processes. The drive towards energy efficiency and the more exacting tolerances that this will imply should push the industry towards more integrated working patterns from design, through to production and installation.

4.3.1.3 Structural and building 'skin' trades

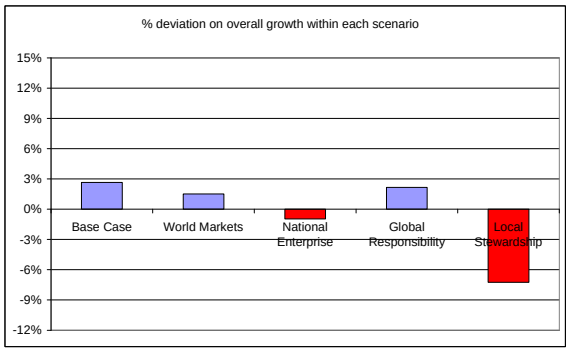
These groupings are largely self explanatory, except maybe that of building envelope specialists. This occupational category was developed out of some research commissioned by ConstructionSkills investigating the content of a number of Standard Occupational Classifications (SOCs) with the suffix 'not elsewhere classified (nec)'. The biggest of these was construction trades nec (SOC5319). This research came to the conclusion that around 50% of those within this classification were workers involved in curtain walling, and concrete, timber, synthetic and metal exterior cladding. Thus a new occupational grouping called building envelope specialists was created to accommodate these types of skills.

Figure 26: Structural and building 'skin' trades

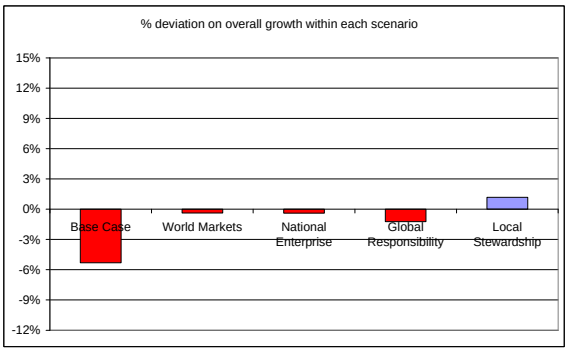
Bricklayers **Building envelope specialists**



Roofers



Steel erectors/structural



There are some significant differences across the scenarios for the different occupational groupings. The high growth of bricklayers and building envelope specialists under the Base Case is an extrapolation of recent strong increases in employment for these trades and the relative strength of the new work sector compared to R&M. Under the World Markets and Global Responsibility scenarios, these two occupations also benefit from their relatively higher prevalence in the new work sectors, despite the likelihood that growth in off-site production could lead to a lower requirement for such skills.

Roofers are also relatively more prevalent in the new work sectors than in R&M, thus leading to a lower than average growth in employment under National Enterprise and Local Stewardship, where the focus has switched to R&M.

Demand for steel erectors and other structural trades grows more slowly than the overall average within the Base Case, but under the four scenarios there is little difference.

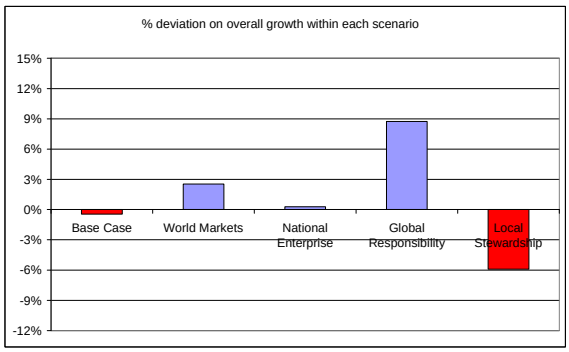
4.3.1.4 Building services engineering trades

Building services engineering trades are likely to have two pulls on relative demand going forward. Increasing use of off-site production and modern methods of construction may lead to a lower requirement for fully qualified plumbers and electricians as increasingly wiring and piping becomes an integral part of, for example, modular systems.

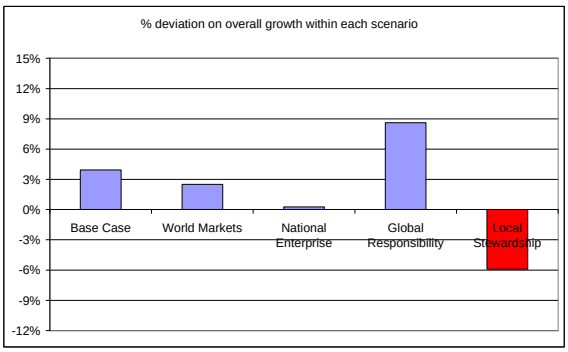
Conversely substantial growth in the take-up of renewable technologies and micro-generation to help mitigate climate change could lead to a significant need to expand the building services engineering workforce. Thus under the Global Responsibility scenario, with its emphasis on addressing climate change through carbon neutrality and micro-generation, employment requirements for plumbers and electricians grow faster than its overall average.

Figure 27: Building services engineering trades

Electrical trades & installation



Plumbing & HVAC trades

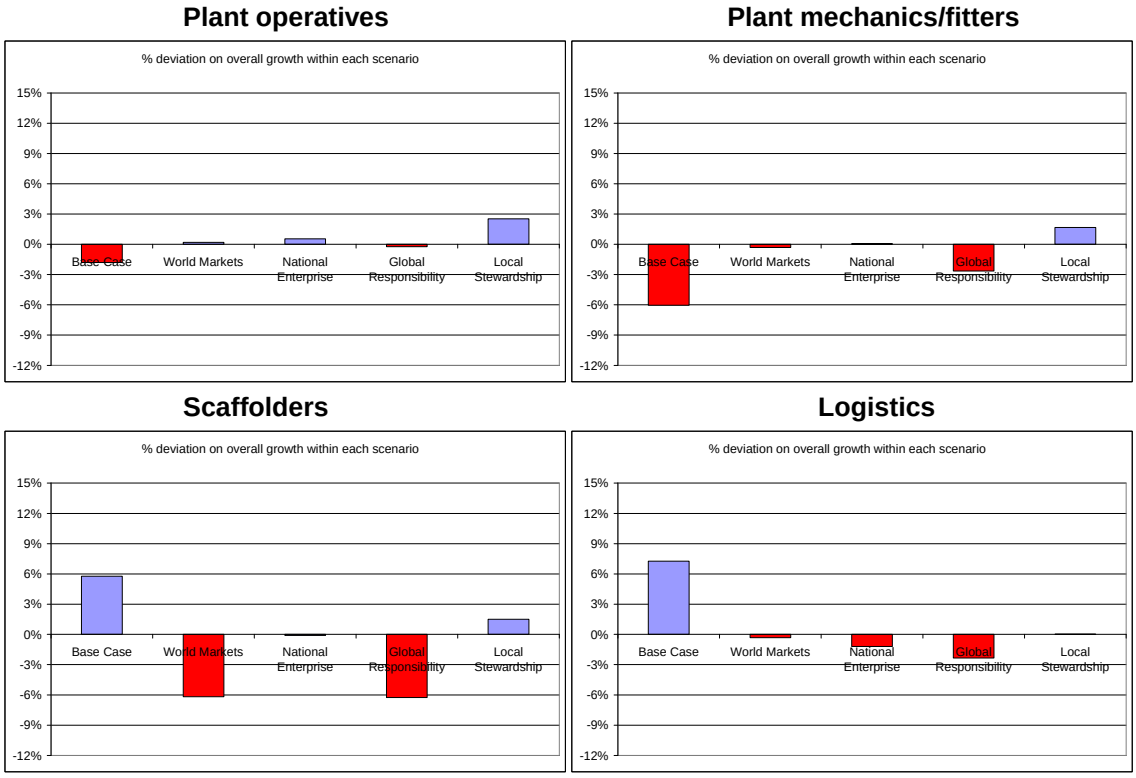


4.3.1.5 Plant related trades

Employment levels for plant operatives and plant mechanics and fitters are likely to grow roughly in line with overall growth within each of the four scenarios. Strong growth in off-site production is likely to lead to increased needs for craneage as large pre-fabricated sections are manoeuvred into position on-site, but demand for these two occupations is also affected by changes in the work mix, as they are more prevalent in the non-residential building sectors than elsewhere.

Demand for scaffolders is predicted to grow more slowly than the average within the World Markets and Global Responsibility scenarios as increased mechanization leads to an expansion in the use of access platforms.

Figure 28: Plant related trades



Logistics occupations (materials handling and transport as against logistics planning and scheduling) grow more strongly than the average within the Base Case, but are roughly in line with the average for the four scenarios under the assumption that increasing environmental concerns help to drive more local sourcing of products and materials where appropriate.

4.3.1.6 Other main trades

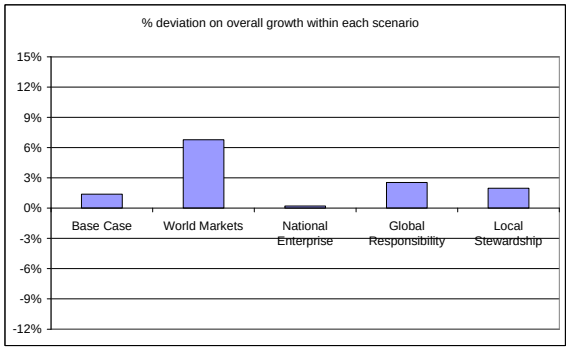
Wood trades & interior fit out employment grows at or slightly above the overall average within each scenario and the Base Case, except for National Enterprise. This occupation is relatively most prevalent with the commercial construction sector, which is one of the fastest growing under the World Markets scenario.

In contrast, painters and decorators are marginally more prevalent in the R&M sectors, favouring higher growth under National Enterprise and Local Stewardship.

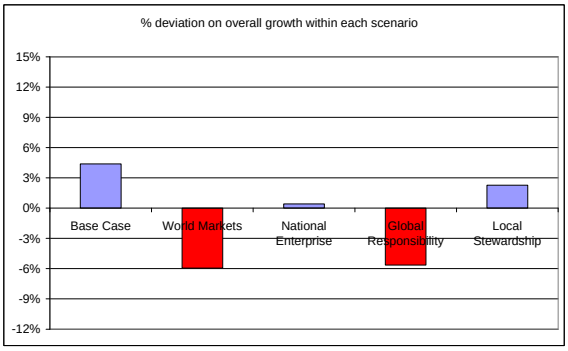
Furthermore, this occupational grouping may experience increased automation in an off-site setting under the World Markets and Global Responsibility scenarios. The same is true for floorers, while demand for glaziers grows more slowly than the overall scenario averages in all cases. This occupation is one considered most at risk from automated techniques in a factory environment. Glaziers are relatively more prevalent in the new non-residential building sector, hence the larger negative difference in growth under the Local Stewardship scenario.

Figure 29: Other main trades

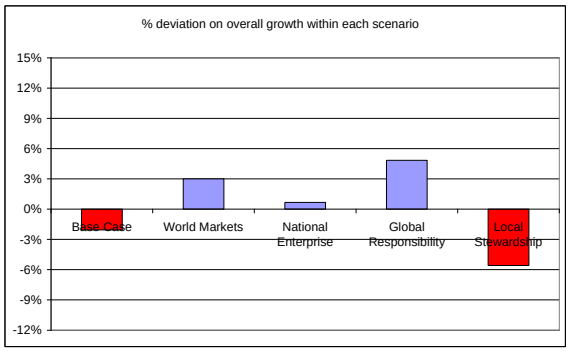
Wood trades & interior fit out



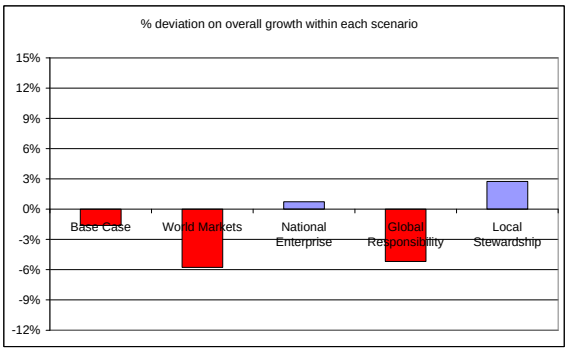
Painters & decorators



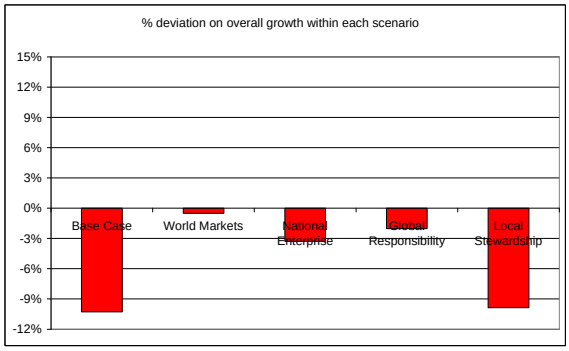
Plasterers & dryliners



Floorers



Glaziers



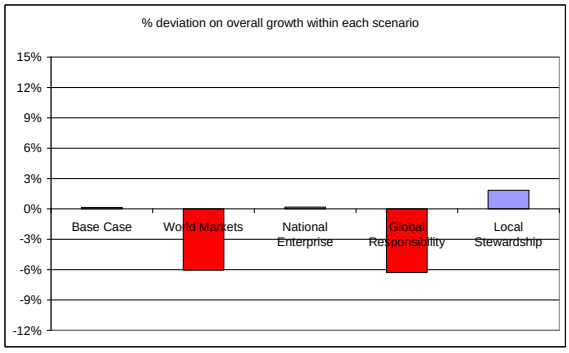
While plasterers and dryliners are expected to grow under the World Markets and Global Responsibility scenarios, increasing moves away from wet trades, particularly in an off-site environment, means that it will probably be the latter skills that benefit rather than the former.

4.3.1.7 Other occupations

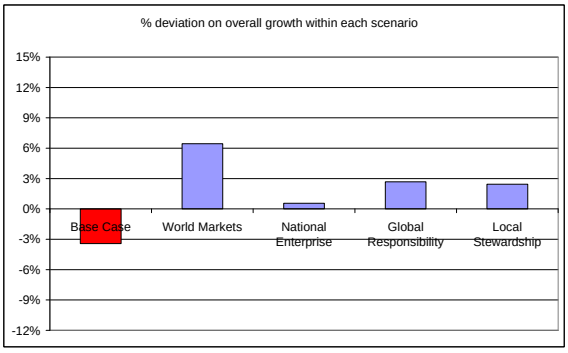
Standard Occupational Classifications give little indication of what might be included under the specialist trades nec grouping, but the assumption is that it could include a considerable number of what might be considered heritage skills of one sort or another. This would certainly account for the lower relative growth rates of this occupational grouping under the World Markets and Global Responsibility scenarios, with their higher focus on new work than National Enterprise and Local Stewardship.

Figure 30: Other occupations

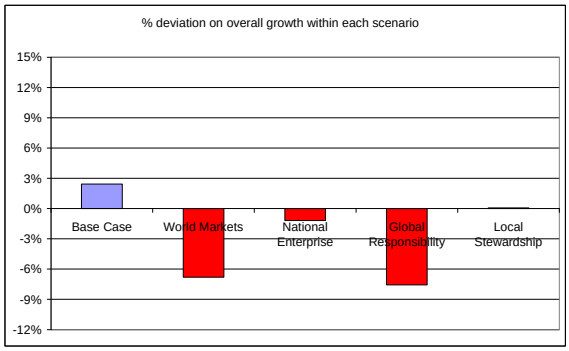
Specialist trades nec



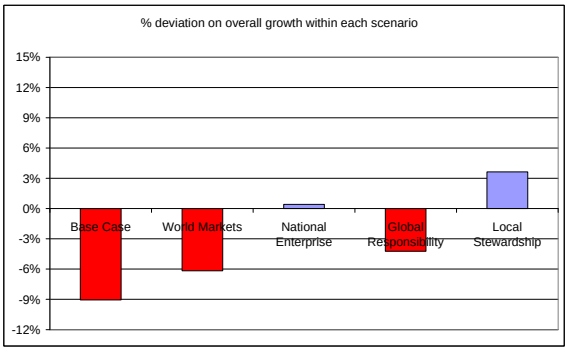
Labourers nec



Civil engineering operatives nec



Non construction operatives



The relatively slower growth in civil engineering operatives under World Markets and Global Responsibility is in part due to changes in the workload mix and also a shift towards a smaller number of bigger projects.

4.4 Some sensitivities

The Base Case and the four scenarios have adopted a range of assumptions about GDP, construction output growth, productivity gains, changes in the sector mix of work, growth in the level of off-site production, and the amount of construction activity driven by the imperative to mitigate climate change. The assumptions lie within a range thought likely given past trends and possible future developments. However, we have looked at two 'outliers' as examples of what might happen under two specific situations. One is that technological change in the industry speeds up to a level unheard of in the past; the other is that the world economy slows dramatically and the UK suffers a decade of little or no growth, as the current travails of financial institutions become much worse and spill over into the rest of the economy with prolonged adverse effects.

4.4.1 A high innovation scenario

In our calculations for the four scenarios, our assumption underlying a transfer of production from an on-site to an off-site environment was an annual average growth rate of 10% to 2020, which gave a best case outcome of off-site manufacturing accounting for about 12% of total construction.

However, what if the move to off-site was much faster than this, leading to perhaps 25% of industry activity moving off-site by 2020, accompanied by significant automation of processes? The table below illustrates the occupations that could be most significantly affected by a much stronger move to off-site than currently seems likely.

Figure 31: Likely effects of very strong move to off-site construction

Senior & Executive Managers	No significant effect
Business Process Managers	No significant effect
Construction Managers	Short project times, but more project management needed. Need to understand the total construction process and develop understanding of manufacturing processes
Office-based Staff (excl. Managers)	No significant effect, if off-site manufacturing staff remain recorded under construction employment
Other Professionals/Technical Staff & IT	IT grows to facilitate better project management
Wood Trades & Interior Fit-out	Significant level of automation – shrinking requirement for occupation and de-skilling
Bricklayers	Significant level of automation – shrinking requirement for occupation and de-skilling
Building Envelope Specialists	Could become more important on-site as skilled assemblers. Tighter tolerances, the need to make sure of a good fit on-site leads to increasing requirement
Painters & Decorators	Significant level of automation – shrinking requirement for occupation and de-skilling
Plasterers & Dryliners	Significant level of automation – shrinking requirement for occupation and de-skilling
Roofers	Less potential for automation than some trades, but could still see some change
Floorers	Significant level of automation – shrinking requirement for occupation and de-skilling
Glaziers	Could be the trade at most risk of substantial automation in a high off-site view – process of installation could become not dissimilar to that in a car plant
Specialist Building Operatives nec	
Scaffolders	Less demand for scaffolders, more use of access platforms
Plant Operatives	Likely to grow in importance
Plant Mechanics/Fitters	Likely to grow in importance
Steel Erectors/Structural	Likely to grow in importance

Labourers nec	Significant reductions as less work on-site requires less of the 'brickies mate' type of employment such as waste removal and clearing up
Electrical Trades & Installation	De-skilling in some areas off-site with manufacturing of pods with integrated electrical systems, but faster build times will require more intensive use of M&E employees on-site.
Plumbing & HVAC Trades	De-skilling in some areas off-site with manufacturing of pods with integrated and standardised plumbing systems, but faster build times will require more intensive use of M&E employees.
Logistics	Logistics planning and scheduling skills likely to grow in importance.
Civil Engineering Operatives nec	Largely unaffected by move to off-site
Non Construction Operatives	No significant effect

However, it should be recognised that there are limitations to any shift off-site. Its effects are mainly confined to the new work sector, which includes major refurbishment of non-residential buildings. It is difficult to see how working practices relating to the routine and cyclical maintenance of existing buildings would be materially affected until there is a significant stock of existing buildings that have been built using off-site techniques. This argument is further strengthened by the recognised need to provide traditional ConstructionSkills to service the Heritage sector, which is defined as all structures built before 1919. A report by English Heritage estimated that there were some 4.41 million historic dwellings, and 550,000 historic commercial buildings in England that came under this definition in 2005.

While this sensitivity has not been fully modelled, we have taken the World Markets scenario as that most likely to see the fastest technological growth and have assumed that the doubling of the rate of take-up in off-site production would produce a scenario where productivity gains for the new work sector would increase from 2% to 3% and R&M from 0.5% to 1.5%, giving an overall productivity gain of some 2% a year, equivalent to the "best case" productivity assumption referred to earlier in section 4.2 of this chapter. This results in overall output growth over the period 2006-2020 of 46%, but only a 17% increase in employment from the 2006 base.

4.4.2 A lost decade

The 'lost decade' sensitivity assumes that the current credit crunch has a lot further to unwind and that it severely damages the global economy. Protectionism rises sharply and economic growth and trade both stagnate with a sharp squeeze on corporate profits, employment and personal incomes. We thus end up in a situation of Local Stewardship "plus", lasting for a decade or more before easing. Under this sensitivity, construction output growth drops to zero on an annual average basis between 2006 and 2020. However, employment in the industry still grows by 14% as productivity declines by 0.3% a year over the period, and there is a very significant shift from new work to more labour intensive R&M activity.

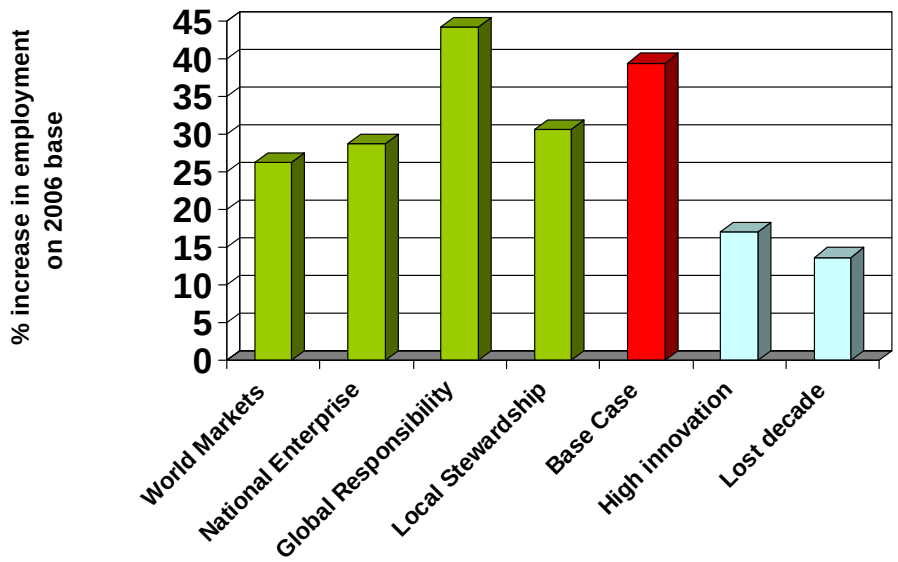
4.4.3 Overall employment sensitivities

Whilst it is possible that a combination of the two factors discussed above could work together to reduce 2020 construction industry labour force requirements to below 2006 levels, it is relatively unlikely. A buoyant level of demand growth and market competition is likely to be more

conducive to construction industry innovation, such as a swing towards MMC and employment saving productivity gains, whereas a stagnant level of total construction output may result in a proportionate shift towards more labour-intensive R&M activity where the potential application of MMC is more limited. Without both a prolonged economic downturn and a significant swing towards MMC, it seems unlikely that construction industry employment in 2020 will be below its 2006 level.

The effect on total employment requirements of the individual sensitivities compared with those of the four scenarios and the Base Case is show in Figure 32.

Figure 32: Change in employment 2006 to 2020



Source: ONS, Experian, SAMI Consulting, ConstructionSkills.

4.4.4 High Innovation construction model (2020 Home)

As an aid to evaluating the extent to which technological advance could be implemented in ideal circumstances we describe the construction process of a future home. This is an optimistic view of what might possible to maximise on-site productivity but not all suggestions may be desirable. No consideration has been given to costs.

Figure 33: The 2020 home

Foundations	Relatively conventional, reinforced concrete cast on-site, in insulating formwork. Concrete is self levelling, with formers/templates with holding down bolts for the panellised walls
Flooring	Ground floor arrives in several concrete insulated panels which will fit precisely onto the foundations. Services holes will be preformed in the correct positions.
Utilities	Utilities ducts will be built into the foundations pre-located in the insulating formwork
External Walls	Panellised external walls craned into position on foundations and secured, and external and internal joints sealed using proprietary systems. The panels are fully glazed, externally insulated and clad with brick slips. Services are incorporated into the walls off-site according to design. Inside faces are pre-painted/ready to paint

Pods	Pods for bathroom, toilets and kitchen arrive fully tiled with all services built-in, matching the service ducts in the floor slab. A building services pod with water heating, ventilation control, energy recycling, waste water recycling etc. is also installed to be connected to ducts and pipes pre-installed in walls and internal floors
Internal walls and floors	Internal walls and internal floors are panellised and slotted in by crane in conjunction with any pods. Internal walls arrive fully finished with click fit cabling installed. Some jointing is required on some walls. Where possible internal walls are designed without services within them to permit easy removal/relocation of walls at a later stage
Heating/cooling system	Minimal heating /cooling is provided through air circulation systems, ducts pre-installed in internal floors or walls. The administrative unit is pre-installed in the services pod
Roof	Pre-insulated and pre-covered roof panels are craned into position in conjunction with mechanical moveable working platforms. All joints click fit with minimal bolting etc. to complete structural and weather proof integrity. Rainwater furniture also click fit to pre-installed attachments on the roof and wall panels. Roof probably comprises photo-voltaic cells
Floor Coverings	All floor coverings arrive accurately cut to fit rooms. Coverings can be laid directly onto the panellised floor slab or internal floors
Alarm systems, building control, entertainment systems	All wireless. Where necessary units are pre-installed off-site

4.5 Early warning signs

The following table highlights some of the early warning signals that could act as major indicators of the direction in which the world is moving. They are by no means mutually exclusive and it is likely that a combination of factors will need to come together before it will be possible to say for definite towards which scenario we are likely to be moving. Other, more construction-specific factors can also provide an indication of the way forward, such as underlying trends in output and productivity, and movements in the workload mix, in particular between new work and R&M.

Figure 34: Early warning indicators

Indicator	World Markets	National Enterprise	Global Responsibility	Local Stewardship
Open world markets (1) versus protectionism (2)	1	2	1	2
Increased international co-operation/co-ordination (1) versus retreat to nationalism (2)	1	2	1	2
International democracy (1) versus local democracy (2)	1	2	1	2
Self-regulation (1) versus government diktat (2)	1	1	2	2
International contractor domination of construction markets (1) versus continued fragmentation (2)	1	2	1	2
Rapid innovation & take-up of off-site construction (1) versus business as usual (2)	1	2	1	2
Stabilisation of energy markets (1) versus further escalation of energy costs and energy security concerns (2)	1	2	2	2
Fragmented national/local response towards combating climate change (1) versus strong international consensus & agreement (2)	1	1	2	1
Move to carbon neutrality rests on aspirational targets and pricing (1) versus pricing, regulation, taxation and subsidy (2)	1	1	2	2
Social responsibility (1) versus dog-eat-dog (2)	2	2	1	1
Mobility of international labour markets (1) versus controls/other constraints on international movement of labour (2)	1	2	1	2

5 Conclusions

5.1 Basis of the scenarios

This report has developed and considered the potential construction employment and skill implications of four possible alternative scenarios or views of the future together with that of a Base Case which represents an extrapolation of recent trends. The scenarios deliberately cover a range of different futures. In addition to the scenario storylines, we have made a number of quantitative assumptions regarding construction output and productivity growth which are considered to be realisable within each of those storylines. This has enabled us to obtain a broad indication of the quantitative changes in industry employment requirements which might occur by 2020. As previously emphasised, the nature of scenarios is such that the figures so obtained do not represent a set of forecasts but rather a series of plausible outcomes which can be used to inform future thinking.

5.2 Changes in construction output levels

Under the Base Case and the four scenarios as developed, total construction (new plus repair, maintenance and improvement) output grows cumulatively in real terms over the period 2006 to 2020, such that in 2020, it lies within a range approximately 15% to 50% above its 2006 level. The upper levels assume that despite some probably inevitable short-term cyclical fluctuations, the global economy will continue to enjoy the levels of stability and growth seen over the past decade or so and that in addition, growing concerns over climate change and energy security will lead to the increased levels of investment aimed at creating an energy efficient and sustainable built environment.

However, while total new work output in 2020 under the Base Case, World Markets and Global Responsibility scenarios could be around 50% higher than its 2006 level, it is only anticipated to be slightly higher under the National Enterprise scenario and is actually a little lower under the Local Stewardship scenario. Thus, whilst significant real growth in new construction output is a real possibility, it is by no means certain.

In contrast, the Base Case and all four scenarios suggest a real increase in R&M construction output over the period to 2020, with the cumulative level of growth ranging from perhaps a little over 20% under the Base Case up to around 50% under the Global Responsibility scenario.

5.3 Construction industry employment levels

Under the Base Case and all four scenarios being considered, a significant increase in construction industry employment could be expected. Indeed, the scenario assumptions adopted point to an increase of somewhere between one quarter and approaching one half over the period 2006 to 2020, or an additional 0.6m to 1.1m jobs on top of the 2006 total of some 2.4m.

While under the National Enterprise and Local Stewardship scenarios, the assumed rate of economic and construction output growth is lower than under the other scenarios, the downward pressure on employment growth is partially offset by the likelihood of a higher proportion of R&M growth and a lower rate of innovation and productivity growth.

Analysis of construction industry trends and drivers suggests that perhaps only two major factors could result in substantially reduced levels of construction industry employment in 2020 from those envisaged under the four chosen scenarios and Base Case, namely:

- a very serious and prolonged economic and financial downturn and/or major structural constraint on further growth such, for example, as an acute energy shortage, which resulted in a long-term fall in total real construction output. A downturn of such severity would not be without global precedent, and while Local Stewardship envisages a difficult economic environment, a severe and prolonged recession has not been incorporated in any of the scenarios under discussion. It must nevertheless be viewed as a potential downside risk, albeit perhaps an outside one;
- a very marked acceleration in the growth of off-site production over and above that envisaged under the selected scenarios, coupled with a high degree of automation in the associated manufacturing processes.

Whilst it is possible that a combination of these two factors could work together to reduce 2020 construction industry labour force requirements to below 2006 levels, it is perhaps relatively unlikely since a buoyant level of demand growth and market competition is likely to be more conducive to construction industry innovation, a swing towards MMC and employment saving productivity gains, whereas a stagnant level of total construction output may result in a proportionate shift towards more labour-intensive R&M activity where the potential application of MMC is more limited; and without both a prolonged economic downturn and a significant swing towards MMC, it seems unlikely that construction industry employment in 2020 will be below its 2006 level.

Analysis of the conditions that might be expected to prevail under the four different scenarios being considered points to a number of specific conclusions with respect to future construction industry employment and skill requirements, a number of which are strongly interlinked.

5.4 Total workforce requirements

The scenarios suggest that there is a fair chance that there could be a substantial increase in UK construction industry total employment requirements over the next ten to fifteen years. Under certain of the scenarios this could also be combined with a very competitive and open global market for workers with professional and other skills, leading to a possible reversal of the recent migration of construction workers into the UK. Competition for new industry recruits, in what could be a reducing overall pool of labour, may therefore intensify.

There is consequently a strong and urgent case for the UK construction industry to address how a career in the industry can be made more attractive to potential employees in order to improve both recruitment and retention. This is likely to require a combination of measures, including improved health and safety, better on-site conditions, ongoing training and career development and other steps to enhance productivity as a possible means of paying competitive remuneration packages.

The industry may also be able to tap a wider pool of potential labour if it is able to embrace MMC on a much more meaningful scale and move a significantly greater proportion of its production into a factory environment, a step that should also have the potential to increase labour productivity and reduce overall labour requirements.

Should the higher rates of future construction industry employment growth and skill demand envisaged in certain of the scenarios fail to materialise, either as a result of events external to the industry or measures taken by the industry itself to improve labour productivity, then the industry will have the option of adjusting its future rate of recruitment and training accordingly. To ignore or delay the scale of potential recruitment and training challenge, however, could lead to an acute construction industry skills shortage.

5.5 Energy efficiency and carbon neutrality in the built environment

All four scenarios envisage growing pressure for improved energy efficiency across the built-environment, although there is some variation in the precise drivers for such change (for example, awareness and action on climate change fears, adaptation versus mitigation, and/or concerns over energy costs and security), in the pace at which such change occurs and in the nature of the response.

Under all scenarios, there is likely to be a need for a broad-based and early improvement in basic skills and knowledge associated with energy conservation.

Pressure for improved energy efficiency is also likely to result in various changes in construction methods with an emphasis, among other factors, on achieving improved air-tightness. Coupled with the problems that could arise from the rate of increase in industry employment and skill requirements, this may act to reinforce the potential advantages of using larger pre-fabricated components produced off-site.

In terms of specific skill needs, all else being equal, a shift towards construction of more energy efficient buildings can be expected under most scenarios to increase demand for electrical and hvac trades, due both to the installation of more monitored and controlled building environments as well as greater investment in renewable sources of energy.

M&E tradespeople may require greater skills in assembly and commissioning than at present, particularly in the event of more off-site manufacturing. Indeed, the breadth and depth of skill needed may in some instances be narrower than in the past, as the knowledge required may be limited to that necessary to connect and install pre-assembled proprietary controls and other equipment rather than to build entire systems on-site.

Indeed, dramatic increases in the use of technology such as micro-generation are likely to be dependent on cost reduction and therefore on maximising the use of off-site components, leading to complete packaged modules that will simply need fitting on-site and connecting to the electricity system. The installation may not necessarily involve fully trained electricians, but will probably need specially trained installers who understand the structural issues

The methods of construction adopted to achieve greater levels of energy efficiency are also likely to favour a relative increase in demand for woodworking and other dry trades and in building envelope and internal panel assembly skills in general. Some de-skilling on-site may occur, but those involved will need to know how to handle, assemble, connect and commission components correctly without causing damage. Some suppliers may provide equipment on a supply, install and commission basis.

Those being given trades training will need to have the basic education to be able to read, understand and implement instructions for new methods and materials; in some instances, this may mean a raising of the educational standards of recruits.

Finally, greater use of larger prefabricated panels and other building components is likely to result in more intensive site craneage, powered access and other mechanisation, requiring additional technical and health and safety skills.

5.6 Construction professionals and managers

The expected shift towards greater energy efficiency and sustainability will place new demands on both construction industry professionals and construction managers.

Under all four scenarios, albeit to a varying degree, there is likely to be an increased focus on the whole life performance and cost of buildings and infrastructure, particularly with respect to issues of energy usage. This will require a higher level of understanding on the part of the construction professions of whole building performance and how the different elements of the building inter-relate to drive overall performance and cost. To the extent that such changes are accompanied by an increased shift towards off-site production and prefabrication, designers will also have to acquire the skills not only to design the building against new performance criteria but also how to design and configure components in such a way that they can be manufactured efficiently using an automated factory process. This may present a sizeable challenge, given the historic compartmentalised structure of the UK construction industry.

Construction managers too will need a broader level of understanding with respect to the design and construction of the building (where each individual unit may require certification to a given performance standard) and, if MMC are increasingly adopted, to project planning, logistical planning and commissioning as well.

A higher level of supervision is also likely to be required across site activities to achieve the requisite standards of build.

5.7 MMC and off-site production

The fastest progress in achieving greater use of MMC and off-site production is assumed to occur under the World Markets and Global Responsibility scenarios. Lower rates of growth, competition, innovation and new construction together result in a lower rate of take-up under the National Enterprise and Local Stewardship scenarios.

Some of the potential drivers for MMC have already been flagged in the preceding paragraphs.

Obtaining critical mass and scale of production will be key to any marked acceleration in the rate of take-up of off-site production and this in turn is likely to hinge critically on a greater degree of standardisation of design detail and components. This is all most likely to occur with a broadly-based combination of government (as potential facilitator, sponsor and major client) and other client and cross-industry support. To date, the level of dialogue and collaboration between designers, contractors and building material producers appears to be sadly limited, and the

industry needs to adopt a much more proactive stance on this issue. Material and equipment producers are unlikely to be willing to risk and fund the necessary investment in automated production facilities without strong support from elsewhere in the industry. Anything that can be done to improve the dialogue between manufacturers and others in the construction industry is to be welcomed, given the recruitment, skill and climate and energy related issues facing the latter.

More generally, there also needs to be a close watch on, and study of, the implications of growth in off-site methods and what precise skills will be transferred, lost or learnt.

5.8 Planning and logistics

Greater use of off-site production and prefabrication of larger components is likely to be accompanied by more rapid on-site construction times for projects accompanied by increased demand for project planning and for logistics planning skills to ensure correct sequence and timing of delivery of components to site.

5.9 Information and telecommunications technology

There is a generally accepted view that the current trends in the use of ICT in design will be extended in quality and scope, even if the pace of development and application within the construction sector may well vary across scenarios.

The logical extension is for greater use of ICT on-site, integrating design with the manufacturing, delivery, construction, commissioning and operational processes, although this is likely to be truer of larger sites and new-build, rather than of small sites and R&M work.

The main areas where change may variously be expected to occur include:

- Greater use of integrated information systems, with a critical need for much increased interoperability between different systems, covering design, scheduling, manufacture, delivery/site logistics through CAD (3D, object based, 4D, 5D – including cost and time) if the potential is to be maximized.
- Full integration of site drawings with off-site manufacture and design.
- Components tracked onto site (barcodes etc.) through automated procurement and supply networks, with guidance for installation, maintenance and even to eventual recycling.
- Use of hand held devices on-site to access information requiring an on-site workforce that is computer literate and skilled in working collaboratively.
- Client demand for higher levels of information, in particular for visualisation of buildings/walkthroughs and virtual prototypes, to assist design, procurement and asset management, and timely decision making.
- Connection of design models to off-site factories to enable easier bespoke construction.
- Development of design models for training in the operation, maintenance, application and use of specialist buildings (hospitals etc.).

- Improved information for owners and users of completed buildings.

At professional level, the main skills and training implications appear to be the continued development of CAD skills and greater effectiveness in, and attention to, detailing.

Construction professionals will need to have a wider skill base in ICT operations to integrate design, scheduling, manufacture, delivery/site logistics. As is the case with MMC and the drive for carbon neutrality, this will involve the application of a wider range of skills than that currently held by many individual professionals including design disciplines, in particular an appreciation and understanding of how the various elements of a building inter-relate both with respect to its construction and lifetime performance.

Until there is more integration between site and designer, there will be little site advantage of much higher levels of ICT, outside the possibility of working to the latest updated drawings. However, if such changes occur, there will be changes in the skills needed to take full advantage. Higher levels of logistical planning skills, scheduling and site administration will be required. It is probable also that site supervisors will need to liaise more with designers and suppliers than at present.

Also on-site by 2020, operatives could routinely use hand held devices giving installation, programming and safety information etc. (Super-Blackberries for builders). The hardware and software probably already exist. What is currently missing is wide application of the intellectual input and the ability to disseminate relevant material. The skills required for using these devices are twofold: first, the ability to use small electronic equipment; secondly, the ability to use the information available, to understand that the information is necessary, and the need to apply it accurately. This will require general education in construction rather than specific skills training.

Apart from improving the construction process, ICT is likely to provide the potential ability, through built-in sensors/intelligence, to monitor the use and maintenance of a building component throughout its life, calling for intervention if necessary, from humans or by communicating with other components. Buildings may also contain more remotely-controlled devices: enabling users to ‘drive’ many aspects of buildings from elsewhere. The installation of these items is not considered likely to have a great impact in on-site skills requirements.

Finally the wider use of ICT is likely to change the end use of buildings and affect their design and operation. More rapid change will require greater flexibility in designs and during the design period, imposing further demands on designers.

5.10 Repair and maintenance

The market for R&M is anticipated to increase in size in real terms between 2006 and 2020 under all four scenarios being discussed. Although the retro-fit/R&M market may not be a strong driver of new and additional skills, its size and prospects nevertheless mean that there is a clear need to preserve “heritage” skills, a need that may be reinforced as a result of the expected increase in pressure to retro-fit or upgrade existing buildings to improve their energy efficiency in response to concerns over climate change and/or energy costs and security.

5.11 Multi-skilling

The anticipated future demand for R&M services can be expected to sustain a strong level of demand for multi-skilled tradesmen, both to ensure acceptable levels of productivity and cost, particularly on smaller projects, and because a growing level of upgrade and retro-fit work is likely to involve tasks that cross traditional trade boundaries. Indeed, there seems likely to be an increased need for “hybrid” trades (e.g. plumbers with some electrical knowledge) because of blurring of boundaries and multi-skilling in general.

In the new work market for smaller projects, in particular, demands for a pool of multi-skilled workers may result from pressures to improve productivity and adapt to new methods of construction where traditional trade boundaries perhaps become blurred. However, such demands may well occur in parallel with an element of de-skilling and growth in (perhaps semi-skilled) specialisms on larger projects, also a response to application of new methods and materials.

5.12 Evolution of skill requirements and training courses

Change is a feature of all four scenarios, albeit at different rates and in different directions, and with such change will come at least some degree of further innovation with respect to construction methods, materials and resulting skill requirements.

Industry sources have referred to the frustrations that can arise for both employer and newly trained employee when colleges or other training fail to keep abreast of the technical developments and associated changes in construction methods and skill requirements that are occurring on-site, and that as a result, albeit perhaps in extremis, the newly qualified employee arrives on-site to find that his or her newly acquired skills are redundant.

While the problem may not be an easy one to solve, it would appear that more attention needs to be given to improved liaison between training organisations and industry employers in order to ensure that the appropriate courses are continually updated in the light of site practice. Whether it is feasible to reduce time spent in class on acquisition of basic generic construction skills onto which specialist or even proprietary skills can then be bolted, perhaps largely through subsequent on-site training, appears worthy of investigation.

Given the changes anticipated within the industry, there is also likely to be a greater ongoing need for a combination of retraining, re-skilling, and upskilling of those already in work, particularly as a substantial proportion of the industry’s 2020 workforce is already at work in the industry.

Indeed it is important to stress that training will also not just be about numbers, but also about possibly small and subtle, but nonetheless important, shifts in the future skills and knowledge required by a particular trade.

5.13 Health and safety

It is probable that the drive to improve health and safety in construction will also continue to a degree in all the scenarios being considered, driven by clients, government and enlightened contractors, although the safety content of training can be expected to be higher in the socially cohesive scenarios than in the individualistic scenarios.

Optimistically, the accident rate will fall in all the scenarios, and there will be systems in place to maintain this improvement, requiring training. Increasing client awareness of the risks and criminal liabilities, particularly under the more socially cohesive and regulated scenarios, is likely to mean that safety by design will be viewed as part of the normal design process.

In all scenarios it will still be the larger new-build construction-sites that will have a significantly higher emphasis on safety, and hence a higher demand for safety training, rather than the smaller renovation or R&M projects. In the high innovation scenarios, changes in products and processes will require continual reassessment of the level and type of training in site safety to meet the needs of the new processes, such as heavy lifts and using new equipment.

5.14 Change in industry culture

The various skill changes anticipated in the industry and flagged above require new technical and practical knowledge.

However, to a greater or lesser extent under all scenarios, a change in industry and employee culture and mindset will also be essential if the anticipated requirement for improved quality, accuracy and precision (vis-à-vis improved energy efficiency, greater prefabrication and air tightness standards) is to be achieved successfully and if damage and waste during construction is to be avoided. This change in mindset will require training, an explanation and understanding on the part of the workforce as to why the change is required, and clear leadership at all levels and from all industry participants including clients. Again the industry should look to acquire new entrants with a higher level of educational achievement.

5.15 Key indicators of change

Reference has been made in Chapter 4 to the early warning indicators that may help to identify the precise direction of future changes within the UK construction industry and the resulting skill requirements. In turn, these could assist the industry in achieving a better degree of forward planning and preparedness for change.

It is therefore recommended that changes in the environment within which the industry operates, together with key industry practices, should be regularly monitored as an aid to improved long-term workforce planning and training.

Appendix A

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Appendix B

About us

Who we are

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