

Changing to Compete

Review of Productivity and Skills in UK Engineering Construction

Submitted to the Secretary of State for
Business, Innovation and Skills



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Foreword

Following the dispute in February 2009, about the use of foreign contractors and labour on UK engineering construction projects, Lord Mandelson asked me to review the productivity and skills of the industry in the UK and make recommendations.

It has been clear from our discussions with a wide range of managers, union officials and shop stewards that the industry can take pride in several areas. It has a good health and safety record. There is a highly skilled workforce. It completes a wide range of major capital and repair and maintenance projects to a good standard. The UK is fortunate still to have the engineering and craft skills needed to build new infrastructure projects.

Many in the industry, however, believe that its productivity could be significantly improved and that is also my conclusion from the evidence the Review team has compiled.

The changes that will need to happen to achieve better productivity are complex and inter-related but are largely to do with better management of projects and improving the relationships between employers and employees and their unions.

Other industries in the UK have faced similar problems and have been able to overcome them and emerge in much better shape. Engineering construction has to do likewise and could benefit from a greater willingness to learn from other sectors and its own successes. The changes recommended in this report are important if the sector is to take full advantage of the new nuclear, other power generation and large industrial projects over the next 20 years.

It has been a pleasure to work with clients, contractors, unions and the workforce on this review. They have all given very generously of their time over the past six months. I appreciate their help and hope my recommendations will help achieve a better future for all who work in this industry.

I am also very grateful for the excellent support I have had from my Review team of David Rawlins and Tanya Sheridan, Christopher Moir (Warwick University) and officials in the Department for Business, Innovation and Skills and the Department for Energy and Climate Change.

Mark Gibson

Chief Executive

The Whitehall & Industry Group

Executive summary

This Review of engineering construction has sought to answer two fundamental questions. First, is it the case that productivity and skills in UK engineering construction lag that of other industrialised countries, particularly the United States and Continental Europe? Second, regardless of the productivity position of the UK-based industry, what more should be done to put the UK-based engineering construction industry and workers in a good position to compete for business and jobs in the UK and internationally?

The engineering construction industry accounts for only 0.4% of the Gross Value Added in the economy but is critical to the UK's future investment in vital infrastructure. It designs, engineers, constructs, maintains, repairs and decommissions plant for the energy, chemicals and oil and gas sectors.

The evidence available to the Review suggests that the productivity of engineering construction projects in the UK is very variable – up to 30% better or worse than the average. This variability far exceeds the gap between the UK and other countries. However, for the construction, repair and maintenance of oil refining, chemical and pharmaceutical plant, the productivity of projects in the UK between 1998 and 2008 lagged the US Gulf Coast by 11% and Continental Europe by 5%.

The Review has found that the technical skills of the UK workforce are as good as those in other countries. This reflects the high quality training being provided by the Engineering Construction Industry Training Board, backed by contractors and trade unions. There are, however, concerns about the quality and number of supervisory staff available as well as the availability of some craft trades, experienced planners and project managers.

The second question is particularly important. The need to move to low-carbon sources of energy, particularly electricity, will require substantial investments around the world. Building nuclear and other low-carbon electricity generation, building biofuels plants and increasing the energy efficiency of existing process plant are important parts of the transition to a low-carbon economy. The pressing need to reduce carbon emissions makes it vital these projects are completed on time, on budget and are of good quality.

There are some excellent projects in the UK. The variability, and in some cases under-performance, seen on productivity is due to the patchy use of best practice in project planning, project management and industrial relations management. This has been combined recently with unprocedural action among the workforce which, as well as decreasing productivity, has harmed the industry's reputation.

Both clients and contractors should lead improvements and this Review concludes that **the Capital Projects Clients' Group should be established formally by March 2010 to drive improvements in the performance of UK projects. Also, the remit of the Engineering Construction Industry Association should be expanded to promote the use of best practice on productivity and a programme of activities established with its members by June 2010.**

Many different skills and competences are important for the success of engineering construction projects. The UK engineering construction industry has a statutory levy to fund training and the Review Team has also heard about good practice by individual employers – particularly in training graduate engineers and designers. However, the current funding arrangements are not providing enough training places for UK workers to be able to take advantage of future opportunities. Employers in the industry are reluctant to increase the training levy, partly because of competition from non-UK companies who generally do not pay a UK training levy. Also, employers' rates of return on training are low due to short-term employment caused by fluctuating workloads.

With the large growth in workload anticipated in future, there will be a more general skills shortage – it is estimated that there will be around 30,000 extra job opportunities by 2014/15. This Review recommends that the skills shortage should be addressed by the industry, clients and Government by **doubling the numbers of relevant apprentices from 500 on-site apprentices in 2009 to 1000 by 2011 and increasing the number of training places offered on engineering construction projects. Government should contribute £4.5 million per year to this training from the funding announced in its recent Skills Strategy.** Working with Government, the industry should also look for opportunities to develop the skills used in engineering construction through projects in other sectors.

This Review concludes that **the training levy should apply to non UK-based companies as soon as possible but acknowledges that the Engineering Construction Industry Training Board will need to consult further** to ensure full discussion of the costs and benefits and to find a workable way to implement such a change.

The recent poor industrial relations are of major concern to clients, contractors and unions in engineering construction. Some clients and contractors interviewed felt it was putting future investment in the UK at risk. This Review recommends **contractors, unions and the workforce should work together to ensure good industrial relations across the industry through dialogue and by building trust on all sites.** The Review heard strong views from the workforce about foreign workers undercutting UK terms and conditions but has not found any evidence that this is the case. It welcomes further moves in the recent agreement between employers and unions to ensure transparency in the application of terms and conditions.

Due to the cyclical and seasonal nature of the engineering construction industry, many people expect to be employed for a short period of time and to change employers frequently. This lack of continuity of employment seems to be a significant factor in the training and industrial relations issues the Review has encountered. Some companies see a business case for providing continuous employment for a majority of their workforce: better trained and more committed employees.

The Review notes that large investment programmes provide opportunities for investment in skills and greater continuity in employment relationships. This Review recommends **the Department of Energy and Climate Change should set out, in its planned 2050 Vision document, potential scenarios for the progressive decarbonisation of the power sector and roles that might be played by different types of generating plant consistent with security of supply and the transition to a low carbon economy, backed as far as possible by a stable regulatory framework** to facilitate such investment programmes.

There is a detailed set of rules on terms and conditions and industrial relations for craft workers in engineering construction, the National Agreement for the Engineering Construction Industry (NAECI). While this agreement seems to limit the opportunities to attract people to the industry with terms and conditions that suit their personal circumstances, employers and the workforce want to retain this standardisation. This Review has seen evidence that NAECI rules are not always properly enforced or given due regard. This Review recommends that **all parties should ensure the NAECI is fully implemented.** Furthermore, it recommends **there should be a collaborative look at how the NAECI agreement could be developed to meet the needs of future large projects, particularly nuclear new build.**

Finally, this report summarises previous research and initiatives aiming to improve productivity and skills in the UK engineering construction industry. The Review has sought to build support for collaboration and change from the most important players in the industry. It recommends that **a Forum should be established by January 2010 bringing together clients, contractors, trade unions and bodies such as the National Joint Council together with Government for 18 months to oversee implementation of the Review recommendations and to catalyse action and promote change.**

1. Purpose of the Review

- 1.1** This Review was established by Lord Mandelson and John Denham against a backdrop of concern among clients and UK engineering construction contractors of under-performance in the industry. There was a perception that poor productivity was a barrier to UK-based companies winning contracts. It also followed the recommendation by ACAS, following the industrial dispute at the Lindsey Oil Refinery in February 2009, that such a review should “consider the productivity, skills and employment relations issues bearing on the overall competitiveness of UK companies in tendering for projects on large construction sites.”¹
- 1.2** As part of the move to a low carbon economy, government policy on nuclear energy is to enable investment in the UK from the earliest possible date and with no cap on the amount of new build. This highlights the importance of having a highly productive industry able to build and maintain these new power stations. These will be huge investments of time, money and manpower.
- 1.3** Nuclear power will be an important part of the generating mix needed to meet the UK’s energy needs and targets for reducing emissions and it is essential that nuclear, clean coal and renewable projects are delivered successfully. Further investment in gas-fired power stations – and in other facilities such as gas storage – will also be needed and there will be significant opportunities for UK-based companies from this investment and other investment around the world. Given the long lead times for change in this industry, it is important to identify and address now any problems in productivity and capability that exist.

¹ ACAS (2009) Report of an inquiry into the circumstances surrounding the Lindsey Oil Refinery dispute.

For example, the target of 15% of energy to be generated from renewable sources by 2020; DECC (2009) *The UK renewable energy strategy 2009* http://decc.gov.uk/en/content/cms/what_we_do/uk_supply/energy_mix/renewable/res/res.asp

Terms of Reference

- Assess the state of productivity in engineering construction in the UK
- Identify the key inhibitors to productivity, including skills
- Compare productivity levels with those experienced on overseas sites
- Identify changes in practice and factors and their effect on productivity in the period since the ECITB 2005 review
- Identify specifically the factors influencing success for UK-based companies bidding for UK and foreign, especially other European Union, engineering construction contracts (over the last 6 years)
- Make recommendations on:
 - Ways to improve skills and productivity in the UK engineering construction industry
 - What steps small firms can take to compete and to develop new skills and technologies in process
 - Strengthening the links between procurement of major public projects and provision of training through methods such as contracting
 - How procurement practices can be geared to support productivity in UK firms

2. The Engineering Construction Industry

- 2.1** The engineering construction industry in the UK designs, engineers, constructs and maintains process plant across the oil and gas, water, environmental, steel and metal, cement, glass, paper, brewing and distillation, food, power generation, nuclear waste reprocessing, pharmaceuticals production, petrochemical and chemical sectors. It represents around 0.4% of whole economy GVA² and makes a vital indirect contribution to the economy by supporting its infrastructure. This Review has considered the on-shore engineering construction sector, covering both on-site and off-site work.
- 2.2** Out of the sectors above, the main **clients** for the industry are power generation, oil and gas, chemical and biofuel companies. After successive rounds of consolidation and mergers over the last 15 years, most of these companies are multinationals and many have their headquarters outside the UK. Recent **major capital investments** in engineering construction include Combined Cycle Gas Turbine power stations and Combined Heat and Power plants (RWE Npower, E.ON, EDF, Marchwood Power, Dong Energy, Centrica, Conoco), Flue Gas Desulphurisation of coal fired power stations (Scottish and Southern, Scottish Power, RWE Npower), Liquefied Natural Gas storage and handling facilities (Transco, South Hook LNG, Dragon LNG), Biofuel production (Ensus, Vivergo), oil refinery upgrades (BP, Total, Exxon, Chevron, Shell) and chemical works (Ineos, Basell, SABIC).
- 2.3** These and other clients also invest in **smaller projects and repair and maintenance** undertaken by engineering construction contractors.
- 2.4** There are also significant anticipated capital investments in the UK and overseas in new low-carbon energy generation. This includes renewable energy, nuclear, combined heat and power, biofuels and clean coal with carbon capture and storage. It is estimated that the global market value of nuclear new build could be £20 billion per year by 2020.³ The renewable energy sector was worth £31 billion in 2007/8 (build, repair and maintenance and other activities) and is forecast to grow by more than 5% per year.⁴ There will also be engineering construction work, decommissioning older nuclear power stations and adapting process plant to increase resource efficiency and meet changes in demand. For example, in the refining sector, demand for diesel and aircraft fuel is increasing and for petrol, reducing.⁵
- 2.5** In the **supply chain**, approximately 330 engineering construction contractor companies are members of the industry's trade organisation, the Engineering and Construction Industry Association (ECIA). The turnover of the 10 most active contractor companies in 2007 ranged from £410 million to £2.4 billion. About 250 of the member companies are SMEs (less than 250 employees).⁶

² Estimate based on comparison of the engineering construction industry with the general construction industry in terms of turnover and GVA. Not all of the revenue of companies operating in engineering construction comes from that industry so this estimate is likely to be at the upper limit of the industry's contribution to the whole economy.

³ BIS (2008) *Economics Paper: Towards a low carbon economy – economic analysis and evidence for a low carbon industrial strategy* p80.

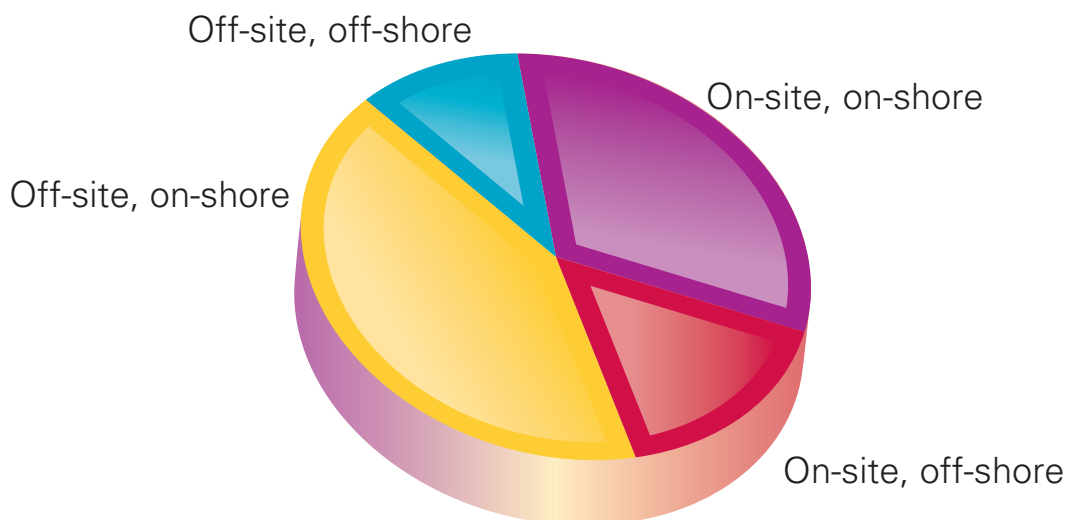
⁴ *Ibid*, p60.

⁵ M. Wicks (2009) *Energy security: a national challenge in a changing world* p110. DECC.

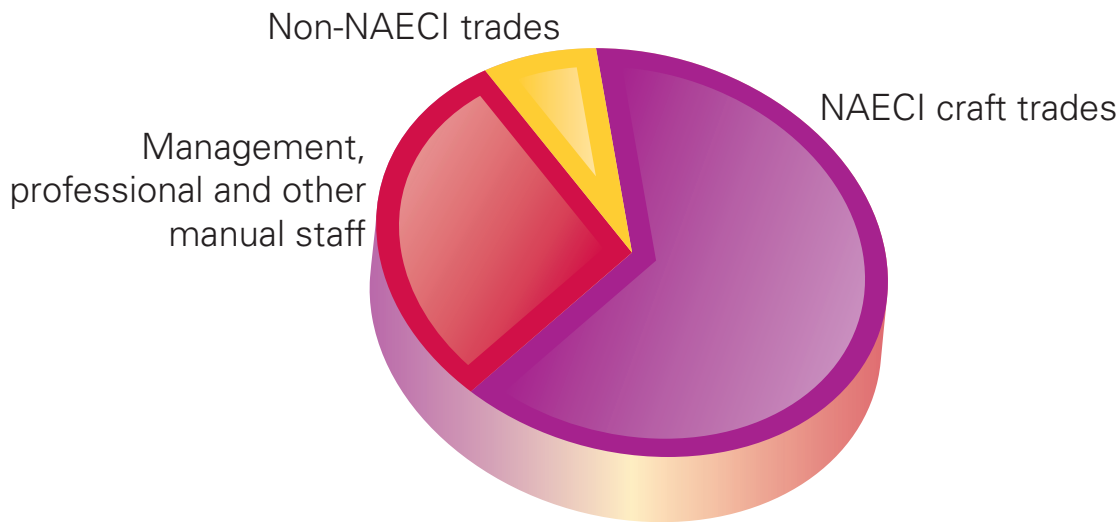
⁶ By comparison: in 2007 there were approximately 270,000 companies in general construction; companies in the top 10 by turnover ranged in size from £1.3 billion to £5.8 billion; and there were approximately 200,000 SMEs.

- 2.6** The majority of the work carried out by the industry (most major projects and some smaller projects as well as repair and maintenance) is done under the National Agreement for the Engineering Construction Industry (**NAECI**), a voluntary, detailed collective agreement which sets specific pay rates and conditions for craft workers and detailed arrangements for conducting industrial relations between employers and employees. Most major UK engineering construction capital projects are designated as being bound by NAECI conditions, either as Category 1 (major new construction projects) or 2 (long term repair and maintenance operations).
- 2.7** A snapshot of the twenty Category 1 and 2 projects underway in March 2009 showed that of the 307 contractors involved during the lifetime of those projects, 270 were based in the UK and 37 were **foreign contractors**.
- 2.8** The **size of the workforce** in 2008 was approximately 55,500 (on-site and off-site combined) including approximately 15,000 off-shore workers (Figure 1a).⁷ Roughly two thirds were in NAECI craft trades and the remainder in management, professional and other manual staff or in non-NAECI trades (Figure 1b).

Figure 1a. *Engineering construction workforce 2008*



⁷ Data are from a spot date during 2008; the total number of instances of employment during 2008 was higher – approximately 74,700.

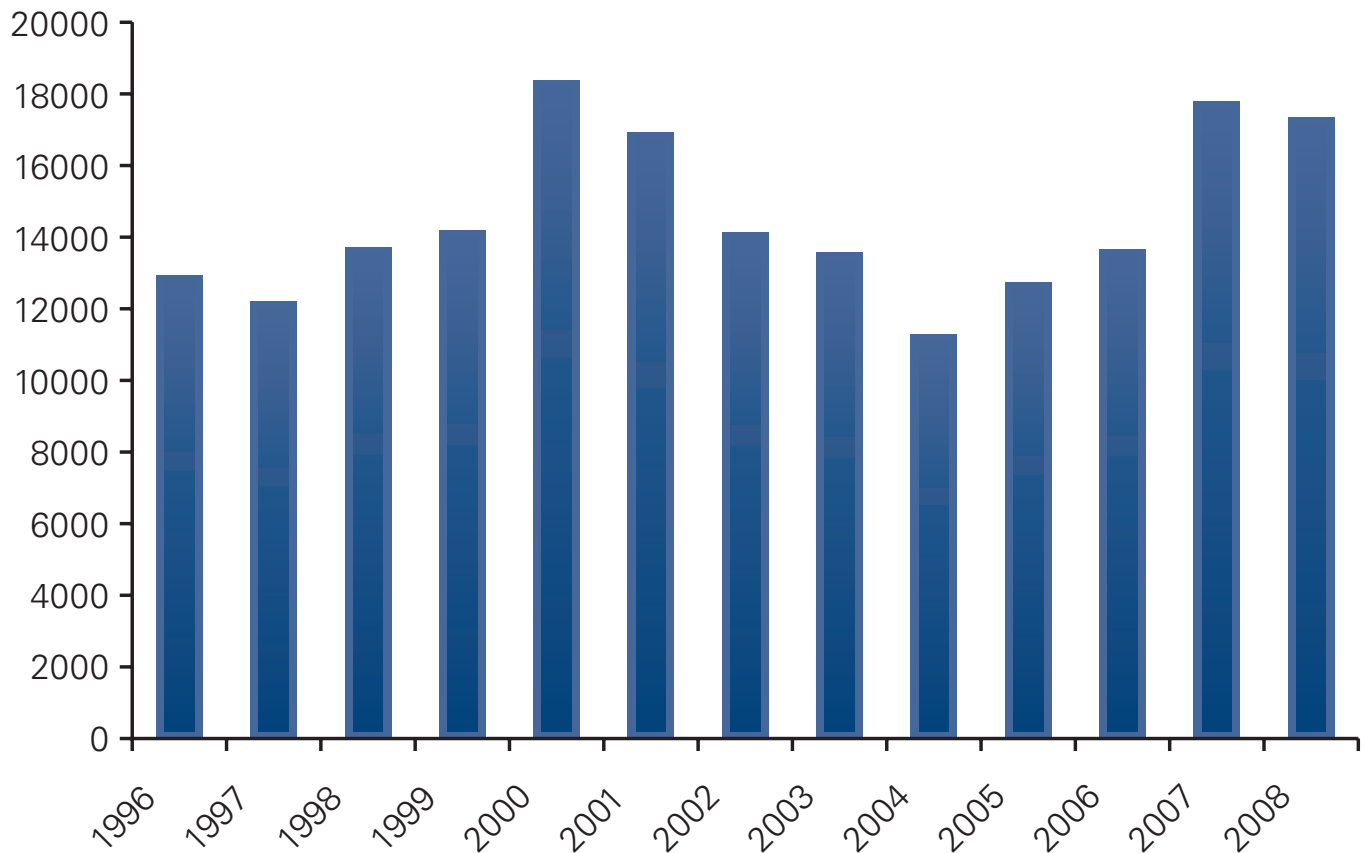
Figure 1b. *Engineering construction roles 2008*

Source: Engineering Construction Industry Training Board (ECITB)

2.9 However, the total number of people employed in engineering construction varies considerably depending upon the number of major projects underway at a particular time and labour mobility in and out of the industry (Figure 2). This illustrates the significant variation in the **volume of activity** in the industry. There have been marked cycles of growth and shrinkage on an annual basis. Added to this is significant in-year variation in the volume of regular repair and maintenance and major projects with seasonal peaks and troughs corresponding to when operators schedule major work. For example, the craft labour on Category 1 and Category 2 sites between January 2008 and October 2009 fluctuated between 12,367 and 7,171.⁸ This cyclicity has led to a situation where the workforce contains a high proportion of people who have permanent employment status but are effectively employed for a fixed period, sometimes of short duration.

2.10 On major projects, a substantial proportion of craft workers live away from home for the duration of a particular project – so-called travelling men.

⁸ Source: National Joint Council for the Engineering Construction Industry (NJC).

Figure 2. *The cyclic nature of the industry: on-site, on-shore workforce 1996-2008*

Source: ECITB

2.11 The **demographic makeup of the workforce** is ageing, with 41% of the on-site workforce being over 50 and 65% over 40. It is also homogeneous – mostly white male – and there are very few women (1%) or black and minority ethnic (BME) people (2.1%) employed on site, though the numbers are higher in off-site roles (19% and 7.8% respectively).⁹

2.12 There is an industry **training levy** administered by the Engineering Construction Industry Training Board (ECITB) which, together with funding from Government, supports apprentices and workforce training. Employers also fund additional training and some have their own training centres. They also pay the employment costs of their staff while they are being trained.

⁹ Source: ECITB.

- 2.13** Compliance with the NAECI is monitored by independent auditors appointed to Category 1 and 2 projects. The auditors aim to interview all contractors before they start work on site to ensure they are aware of the NAECI conditions, that they are members of a NAECI signatory organisation and that they have appropriate sickness and accident insurance cover. They then compile data on the numbers and grades of employees to whom NAECI applies on a particular project, the contractors and sub-contractors, the hours worked and authorised and unauthorised absences. They also check whether the correct rates and allowances are being paid to employees. They report to the Project Joint Council which brings together management and unions on the project concerned.
- 2.14 Industrial relations** in the sector have been notable during 2009 for a series of further unofficial stoppages after those at the Lindsey Oil Refinery. Prior to 2006, instances of unofficial action were low but more recently there has been an undercurrent of so-called “unprocedural action” in the industry where days have been lost without agreed procedures being followed. In 2008, these amounted to approximately 15,500 days, 1% of approximately 1.5 million days that were worked in that year (ECIA data). Almost 30,000 days were lost in the first seven months of 2009, despite a decrease in the industry workload.
- 2.15 Civil construction** is an important element of many projects, particularly on new build. However, civil contractors do not work within the scope of the NAECI and civil construction has not been considered in detail in this Review.
- 2.16** With one exception, the Nuclear Decommissioning Agency, there is little or no direct **public procurement** of engineering construction, although some of the contractors in the industry also work on general construction projects procured by the public sector and, therefore, have experience of the types of contracts and conditions used there. The public sector also procures projects which use the same skills and trades as engineering construction, for example welders, platers, electricians, project managers and planners. Public sector agencies do also have considerable influence over the markets that engineering construction clients operate in, particularly energy and water, and on planning consents.

3. Productivity and Skills in Engineering Construction

What is productivity?

- 3.1** Productivity in engineering construction is, as for other industries the level of output for a given input. In engineering construction, the term is applied in a variety of ways using measures of inputs (such as numbers of hours worked), outputs (such as inches of weld completed) and scope of activity (such as time taken for a particular milestone to be achieved) depending on what is of interest.
- 3.2** Relative differences in productivity are the result of different proportions and performance of capital and people used in a particular activity or, at the level of a whole industry reflect variation in how much is made by the industry versus being bought in from elsewhere. A whole industry economic analysis of productivity would consider all these factors. However, the engineering construction industry covers multiple sectors and activities, and UK and EU official statistics no longer classify the output of firms engaged in engineering construction to a specific heading within the Standard Industrial Classification (SIC). This means that it is not possible to estimate the relationship between engineering construction inputs and outputs using official data. This Review has, therefore, focused on the productivity of individual projects.

The Review process

- 3.3** This Review has been based on evidence collected:
- by analysis of the available literature on productivity in the industry;
 - through meetings and discussions between March and October 2009 with senior managers from over 50 clients and contractors in the UK, Europe and the United States, including 13 site visits to projects in the UK, France, Germany and the US;
 - through an ongoing dialogue discussion with the ECIA, ECITB and National Joint Council (NJC);
 - through several meetings with Trade Union national officials and shop stewards; and
 - through commissioned, quantitative research by Independent Project Analysis Inc., who have compared the labour productivity of over 1000 projects in the UK, the US and Europe (see box, p.16).
- 3.4** The review found few quantitative studies of productivity in the sector. The best is a careful comparative study by the National Economic Development Office (NEDO) in 1990 of two almost identical polyethylene tetrathalate (PET) plants built in the US and UK for Kodak ("the Kodak report").¹⁰ This showed that productivity (in that case hours worked to complete the project), accounting for variations during construction, was 42% better at the site in Columbia, South Carolina, than in Workington, Cumbria. There were two types of factors explaining this difference. First, there were factors outside constructors' control: construction

¹⁰ NEDO (1990) *A comparative study of simultaneous construction of two Kodak PET plants built in the UK and USA.*

in Workington led that in Columbia by four months, giving the opportunity for learning from problems on the earlier project; the UK project was fully scaffolded whereas in the US, only “easifix” scaffolding was used as and when required and otherwise men worked off trestle ladders (suitably harnessed); and more work was needed to meet the regulatory requirements in the UK for fireproofing, cladding and the use of armoured cable. The weather was not a significant factor in either project.

- 3.5** Second were factors within constructors’ control: the activity rates were lower and there was more lost time in the UK project; the US workforce was more individually accountable for performance than the UK workforce; there was a greater supply of skilled men, particularly welders, in the US; and there was more flexible use of labour in the US and, in particular, greater substitution of “helpers” or less skilled men for skilled men.
- 3.6** A report in 2002 by Independent Project Analysis to a conference of the Industry Benchmarking Consortium presented analysis of the labour productivity of European projects between 1972 and 2001. The sample was 324 projects, 96 from the UK, with a median value of \$12 million, an average of \$34 million and a range between \$3 million and \$500 million. They found that UK projects underperformed US Gulf Coast projects by 11%.¹¹
- 3.7** Other reports by NEDO between 1970 and 1991,¹² the European Construction Institute¹³ and the Construction Industry Institute (CII)¹⁴ in the US have examined in detail the factors that help make engineering construction projects successful. Two initiatives, the offshore CRINE initiative (Cost Reduction Initiative for the New Era) in the early 1990s and ACTIVE (Achieving Competitiveness Through Innovation and Value Enhancement) in the late 1990s¹⁵ brought together the latest thinking at those times. These were industry-led and Government-supported initiatives to apply these success factors to the offshore oil and gas industry and on-shore engineering construction respectively.
- 3.8** The recently updated ACTIVE principles¹⁶ cover effective:
- Project Concept and Definition
 - Project Team Management
 - Supply Chain Relationships
 - Information Management and Communications
 - Project Risk Management
 - Innovation and Continuous Improvement
 - Project Execution
 - Performance Measurement

¹¹ E. Merrow, K. Sonnhalter and K.A. Brown (2002) *Understanding Construction Labor Productivity in High Wage Countries*, Independent Project Analysis Inc & IBC.

¹² NEDO (1970) *Large Industrial Sites*; NEDO (1989) *Promoting Productivity in the Engineering Construction Industry*; NEDO (1991) *Partnering: Contracting without Conflict*.

¹³ ECI (1994) *Total Productivity Management Vol 1 – On-site Productivity*.

¹⁴ <http://construction-institute.org/scriptcontent/bp.cfm?section=aboutcii>

¹⁵ ACTIVE (1998) *ACTIVE Workbook* second edition.

¹⁶ ECI (2009) *ACTIVE Workbook* third edition.

3.9 In 2001/2, the ECIA, with support from the Department of Trade and Industry, produced guidelines on the use of Key Performance Indicators (KPIs) in engineering construction. Although welcomed at the time, these have not been extensively adopted by the industry as a whole.¹⁷

3.10 In 2005, Ivor Williams interviewed approximately 40 companies and the trade unions in the engineering construction industry for a report for ECITB.¹⁸ He described widespread dissatisfaction with the levels of productivity in the industry and views about the reasons for this underperformance and the lack of consensus on possible solutions.

Productivity in 2009

3.11 The strong impression gained by talking to senior managers, unions and shop stewards in the industry today is, that while the quality of constructed plant in the UK is generally good, productivity is very variable between projects in the UK and often lower than client and contractor managers' expectations, particularly if they have worked on projects in other countries. Reasons given by one or more of these groups of people include: unexpected restrictions caused by the condition of the site which only came to light after construction had started; inadequacy of the design; delays in delivery of equipment to be installed; poor project scheduling or the organisation of the site; low work rates; inadequate supervision; and industrial disputes which have led recently to unofficial stoppages.

3.12 Low work rates are of particular concern for clients and contractors and these are partly due to high rates of lost or unproductive time on some projects – anecdotally in a few extreme cases, up to 75% of the working day can be lost. Managers often express the view that projects in continental Europe and the US are more productive and that this is due to the higher work rate on those projects, greater commitment from craft workers and, in particular, better supervision. Sometimes the perceived differences in productivity can be very large.

3.13 It is not easy to judge how much of an effect these problems cause in terms of the costs of delays as objective data are commercially sensitive and have not been available. However, many in the industry would say that, combined with the higher manning levels that appear to be used in the UK compared to other countries the effect is very substantial.

3.14 The Review commissioned quantitative research to provide some objective evidence about comparative productivity (see box overleaf). The findings confirmed the high variability of productivity reported in other studies and observed by many of the people spoken to in this Review.

¹⁷ ECIA (2002) *Key Performance Indicators*.

¹⁸ I. Williams (2005) *Productivity in UK Engineering Construction – a view from the industry*, ECITB.

Quantitative research on productivity and skills

Independent Project Analysis Incorporated (IPA) were commissioned to undertake a comparative analysis of productivity between projects in the UK and in the US and Europe. For over 20 years IPA have provided a benchmarking service for clients of engineering construction in, predominantly, the oil, chemical and pharmaceutical sectors. They used their extensive database of indicators about project management and control to compare groups of matched projects, similar in size and scope. Productivity measurement was in terms of a Labour Productivity Index – the hours worked for a particular scope of project divided by the average hours for the group – and a Labour Cost index – the cost of those hours divided by the average cost for the group. IPA's detailed report is published alongside this Review.¹⁹

The sample used contained 1,011 completed capital projects from over 100 different client organisations in the UK (60 projects), the US (692 projects including 141 from the Gulf Coast) and continental Europe (259 projects). Each project included in the sample had a value of more than \$3 million (at 2003 exchange rates) and was authorised between 1998 and 2008. Approximately 80% were between \$3 and \$99 million as this reflects the pattern of activity in the oil and chemicals sectors during the period which has been dominated by small to medium sized capital projects.

The UK sample included approximately 15 projects in the size range \$50 – 99 million and 14 projects greater than \$100 million – these are likely to have been NAECI Category 1 or 2 projects. Because of the confidential nature of IPA's data, it is not possible to specify which projects were involved.

Two important limitations are that the sample does not include power projects or smaller repair and maintenance work, though the projects that are included are similar in their complexity and use the same trades and skills. Nonetheless, this is the first time that objective, quantitative evidence on engineering construction productivity in a large number of companies has been published.

The Review has considered the IPA findings alongside the evidence from the discussions with people in the industry. Where these two sets of evidence have led us to disagree with IPA's conclusions, this is made clear in this report.

The IPA analysis showed that across all countries there was a high degree of variability (+/- 30% around the mean) between individual projects, much greater than the between-country variability. However, UK projects authorised between 1998 and 2008 were less productive than projects in the US Gulf Coast and Continental Europe (Table 1). The 11% difference between the UK and US Gulf Coast was statistically highly significant.

¹⁹ E.W. Merrow, K.A. Sonnhalter, R. Somanchi, and A.F. Griffith (2009) *Productivity in the UK Engineering Construction Industry*, Independent Project Analysis Inc.

The difference between projects in the UK and Continental Europe as a whole was 5%. This result was statistically significant at about one chance in ten of being random. But if projects other than revamp projects (adding new or improved equipment to existing plant) were considered on their own, the difference was 11% and the statistical reliability increased to about two chances in 100 of being random. This is because there appears to be a general under-performance of revamp projects in both UK and European projects compared to the US Gulf Coast which disguises the difference in other types of project (greenfield, add-on, co-located and expansion projects) between the UK and Europe. Lower wage rates in the UK remove the productivity disadvantages with the US and other countries at current exchange rates.

Table 1 – Comparative labour productivity, 1998-2008*

US Gulf Coast	1.00
Germany	1.05
Continental Europe	1.06
The Netherlands	1.08
UK	1.11
France	1.20

*Larger index numbers indicate poorer productivity. For example, relative to US Gulf Coast, UK projects have 11% worse productivity. Countries represented in Continental Europe were France, Germany, The Netherlands, Italy, Spain and Ireland.

- 3.15** Overall, the differences in productivity found in the quantitative analysis were not as great as suggested from some of our meetings with senior managers. These sources of evidence are not directly comparable so it is not possible to be sure about the reasons for this discrepancy. One explanation could be that managers' perceptions may be based on a sample of projects from their own experience that is likely to be much smaller than the one IPA used.
- 3.16** The causes of lower relative productivity are likely to be complex and to stem from the actions of all parties involved. In the following sections, we look at the factors affecting productivity on UK projects.

Factors affecting productivity

- 3.17** At the level of the national economy there are five main factors which affect productivity: physical investment; innovation including use of research and technology; the skills and education of the workforce and general population; competitive firms and markets; and enterprise – the drive of individuals to create and grow new businesses.²⁰ At the level of a particular industry or an individual company these factors are also important and the Review has looked for evidence about each of them.
- 3.18** The lack of consistently collected and relevant data across the industry was a major obstacle to the Review in attempting a comprehensive analysis of the way these drivers apply to productivity in engineering construction. Also, while the project data in IPA's database (see box, p.16) is a rich source of information about what makes for successful projects and sheds light on criteria relevant to productivity, it was not collected with the purpose of examining the five drivers referred to above. In the following sections we therefore bring together and balance evidence from a range of sources to look at the factors affecting productivity.
- 3.19** At the level of individual projects, in IPA's view there are eight factors significantly affecting project productivity where the UK does less well than in other countries:
- the use of integrated client teams involving construction and operations managers from the beginning of the project;
 - investing sufficient time in planning and scheduling before construction;
 - the criteria for contractor selection;
 - the schedule strategy, particularly the amount of design completed when construction begins;
 - using robust project controls owned by the client;
 - having sufficient numbers of supervisors;
 - using local labour (as opposed to men travelling within the UK); and
 - involving craft labour in construction task planning.

These are discussed in detail in IPA's report and are referred to below.

Investment

- 3.20** The scale of investment in many of the projects considered by the Review is large and comparable to major civil construction projects. The primary contribution capital investment makes to labour productivity is in substituting for labour. In an engineering construction context this includes the use of construction machinery such as automatic welding equipment; the exploitation of information technology for 3D modelling and prevention of clashes between installed parts; and electronic inventory and documentation systems. These techniques are well-established on many UK projects.

²⁰ HM Treasury (2006) *Productivity in the UK 6: Progress and New evidence*
http://www.hm-treasury.gov.uk/d/bud06_productivity_513.pdf

- 3.21** Also well-established are off-site manufacture and modularisation. Large bought-in equipment, such as turbines, chemical reactor vessels or storage tanks, are routinely manufactured or part-assembled off-site and lifted into position. The main limitation to doing more of this is usually transport access to the site. On some sites, modularised pipe or cable racks are assembled off-site, moved into position and then connected to the rest of the plant. Pre-fabrication of support structures and building shells is also sometimes used. All of these help increase productivity by moving labour off-site into environments where quality, safety and cost can be better controlled.
- 3.22** In their report to the Review, IPA's view was that there was limited scope for substitution of capital for labour in projects and that there were no significant differences in the degree of substitution between OECD countries. For example, they observed that US and European practice in the use of automated design systems or shop fabrication of pipes was very similar.²¹

Best practice and innovation

- 3.23** There is already a substantial body of best practice literature for engineering construction, including the recently updated ACTIVE principles and material published by the Construction Industry Institute in the US, and it has been surprising during our discussions that more people have not referred to it. When asked about this, the reaction has been that managers already know what good practice is. This has sometimes come, however, with an admission that they don't use it.
- 3.24** The IPA research found that a key factor for project success and higher productivity was having integrated client project teams involving project management, construction and operations managers from the start of the project and that this was less likely to happen in UK projects than in other countries.
- 3.25** A second factor was sufficient front-end planning and detailed, resource-loaded scheduling, again less likely to be done on UK projects than on those in the US and Europe. It is striking that the overlap between the engineering design phase and the construction phase is much larger on UK projects than in US Gulf Coast projects – the construction starts sooner before less of the design work has been completed and the engineering takes longer overall. This finding was confirmed at several of the sites we visited and although acknowledged as counter-productive to good productivity and potentially causing delays and rework, pressure to start construction seemed high, sometimes apparently driven by clients or their financiers demanding to see progress on the ground.
- 3.26** A third element of project management that makes a significant difference is the rigour of project controls of milestones and costs. IPA found that sophisticated project controls, led by the client, led to greater productivity. However, on UK projects, clients were less likely to use the most rigorous control processes, despite this having clear benefits in keeping control of the overall progress of the project, and more likely to delegate project controls to their contractor.

²¹ E.W. Merrow, K.A. Sonnhalter, R. Somanchi, and A.F. Griffith (2009) *Productivity in the UK Engineering Construction Industry*, Independent Project Analysis Inc – footnote 17.

- 3.27** Related to this is the way that technical and other project data is shared between the different parties on site. Some companies that develop data handling systems have expressed concerns about what they see as cultural barriers to investing in processes and systems to share information between contractor companies despite it helping the smooth running of the project overall. These barriers seem to stem from worries about compromising the way that risk is shared between the different contractual parties on a project.
- 3.28** The organisation of on-site facilities for the workforce is another area where use of best practice is adopted on some, but not all, sites. Examples include opening canteens before and between shifts so that employees can have a meal, organising working time to enable travelling men to travel home more often if they choose and staggering tea breaks in canteens. Where management and unions agree on these, it can have a positive effect on industrial relations as well as on effective deployment of the workforce.
- 3.29** These findings about the patchy use of existing best practice might imply that innovation is not a feature of the UK engineering construction industry. However, it is encouraging that UK contractors, including some smaller companies, have developed and adopted new techniques and processes. Also, the international client base in the industry and, on some projects, the use of foreign contractors has resulted in new processes being used.
- 3.30** One example is the now widespread substitution of mobile cranes for scaffolding for many tasks. The 1990 “Kodak report” referred to earlier cited the greater flexibility of these “cherry-pickers” as one of the factors that contributed to the greater productivity seen in the US project versus the one in the UK – at that time, scaffolding was by far the most common way to achieve access at height. The UK now appears to have caught up and adopted this “new-to-the-UK” innovation. Other flexible access-at-height techniques are also starting to be adopted on UK sites. Cumulative innovations such as these have helped to reduce dramatically the duration of construction in recent years.
- 3.31** Other significant innovations are projects that have features only found in the UK. For example, the Liquid Natural Gas tanks at the Isle of Grain are the largest in the world and have involved extending existing plate welding techniques from the boiler-making and ship-building sectors and applying them to massive cryogenic storage tanks. Similarly, the Sellafield Product Residues Store is the only one of its kind and contains novel, bespoke handling equipment manufactured in the UK to the highest standards. In these examples, the UK engineering construction industry and its supply chain are developing new techniques or applying existing techniques in new ways that gives confidence about its ability to build the plant that is being planned for the future.

Client and contractor relationships

- 3.32** The importance of client leadership on projects is a consistent finding from both the IPA research and the Review's discussions with senior managers. Projects seem to work best – to come in on time and budget with good relations between all the parties, minimal IR issues and an excellent safety record – when the client selects contractors on the basis of a strong track record. They should agree contractual terms which establish the appropriate sharing of risk for the type of project concerned. Ideally, they should also promote a culture of working closely together to a common goal with problems sorted out by discussion.
- 3.33** The Review has heard of several recent instances where a client has attempted to transfer all the risk to a contractor but has then accepted a bid at too low a price. The result has been a claims culture, with everyone blaming each other for problems – the desire for savings today resulting in higher costs tomorrow. It also seems to result in insufficient project planning and, in turn, causes delays, poor industrial relations and stress all round.
- 3.34** The IPA analysis did not find a significant relationship between the particular type of contract (fixed price, index rate, reimbursable etc.) and productivity. The Review concludes from this result that it is the way that contracts are set up and managed that is important rather than the type of contract itself.
- 3.35** Clients in the UK tend to be part of multinational companies whose head office takes a view about whether and when to invest in the UK based on the financial returns they think they will make in the medium and long term. The Review has heard that this internal competition for resources often puts considerable pressure on the cost the head office is prepared to sanction for engineering construction, the UK staff resources to run the project and the time allowed to get the plant operational. It is somewhat paradoxical that given the long-term view of investment returns, there often appears to be a short term view about the costs of construction.
- 3.36** Some clients told the Review that they do not currently have the in-house capability to establish integrated teams that can engage with the principal contractors on the detail. Most agree, however, that for large and complex projects this is the right approach and they are considering how to improve their capability in future.

Trust and commitment

- 3.37** Another significant factor affecting productivity is the relationship between employers and employees. Ivor Williams' report in 2005 cited a widespread dissatisfaction from employers about poor craft worker commitment which was manifested in one or more of: work rates that were well below what was expected, taking much longer for breaks than allowed for, high rates of absenteeism during a project, a routine expectation of the availability of overtime, so-called "sympathy" and other unofficial stoppages and an exodus as a project neared completion in order to find the next job.

- 3.38** According to the managers that participated in this Review, many of these practices still occur and alongside them they also describe experiencing a lack of loyalty to the project or an employer. Many employers and clients think there is a mentality of “entitlement” to employment, overtime or bonuses; the Review has seen some of this. Some have observed situations where a minority with the loudest voices hold sway over the majority or where overt militancy has been espoused and even some instances of intimidation and vandalism.
- 3.39** In IPA’s view, it is not so much the labour as the management of the project that accounts for the UK’s lower productivity. Our view is that responsibility does rest ultimately with management but it is a shared one to which all contribute. The practices above are detrimental to productivity.
- 3.40** The Review believes that there has been a breakdown of trust between employers and employees in recent years and that the continuation of these unhelpful practices is in part a manifestation of this. In our view, some of the causes are as follows.
- 3.41** First, the competence and people skills of more **senior management** have a big effect on the employee’s trust of them. UK craft workers seem particularly influenced by the management culture on site, the efficiency with which work is organised and presented to them, the organisation of the site, the canteen, washroom and other facilities provided and the systems in place to promote a strong health and safety culture. During site visits in the UK and overseas, the Review has seen differences in all these factors. It would be going too far to say that well managed sites necessarily have higher productivity but discussions with shop stewards and supervisors confirm that the commitment of craft workers to a project is significantly affected by these factors.
- 3.42** Second, union officials and shop stewards are at pains to stress that they do not object to **foreign labour** working on UK projects providing that qualified, unemployed local and UK national workers have opportunities to apply for posts. This is particularly an issue, as at present, when the volume of work is insufficient to support full employment among the UK workforce. Where clients and contractors have put in place mechanisms on a particular project to ensure as far as possible recruitment from the local labour market, this has been welcomed by local officials and shop stewards and has helped improve industrial relations on a site.
- 3.43** Also important to unions and shop stewards are that NAECI terms, where these are in force, are applied consistently. The Review has heard claims that some non-UK based companies have gained a competitive advantage over UK ones by practices such as: allocating non-UK workers to a lower-paid grade than is appropriate to their skill level; saving on accommodation allowance and/or costs of monthly travel home for non-UK workers; or paying the correct rate but then making deductions in the worker’s home country. Some of these practices have been cited during the unofficial actions that have occurred in 2009.

- 3.44** However, the Review has found no evidence to support these claims. All the NAECI auditors carry out a range of detailed checks on the numbers of people employed and their payments and conditions and none have found any systematic or deliberate under-payment. They have experienced companies that were new to the NAECI, UK-based as well as non-UK based, making mistakes and inadvertently paying the wrong rates, but once the NAECI was explained to them properly, they paid the correct rates.²²
- 3.45** Third, the highly cyclic volume of activity on major projects in recent years has led to uncertainty about the **continuity** of work available. In this industry, a substantial proportion of the workforce is casualised. Individuals, both craft workers and management, are employed for a limited amount of time over the lifetime of a particular project. In times of high levels of activity, demand for skilled labour exceeds supply. This results in workers easily able to find other employment and leaving one employer to go to another, often before the first job has been completed, in order to maintain income. All agree that if an employer was able to offer more continuity of work it would reduce this churn rate which is difficult to manage and lowers productivity. However, contractors are not able to offer continuous employment to all employees because the timing of projects is often uncertain. In times of low activity, skilled workers can find themselves unemployed for a period of time between projects. Concern about the prospect of unemployment has heightened tension recently about the use of foreign labour on UK projects.
- 3.46** Modern management techniques are based on promoting trust and a shared commitment to objectives. Frequent and meaningful dialogue about the business and everyone's respective responsibilities in making it a success is part of this. It is clearly hard, however, for employers and employees to build trust if there is no prospect of a long term relationship between them.
- 3.47** The situation is different between one-off projects and routine repair and maintenance where clients and contractors often have long-standing relationships and workers remain on a particular site for many years. In repair and maintenance, it is much easier for employers and employees to build the trust and loyalty that helps (but does not guarantee) good productivity.
- 3.48** There are other factors that also affect commitment to a project or an employer. First, the quality of **supervision** – the working chargehands and foremen as well as the people at the first level of supervisory management – is key. These managers need to be able to command respect both through their people skills and their knowledge of the job. The IPA research found that the number of chargehands and supervisors was significantly correlated with productivity. This was particularly the case in the UK. It may partly be due to the still widespread practice of appointing chargehands and supervisors on the basis that they are good on the tools rather than good at people management. Also widespread is that chargehands and supervisors are appointed for one particular project but may be back on the tools for the next – only a few companies are able to employ them as managers on a continuous basis.

²² The recent agreement between employers and unions stipulates that managing contractors and auditors must make it clear to non UK-based companies where the NAECI rules apply and what they are. It also addresses concerns that non UK-based workers might cost less in travel and accommodation allowances by stipulating that variations to the provisions for weekend travel home must not result in cost savings.

- 3.49** The differential remuneration for the extra responsibility of supervision is small for chargehands under the NAECI and there is a lack of structured career pathways. Added to that is the psychological barrier for an individual in making the transition from being one of the workers to “management”. All of these factors are likely to be hindering the industry getting the number and quality of supervisors it needs though, on the positive side, numbers attending ECITB supervisor training courses have been increasing.²³
- 3.50** Second, a feature of the way the industry works is that the large industrial plants it builds are by their nature often sited well away from large centres of population and this means that the workforce has to travel, often large distances. The proportion of **travelling men** in the industry varies but may be as much as 50% within a region or 20% between regions. The view of many senior managers is that travelling men are usually motivated to maximise their remuneration while they are away from home and so look for (or even expect) overtime.
- 3.51** There were mixed views about the effect on productivity of having large numbers of travelling men on a project. IPA’s view, based on a small sample, was that a higher proportion of travelling men to local workers tended to be less productive. Research in other industries has shown a negative effect on productivity of large amounts of overtime.²⁴ However, some firms find travelling men to be highly productive. The Review concludes it is not able to generalise on this issue.
- 3.52** Third, there can be a lack of clear **career pathways**, and continuous professional development for existing craft and office-based workers. Many people move frequently between employers and so it is hard for companies to establish long terms career pathways or for workers to remain on them.
- 3.53** Related to this are concerns about the number of young people entering the industry. About 6% (3300) of the workforce leave the industry per year through natural wastage but only about 750 – 1000 join, principally apprentice craft technicians,²⁵ adults improving their skills or retraining and graduates into engineering and project management roles. With apprentices, it is not a lack of interest in joining an apprenticeship scheme but the lack of available work placements that is restricting the number that join. The lack of young people in the industry is very visible on sites and the relatively low numbers entering concerns managers and craft workers alike – it is likely to have a negative impact on worker commitment.

²³ 1152 people attended Supervisory Management Training and Development modules in 2009, up from 756 in 2006. Source: ECITB.

²⁴ R. M. W. Horner & B. T. Talhouni (1995) *Accelerated working, delays and disruption on labour productivity* Chartered Institute of Building.

²⁵ 500 in 2009. Source: ECITB.

3.54 Very low numbers of women and black and minority ethnic people are entering the industry at the craft level, although women and BME representation is improving at graduate level. On engineering construction site visits, the review team met and saw very few women, other than in administration and human resources roles. A 2005 research report found that most female apprentices had a positive experience of working in engineering construction and would recommend it to other women.²⁶ However, the researcher found that some female apprentices had not been given proper opportunities to develop their skills due to male colleagues' perceptions of what women could or could not do, some had experienced a lack of facilities for women such as toilets and showers and one or two had encountered sexual harassment. A number of women taking part in the research felt that "taking stick" from colleagues or managers was part of a female apprentice's lot.

Skills

3.55 Skill levels have a direct impact on productivity at a project, firm and sector level. Craft workers in engineering construction require qualifications at or equivalent to National Vocational Qualification (NVQ) level 3 and trainees are required to be on recognised ECITB training courses – the NAECI sets out detailed requirements for each of the categories of employment under the agreement. Those working in the project office on project management, design engineering and other roles are often graduates and many go on to gain chartered status with relevant professional bodies.

3.56 So this is a highly skilled industry – there are few, if any, unskilled workers in engineering construction roles on UK projects and given the ageing demographic, most have many years qualified experience on a large number of projects. This status is a source of pride for those in the industry and is one of the ways in which the industry promotes itself to new entrants.

3.57 The Review has heard few concerns about the technical skill levels of current UK engineering construction workers and IPA observe that skill levels change only slowly over time. Rather, there are worries that there are, and will be, insufficient skilled people for the anticipated increase in activity in the industry in future. This is true across the different trades and engineering disciplines though current shortages seem particularly to be an issue in project management, planning, engineering design and high quality welding. These concerns stem both from an anticipated shortage of funding for training for the vacancies that will arise (ECITB estimates that there will be approximately 30,000 vacancies for new entrants by 2015 for which current levels of funding will be insufficient) and time-lags in the capacity of contractors to fund work placements for trainees. A report on the development of wind, wave and tidal energy in the UK identified a present and future shortage of skills and high vacancy rates, particularly of project managers and electrical engineers.²⁷

²⁶ A. Andrew (2005) *Young women in a modern apprenticeship scheme in engineering construction*. JIVE Partners.

²⁷ M. Boettcher, N.P. Nielsen & K. Petrick (2008) *Employment opportunities and challenges in the context of rapid industry growth* p10. Bain & Company http://www.bwea.com/pdf/publications/Bain%20Brief_Wind%20Energy%202008_FINAL.pdf

- 3.58** There are also concerns about inflexibility on the part of the workforce and unions in terms of allowing the most productive mix of skilled and semi-skilled labour for a particular task. Also, despite demarcation of trades being banned in the NAECI, disputes over demarcation do still occur.
- 3.59** There is a failure of the market in many sectors to provide enough resources for **training** because the benefits to a particular company from the investment required are lost if the employee concerned leaves. This is particularly true in engineering construction with its high levels of short term employment and is one of the main reasons for the training levy. The costs of training are higher than general construction. Level 3 apprentices, for example, cost an average of £12,600 (differing amounts in Scotland compared to England and Wales) versus £9,820 in general construction though retention and completion rates are high indicating good value for money. The number of applicants for training out-strips the available training funding and work placements available. The costs to employers are significant – apprentice salaries, travel costs and additional training can cost employers as much as £45,000 per person.
- 3.60** Awareness of and skills in **safe working** are high in the UK and the industry has a good record of health and safety compared, for example, to general construction.²⁹ Multinational clients are able to look at safety records between projects in different countries and some have told the Review that the UK record is good compared with other countries (though it could be better). It is difficult to get a complete picture about this because measurement systems differ.
- 3.61** There is a widely held perception among the craft workforce and the unions that the technical skill levels and health and safety training of some of the **foreign workers** being used on UK projects are not as high as those of UK workers. The IPA research found no significant differences in health and safety outcomes between the particular countries studied (France, Germany, The Netherlands, Ireland, Spain, Italy). The Review notes, however, that it is not in any employer's interests, particularly those trying to prove themselves in a new market, to employ people without the skills to do a particular job. The recent agreement between employers and unions has introduced steps to increase the visibility of companies' competency assessment systems.
- 3.62** Finally, where **shop stewards** are employed, their skills and experience seems to be important in achieving good industrial relations. Some sites benefit from experienced and authoritative shop stewards who are well supported by full time union officials and able to engage constructively with the employers' IR managers. Other sites do not, or do to a lesser degree.

²⁸ ECIA (2008) *Engineering Construction Industry Association Year Book* "...the rate of serious reportable injuries to engineering construction workers in 2008 was a quarter of that in general construction".

Competitive firms and markets

- 3.63** The details of which companies tendered for particular contracts have not been available to the Review but clients have told us that it is common for there to be a low number of bids received, particularly for fixed price contracts, and in some cases none from UK companies. Clients often have to compete for investment from a parent company with other investment opportunities around the world and the difficulty of attracting bids suggests that they are unable to offer attractive margins. Other reasons that contractors have offered have included the uncertainty about the precise scope of the work being tendered and the difficulty of sourcing the right labour for the job – in other words, their lack of confidence about being able to manage the risks of the tendered work.
- 3.64** In some cases, therefore, foreign contractors that have been bidding for projects have not encountered a lot of competition and, particularly for specialist tasks, have sometimes had advantages from the experience of previous similar work in their home countries or elsewhere, perhaps for the same client. It has not been possible in the time available for the Review to come to firm conclusions but these observations imply that competition within the UK market is not particularly strong and is unlikely to be providing a significant spur to greater productivity.
- 3.65** However, the Review has seen no evidence of a “race to the bottom” – foreign firms putting in low bids and paying their workers less (see paragraph 3.43). Rather, there is some evidence that at least for some groups of foreign workers, they are managed better and work more productively than UK ones on the same project.
- 3.66** The number of UK-based contractors undertaking projects overseas appears to be low. There were none on the sites visited in Germany, the Netherlands and the US with only six out of 150 contractors at a major site in France and these tended to be specialist contractors. Again, it has not been possible to analyse in detail the penetration of UK companies into overseas markets. Anecdotally, UK companies win work in the Middle East and elsewhere but often don’t in European markets due to language and cultural barriers, reluctance to take on fixed price contracts that are common in continental Europe and strong competition from national firms. The strength of the pound for much of the last five years and the volume of work available in the UK have also been contributing factors.

Enterprise

- 3.67** Scale matters in this industry and, in particular, the ability to procure and manage skilled labour in large numbers is often a pre-requisite for winning contracts. Other factors that are regarded as very important by clients and major contractors are an established, excellent safety record, a track record of delivery and good financial status. This makes it difficult for new entrants to win projects. Also, as in all industries, cash flow is a significant factor for small companies and on big projects with milestone payments, payments that are too infrequent or delayed can be very hard to cope with.

- 3.68** Those smaller companies that have been successful have developed strategies to cope with these issues. For example:
- specialising in providing design or engineering services or in particular trades such as scaffolding, insulation, electrical work or servicing and replacing specialised equipment;
 - developing and maintaining specialist skills that are transferable between a range of projects;
 - focusing on building the commitment of their employees to the company;
 - focusing on repair and maintenance work rather than large projects or looking for different kinds of project to maximise continuity of employment;
 - developing long-term relationships with higher-tier contractors which include scheduled payments to improve cash-flow;
 - developing relationships with other contractors with complementary skills; and
 - partnering with overseas firms either to work in non-UK markets or to improve their prospects in bidding for work on larger UK projects.

Productivity incentives

- 3.69** The NAECI was introduced to bring order to the industrial relations chaos of the 1970s. It has largely succeeded, partly because there are nationally agreed terms and conditions of employment that can be applied to every in-scope project. These remove the need for costly, separate negotiations at each new site.
- 3.70** On repair and maintenance projects, the scope of the work is usually well defined and often of short duration. On these projects, direct financial incentives to individuals or teams or the opportunity to work large amounts of overtime are used successfully by some contractors and they achieve a high work rate and productivity. There are similarities here with industries that use production-line manufacturing where managers are able successfully to operate incentive schemes for teams working on defined scope tasks.
- 3.71** On larger, long term projects, the Review has heard that it has been very difficult for managers to apply incentives for productivity. Attempts to do so have led to a situation where the unions have forced management into paying “bonuses” simply for attendance and safe working, both of which should be core conditions of employment rather than something that should need to be incentivised.
- 3.72** This situation has arisen for two reasons. First, on large and/or long term projects it seems to be very difficult to define precisely enough a set of tasks that can be incentivised in isolation from other inter-dependent project elements. For a particular set of workers, circumstances outside their control could prevent them from meeting a target and they could, therefore, argue that it was not fair they shouldn’t receive the same bonus as others.

- 3.73** Second, there has been an in-principle objection by the unions to the idea that one group of workers might be more productive than another simply through their own efforts. The unions have argued that everyone with the same training is equally productive and it is the circumstances they find themselves in that affects their productivity.
- 3.74** In these situations, the fact that the NAECI provides considerable flexibility to use financial incentives for individuals is irrelevant. The Review has heard of several recent projects where employers have been forced into paying them to everyone to prevent disputes.
- 3.75** In practice, therefore, the way that remuneration is applied in the industry is quite rigid, more so than in other sectors such as general construction. As well as affecting the use of incentives, this rigidity is likely to be a constraint on attempts to promote greater productivity through, for example, changing the differential remuneration for the extra responsibility of supervision or responding to severe local labour market skill shortages.

4. Conclusions

- 4.1** This Review concludes that the productivity of UK engineering construction projects is very variable and for a significant section of the industry – oil refining, chemicals and pharmaceuticals – lower than on comparable projects in the US Gulf Coast and in some European countries. The gap with those countries is much smaller than the one between the UK's most and least productive projects.
- 4.2** The most important factors affecting engineering construction productivity are first, the ways in which projects are set up and managed. Using integrated project teams at the start of the project, allowing sufficient time and resources for planning and engineering design and appointing contractors based primarily on competency are all important. The second factor is the relationship between managers and employees. Both need to improve if the UK industry is to be able to seize the opportunities ahead and consistently complete projects on time, on budget and with good industrial relations.
- 4.3** While the Review has learnt of some good examples of best practice, overall there is not as much use of this as there could be, either on project management or industrial relations.
- 4.4** The Review does not take a particular view about the best way for clients and contractors to share risk or the type of contracts that work best – that will depend on each party's capabilities and the nature of the project – but, ultimately, the costs of project risk rest with the client. Their leadership is critical to success and it is clients that should ensure that best practice is used on their projects.
- 4.5** Recent unprocedural action has reduced productivity and has harmed the industry's reputation and the prospects for future investment. The current poor industrial relations reflect deep-seated mistrust between workers and their employers that has developed in recent years. This situation is not inevitable and there are examples where the interests of both sides are better aligned.
- 4.6** It is for managers to manage in a way that creates an atmosphere of trust and mutual respect, avoiding a command-and-control culture.
- 4.7** Employees should respond by fully complying with agreed working practices and demonstrating commitment to the project and their employer.
- 4.8** The Review has seen little interest in learning from other industries – engineering construction could be more outward looking about trying to resolve its problems.
- 4.9** Foreign contractors and workers have been necessary in the past and will be so in future. They provide a useful spur to competition. The Review has not concluded that the use of foreign workers on UK projects will lead to a "race to the bottom". Although there have been a few instances in the past of mistakes with UK and foreign workers not being treated according to the NAECI terms and conditions, the Review has found no evidence of foreign contractors deliberately undercutting the NAECI in the past year. In the short-to-medium term, UK-based contractors are likely to enjoy a considerable cost advantage over competitors whose costs are in Euros.

- 4.10** Some UK-based companies are taking advantage of business opportunities overseas, particularly in the Middle East, and some are preparing for, and looking for, business around the world on nuclear new build. However, the Review has found evidence that cultural and linguistic barriers may be hindering UK companies from seeking and winning opportunities in other EU member states.
- 4.11** Engineering construction is a craft skill-intensive sector. Even with more use of off-site fabrication and modularisation, traditional craft skills will continue to be an important contributor to engineering construction productivity. There is little evidence to suggest there are significant craft skill differences between the UK, continental Europe and the US.
- 4.12** The demographic makeup of the workforce poses a significant risk that there will be a lack of skilled UK craft workers from about 2014, just at the time when there are likely to be significant opportunities in the UK and elsewhere from new projects in nuclear and other power generation. There is already a shortage of good supervisory staff and particular skilled staff – welders, planners, project managers and engineering designers – and this is likely to be contributing to the productivity gaps noted above. There is an untapped talent pool of women and black and minority ethnic people whom the industry could do more to attract, learning from the efforts made in recent years in general construction. There is also evidence that the culture in companies and on sites can make it difficult to retain women and BME workers and does not support their career progression.
- 4.13** Variability of workload is a feature of the engineering construction industry and makes it impossible to forecast future skill needs with any precision. It also means that it is hard for employers to offer continuity of work to their employees, though everyone agrees it would help build better relationships and improve productivity and some employers make real efforts in this respect.
- 4.14** The Review concludes that while greater continuity would be desirable and is worth further efforts to increase, it will not be possible for everyone. Apart from regular repair and maintenance, the best opportunities to improve continuity are likely to come from major investment programmes, particularly in the power sector. Supervisory staff should be a priority for efforts to improve continuity.
- 4.15** The view of most clients, contractors and unions is that the NAECI has brought stability to engineering construction and provides an appropriate employment framework for the craft workforce. However, many would like to see its flexibilities used better and the review has heard accusations from both management and unions of the agreement not being respected in some instances.
- 4.16** From an economic point of view, NAECI can introduce rigidity into the terms of conditions of workers where more flexibility would be beneficial to both employer and workers. However, there is little appetite within the industry for fundamental reform. The Review concludes that the primary focus should be on making the most of what the NAECI offers.
- 4.17** Chapter 5 sets out the Review's recommendations for action that respond to our analysis and these conclusions.

5. Facing the Future

- 5.1** The need to move to low-carbon sources of energy, particularly electricity, will require substantial investments around the world. Building nuclear and other low-carbon electricity generation, building biofuels plants and increasing the energy efficiency of existing process plant are important parts of the transition to a low-carbon economy. The pressing need to reduce carbon emissions makes it vital these projects are completed on time, on budget and are of good quality.
- 5.2** To meet the challenge of the UK's biggest programme of nuclear new build for decades and to increase, or even maintain, recent levels of inward investment in other types of power generation, oil refining, chemical and other plant will need an engineering construction industry that is more productive and also significantly larger than it is now. This will be in addition to the capacity to repair and maintain existing plant.
- 5.3** There will be significant opportunities for UK-based companies from this investment and from new power projects around the world as well as work in related sectors such as renewable energy generation and biotechnology.
- 5.4** What is the imperative for change in this industry? Without change, the expected increase in demand for engineering construction in a market with a relatively small group of UK contractors supplying the majority of capacity could be envisaged to drive up margins, at least in the short term. This might, in turn, allow higher wages and make the industry more attractive to skilled people to move from other sectors and overseas. They might act as agents of change on the culture and working practices. For this to happen, however, would rely strongly on the custom and practice in the industry reacting in a positive way to such a large demand shock to the system.
- 5.5** How confident could we be in relying on such a positive reaction? Would the effects be enough to allow a potential large scale nuclear new build programme to be achieved on time and within budget? Would oil and petrochemical clients making decisions about mobile investments choose the UK? Would the present and future engineering construction workforce be able to make the most of the opportunities new infrastructure build presents?
- 5.6** This Review concludes that assuming that without change everything will work out in the end is a very high-risk option indeed. Without early, proactive and collaborative action by clients, contractors, the workforce, unions and Government there is a danger that productivity will decline further and the number of skilled people in the UK able to meet the demands and opportunities of the future will decrease rather than increase.
- 5.7** Although skilled workers from outside the UK may be willing to come and work on UK projects, and some are likely to be needed in future, the Review concludes that UK workers should be equipped with the skills to benefit from the opportunities that engineering construction and other large infrastructure projects offer. Also, we cannot assume a readily available pool of overseas workers – workload is likely to increase in other countries too.

- 5.8** The time for this action is now, before the anticipated up-swing in activity in 2011 once again diverts everyone's attention away from the longer term.
- 5.9** The Review, therefore, makes recommendations for actions that need to be taken between now and the middle of 2011 which we believe will help deliver the vision set out below of the future of engineering construction.
- 5.10** In discussion with clients, contractors and unions, the Review has found agreement and significant buy-in to many of our recommendations. Where specific deliverables and timescales have been agreed, these are indicated below. For some recommendations, however, while those in the industry agree with the aspiration behind the recommendation, they are not yet able to accept all the specific actions proposed. This Review, nonetheless, believes all are important and need to be taken forward as a package of measures to deliver better performance.

Vision for the future of Engineering Construction

- 5.11** The UK engineering construction will be an industry:
- that has a track record for building and maintaining plant consistently on schedule, to quality and within budget;
 - that is as productive as the best in the world and competitive in the global market;
 - that is recognised as maintaining the highest health and safety standards;
 - whose regular **clients** are committed to the long term future of the industry and where one-off clients make efforts to improve productivity and industrial relations;
 - with competitive **contractors** who share and use best practice on project management and industrial relations and who manage through trust and respect rather than command and control;
 - with a **workforce** that fully complies with agreed procedures, does not engage in unprocedural action and through its flexibility and hard work shows commitment to the success of the project;
 - with **unions and shop stewards** who, in representing their members' long term interests, do everything they can to keep the workforce productively at work;
 - that thereby help employers to be more competitive and offer greater continuity of employment and the means to pursue a long-term, rewarding career in the industry;
 - that helps the industry to attract mobile investment to the UK;
 - that has and attracts a workforce and managers representative of society as a whole;
 - with strong technical and people skills;
 - with strong and well-trained union representatives who share best practice; and

- which uses an employment framework that:
 - promotes stability, flexibility and high performance;
 - gives UK workers fair opportunities to train and to compete for jobs; and
 - acknowledges the benefits from competition from overseas companies and workers.

Becoming as good as the best

5.12 The use by clients of best practice on project management is patchy. There is currently no collective client forum, other than the Capital Projects Clients' Group (CPCG), which does not involve all the current UK clients. This makes it difficult for a collective view across client sectors to be developed or solutions proposed and taken forward, whether on best practice or industrial relations. Other industries have demonstrated that such fora can be influential in raising the bar on performance.

5.13 This Review believes that clients planning a number of investments, particularly those in the energy sector, should use those investment programmes to drive improvement in the engineering construction sector and thereby improve the success of future projects.

Recommendation 1 Engineering construction clients should show leadership on the use of best practice in project management, adopting approaches to collaboration used successfully in other industries which drive up overall industry performance (without risking anti-competitive behaviours) and:

- adopting contracting strategies that promote constructive relationships with their contractors rather than adversarial ones;
- ensuring that sufficient time and resources are used in planning, design engineering and scheduling the project;
- using integrated project manager teams that can advise on the constructability and future operation of the plant from the beginning of the project;
- controlling project progress and costs; and
- measuring and communicating with their whole supply chain about the productivity being achieved.

How and when this will be delivered:

- CPCG to be established formally as a leadership forum for engineering construction clients to drive improvements in the performance of UK projects – by March 2010

Recommendation 2 Contractors should individually use best practice to improve their productivity, particularly on management of the workforce. They should adopt modern methods of people management which build trust and respect, including for women and black and minority ethnic employees and should avoid command-and-control cultures.

It has been shown in other industries that sharing knowledge between competitors helps improve the performance of the industry overall without damaging an individual firm's competitiveness – engineering construction should do likewise.

How and when this will be delivered:

- ECIA to expand its remit to promote the use of best practice on productivity and establish a programme of activities with its members – by June 2010
- ECIA to establish regular meetings with clients on the use of project best practice – by April 2010
- ECIA to develop a system to recognise contractors that consistently apply and develop good practice – recognition scheme in place by April 2010
- European Construction Institute and the new Royal Academy of Engineering/European Construction Institute Professor of Project Management to work with ECIA, ECITB and CPCG to re-package/re-present ACTIVE to the industry by April 2010
- ECITB to review its training courses to ensure that they contain a focus on improving productivity – by April 2010
- ECIA should consider ways in which it can help ECIA members to promote engineering construction as a career for women and BME employees and ensure their equal treatment for employment and progression opportunities.

Recommendation 3 The workforce, shop stewards and union representatives should recognise that they have an essential role in improving the productivity of the UK engineering construction industry and in thereby securing their own future and that of future workers.

- The workforce should comply fully with agreed procedures.
- Through their individual and collective efforts the workforce should demonstrate by working effectively and flexibly and by proactive problem-solving that UK engineering construction is capable of high levels of productivity.
- Shop stewards and union officials should make every effort to get the workforce to comply with agreed procedures.

Improving supervision

- 5.14** The number and quality of front line supervisory staff is insufficient for the industry's needs. Front line supervisory staff (chargehands/foremen and supervisors) should be selected for aptitude in people management, given the right training and be regarded and supported as part of the management structure on a site.
- 5.15** The Review is aware that contractors in the North East of England, working with the ECITB, are working towards a supervisor academy. This pilot also aims to change contractor behaviour and attitudes, so that supervisors and their skills can be developed and retained in the industry as a whole, despite individual contractors' fluctuating workloads.

Recommendation 4 Clients should require their contractors to ensure their supervisory staff are appropriately trained and provide evidence of their management skills.

How and when this will be delivered:

- ECITB to produce guidance for clients and contractors about appropriate people management standards and assessment for supervisory staff – by April 2010; CPCG and ECIA to publicise this information.

The Review also believes that:

- As it is the contractors' responsibility to ensure that all their staff, including supervisors, are competent, contractors should establish a formal procedure to ensure that all supervisors have the appropriate skills. That procedure may include the requirement for a supervisor's silver card or passes in some of the modules needed to qualify for the card.
- Contractors should do everything they can, where workload permits, to provide continuity of employment and appropriate training for supervisory staff.

Skill shortages

- 5.16** According to ECITB projections of 2008, there could be opportunities for a further 30,000 people (including 5,000 in administrative roles) in engineering construction by 2014/15. When these opportunities start to become firmer they should be promoted both to the existing workforce to give them a sense of their future (while being realistic about the time it can take an individual to progress) and to potential entrants. Currently, women, black and minority ethnic communities and the under-40 age group are under-represented in the industry. Promoting the opportunities and training the industry can offer them gives a chance to expand the talent pool that the industry can draw on.
- 5.17** The skills and knowledge needed in engineering construction, for example electrical and mechanical engineering and project management and design, are also important for building and maintaining infrastructure and some low carbon industries such as wind turbine construction. Engineering construction skills development should enable people to work across these different sectors. It will be important for the skills bodies in this area to work together to help individuals develop skills around which they can build long-term careers.
- 5.18** The corollary of this is that there are opportunities outside engineering construction for individuals to develop the skills needed to contribute to engineering construction projects. These include areas of public sector procurement which require project management and planning, engineering, welding, plating, fitting, electrical and other engineering construction skills. Individuals trained on these projects could develop relevant skills enabling them to enter the engineering construction industry later in their careers.

Recommendation 5 Employers and ECITB should ensure there are clear career pathways for the different occupations in the industry and that these are actively promoted to the existing workforce and to potential entrants, particularly those who are under-represented in the industry in the under-40 age group, women and BME employees.

How and when this will be delivered:

- ECITB to launch its career pathways tool for potential entrants and existing workforce by April 2010.
- To help build pride and commitment, employers supported by ECITB to engage with the existing workforce on these career pathways, how they fit with other, related industries and on future work in the industry. Unions to help communicate these to their members (May to December 2010).
- ECITB working with ECIA, employers, engineering professional bodies and other sector skills bodies to coordinate a programme of events and outreach activities to undergraduate and graduate engineers to highlight opportunities in engineering construction with the aim of increasing graduate recruitment during 2011.
- ECITB should work with organisations aiming to encourage recruitment, retention and progression of women in engineering, construction and related occupations such as the UK Resource Centre for Women in Science, Engineering and Technology.

Recommendation 6 ECITB and contractors with support from Government should double the number of people doing relevant apprenticeships from 500 on-site apprentices in 2009 to 1000 by 2011 and increase other trainee numbers, particularly graduates.

- Government has recognised engineering construction as a priority sector in its skills strategy. It should be prepared to commit £1.5 million per year through the Joint Investment Fund, which employers should match, and £3.0 million per year for extra level 3 apprenticeships.
- During 2010 and 2011 ECITB should use its reserves to increase numbers in priority training.
- ECITB should work in partnership with clients and contractors at the beginning of all major engineering construction projects to identify opportunities for apprentices and other trainees. This can build on the pilot at the Vivergo bio-fuels project in Humberside where the client, working with the ECITB, instituted a programme-led scheme to temporarily recruit local apprentices on the ECITB's books and engaged the contractors and sub-contractors contractually to train and employ them.
- Government has committed to support 20,000 apprenticeship places through public procurement over the next three years. The ECITB should work with employers, their clients and other skills bodies to maximise the impact of this initiative by collaboration to give increased portability of qualifications and apprenticeships across sectors and in the supply chain. Ultimately this will lead to an increase in the number of candidates suitable for engineering construction jobs.

- DECC should use its relationships and contacts with clients to encourage them to provide training opportunities and their contractors to take on more apprentices.

This Review believes that:

- Clients should ensure that at least 5% of the workforce on a particular project are apprentices or trainees on the basis that apprentices spend two years training on site out of a potential 40-year career.

5.19 Workload variability means employers' perceived returns on investment in training can be low which can discourage them from offering training. It is in the interests of individual employers, clients and the industry as a whole to take action to train people for future projects; not to do so risks a significant increase in future project costs. Increasing numbers of work placements for apprentices and other trainees is admittedly difficult in current conditions and therefore ECITB, contractors, clients and Government all need to play a part.

Training levy

5.20 The fact that the industry's training levy does not apply to contractors not established in the UK causes concerns about the competitive advantage these companies have compared to those that are established. It also reduces resources to train engineering construction workers in the UK. If non-established companies were to pay the levy, they would have access to the training offered by the ECITB for their own workforces.

5.21 The Review has heard strong support from UK-established companies in the industry and among trade unions for extending the levy to cover non-established companies. This is not straightforward. Non-established companies working in UK engineering construction usually have established offices in other EU member states and some may be paying training levies or taxes in those countries. However, the Review believes that the training levy should apply to non UK-based companies as soon as possible, though it acknowledges that the ECITB will need to consult further.

Recommendation 7 Provided there are no significant legal implications and provided consultation shows the benefits outweigh the costs, the ECITB levy should be extended to apply to companies working on UK projects that are not established in the UK.

- Government and ECITB should follow formal processes to consider how best to address the concerns about unfair competitive advantage;
- ECITB should consult the industry, including contractors not established in the UK, in the first half of 2010 on the impact and potential benefits of extending the levy to non-established contractors;
- following consultation, ECITB should request any changes needed to legislation; and
- Government should consider favourably such a request and to legislate at the first possible opportunity.

Continuity of employment

5.22 Better continuity of employment in the industry is the single factor that many believe would improve the commitment of the workforce to an employer. It is not a panacea, however, as there are some who like working for part of the year or moving from project to project. Also, where continuity is available such as on some repair and maintenance projects, there is not good evidence that industrial relations, productivity or good practice are much improved. However, there is no doubt that more continuity would increase the chance for modern techniques of management and better employee/employer relationships to be established and productivity to be improved.

Recommendation 8 It is widely accepted that it is in the interests of everyone in the industry, whether engaged in one-off projects or in more continuous work, for there to be greater continuity of employment. There is currently no consensus, and few good ideas, about how this can be achieved, however. The ECIA should include this in their regular discussions with clients (Recommendation 1) until a way forward emerges. The Forum (Recommendation 13) should also consider how better continuity can be achieved.

5.23 One way to help greater continuity is to provide more visibility to contractors about the availability of projects to bid for in the future; this helps them have confidence that they can afford to retain employees when current projects finish.

Recommendation 9 Government, in particular the Department of Energy and Climate Change, should provide further signals and information to the energy generation market that help create the conditions in which energy companies can produce long-term investment strategies. These will help facilitate good project outcomes and security of energy supply.

How and when this will be delivered:

- By April 2010, DECC to build on the Low Carbon Transition Plan published in July 2009 by setting out in its planned 2050 Vision document potential scenarios for the progressive decarbonisation of the power sector and the roles that might be played by different types of generating plant, consistent with security of supply and the transition to a low carbon economy. As far as possible, this should be backed by a stable regulatory framework.

Improving industrial relations on site

5.24 Instances of poor industrial relations and, in particular, unofficial action, are damaging the reputation of the UK engineering construction industry. Clients are already worrying that this will lead to less investment in the UK in future and that the risks of using UK labour and UK firms on nuclear new build will be high. It is not too late to change this situation and to improve the attractiveness of the UK for new investment and to enhance the reputation of UK contractors and their workforce here and overseas.

Recommendation 10 Employers (contractors) and unions should work together to ensure good industrial relations across the industry through dialogue and by building trust on all sites. The National Joint Council plays and will continue to play an important role here. New procedures and rules are not the answer – better relationships and dialogue are.

This Review believes that:

- Employers should engage more strongly with their workforce to build commitment to the project and employer. This involves developing the capabilities of all managers to engage with individuals and treat them with respect.
- Employers, managers, the workforce, shop stewards and unions should honour NAECI commitments, in particular:
 - the correct terms and conditions should be applied to all workers;
 - the workforce should not use unofficial strikes or other unprocedural action as a way of putting pressure on employers; and
 - contractors should not pay wages for periods when unofficial walk-outs have occurred (and clients should not ask them to).
- Unions should develop the capabilities of shop stewards so they can work effectively with management, lead the workforce on site, represent the workforce's perspective and understand the broader industry picture.
- ECIA's industrial relations committee, the ECIA regional network and union networks should capture, share and monitor the impact of industrial relations and employee engagement best practice from engineering construction and other sectors. In particular:
 - unions should be actively involved in supervisor and management training to ensure their role is understood and to build relationships;
 - the current practice by many employers and managers of helping employees to identify new opportunities in redundancy situations should be encouraged and spread as an example of good behaviour, not a rule; and
 - the current widespread practice of trade unions doing a talk at project induction should be extended to all sites and include induction for non-UK workers.
- Managers and shop stewards should undertake study visits to other industries in the UK (such as automotive and aerospace) to learn about how their employment and industrial relations frameworks are managed.
- The Capital Projects Clients' Group should maintain a dialogue with national trade union officers on the perception of international investors about the UK engineering construction industry.

The NAECI supporting the future of engineering construction

5.25 The NAECI has provided significant stability to a previously fragmented and fractious industry. Very few people the Review spoke to supported abolishing it and they feared that to do so would lead to anarchy. However, most agreed that in the way it is currently operated, it does little to promote better productivity in the industry, mainly because employers are not able to make the most of the flexibilities it offers. In particular, a number of people raised concerns that incentive bonuses are being applied in such a way that they are rewarding attendance, which should be a given, rather than productivity.

Recommendation 11 Clients, contractors and trade unions should ensure that the NAECI is fully implemented. For example, where it is agreed bonuses should be paid for achieving productivity targets, they should only be paid when these targets are actually achieved.

5.26 There have been a number of major reviews of the NAECI since its inception in 1981, most recently in 2007, and these have enabled it to adapt to changes in the industry. This Review is not advocating another negotiated revision along these lines. Rather:

Recommendation 12 This Review believes that there should be a collaborative look sooner rather than later at how the NAECI agreement could be developed to meet the needs of future large projects, particularly nuclear new build.

Implementation

5.27 These recommendations will be challenging to implement but early progress will make it more likely that significant productivity benefits will follow after the anticipated up-swing in 2011. However, history shows that there will be a lot of inertia preventing progress. To overcome this:

Recommendation 13 A Forum of clients, contractors, trade unions, the NJC and the ECITB and should be established for a limited period to oversee implementation of this Review's recommendations and to catalyse action and promote change. It should be supported by the industry, the Department for Energy and Climate Change and the Department for Business, Innovation and Skills. Government Ministers should attend some meetings

How and when this will be delivered:

- The Forum chair, membership, terms of reference and method of working to be agreed by January 2010
- The Forum's programme of work to extend for up to 18 months.

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