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Construction skills training for the next millennium

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Construction skills and training needs have changed with the introduction of new business processes, different forms of organizing production and technical innovation. In the UK, training provision has failed to adapt fully to the needs of a modernizing industry. Formal training programmes have been inappropriate in content and inadequate in quantity. Many of them are out of date. An assessment is provided of the types of skill and training required to implement innovative approaches for improving construction performance. It is based on analysis of work carried out during a major national review of construction operative and supervisory skills training in the UK undertaken for the Construction Industry Board. It seeks to provide a framework for analysing skill needs in the context of modern performance targets, together with policy recommendations for decision-makers in firms, government and training institutions. The conclusion that a new generic training programme is required is of general relevance to practitioners, trainers and researchers in the UK and in other countries.

Keywords: Construction skills, training, new technology, business process change, innovation

Introduction

In 1997, UK construction output exceeded £55bn, accounting directly for more than 5% of GDP, or around 10% of GDP when construction-related materials and components are included. UK site-based construction activities employ about 1.5 million people, of whom 1 million are operatives and supervisors working for themselves or employed in 200,000 firms.[1]

Investment in training, equipment and research and development by UK construction firms has fallen in real terms since the late 1970s. In spite of this, labour productivity rates appear to have grown by more than 5% per annum between 1981 and 1995. This was a faster rate of growth than the average for the economy as a whole, but slower than in manufacturing (which generally is a high productivity growth sector). Although the data are problematic in terms of reliability and comparability, labour productivity levels in the UK compare well internationally and recently have been higher than in France, Germany and Japan. Nevertheless, UK construction probably remains more labour-intensive than in Scandinavia, The Netherlands, parts of North America and Japan, where there is greater capital investment and, in many areas, more highly trained operatives (OECD data sources).

One explanation of the recent period of UK growth in labour productivity is that the technical and organizational basis of construction has shifted away from traditional site-based craft processes towards site assembly of manufactured component systems. This is consistent with changing investment patterns in research and development and capital equipment. These have declined in construction, with emphasis further up-stream in industries responsible for manufacturing construction materials and components (Gann *et al.*, 1992; CFR, 1996).

Restructuring during the last 20 years has been broadly beneficial in terms of industrial performance, but we contend that recent improvements in productivity growth result from one-off shifts in working practices. They may not be sustainable in the long term without substantial changes to training, which we suggest are needed in order to provide for emerging and future skill needs. Recent reports show low levels

of training among operatives, and a decline in construction training relative to other European countries (Cannon, 1995; Clarke and Wall, 1996; Steedman *et al.*, 1991; Steedman, 1992 and 1996).

Failure to modernize training infrastructures

Failure to modernize recruitment and training can result in skill shortages, higher prices and poorer quality output. Indeed, by the summer of 1997, reports of skills shortages were widespread in many regions of the UK, particularly in the South – a pattern similar to that experienced in the construction boom of the late 1980s. Under these circumstances, labour costs increase rapidly. By October 1997, the cost of labour for many trades was reported to have doubled from that of the recession five years earlier. This is liable to fuel an inflationary spiral which eventually destroys growth, and contributes to the cyclical nature of construction workloads.

There is a long-term trend in industrial change which relates closely to skills and training. The structure of UK construction and nature of competition have evolved through a process which shapes and is shaped by market conditions. A 40-year period of cyclical activity has resulted in two characteristics which are fundamental to current problems of training: (i) more than 45% of operatives are self-employed, and have no responsibilities for training; and (ii) around 70% of construction output is produced by very small firms working either as subcontractors or on small repair and maintenance projects in conditions where it is difficult to employ trainees.

Although self-employment and subcontracting provide a flexible structure in terms of response to short-term market fluctuations, they are not conducive to longer-term investment for future growth by firms. Fluctuations in output, smaller size and specialization of projects makes it difficult for individual firms to plan labour requirements. Moreover, frequently short-term competitive pressures lead to poaching of skilled labour and act as a further disincentive to training. For these reasons, few construction firms develop human resource plans, and most take insufficient interest in integrating training into their corporate strategies, where these exist at all.

The scope of this paper is limited to the implications of these conditions for the development of future operative and supervisory skills in the context of organizational and technical change. Our arguments are presented within the context of innovation stimulated by more demanding private sector clients, supplier-led initiatives to develop better components and processes, and a partnership between government and industry organizations to set an agenda for implementing the findings of the Latham (1994) Review *Constructing the Team*.

We question whether the outputs of current training programmes are sufficient to meet current and future needs. Is the skill structure sufficiently adaptable to support innovation? To what extent should training be broadly based? To what extent should it be specific to particular trades? Do structural and institutional rigidities hinder training delivery? Are the costs of training too high, are quality and capacity too low? What should firms do to improve their own longer-term performance capabilities? What role should government play in the face of apparent market failure to train?

Data sources for the research

This paper is based on a detailed review of the structure of skills training and provision in the UK construction sector undertaken jointly with the University of Westminster (CIB, 1998).[2] It was carried out in late 1996 and through 1997, when many construction markets were experiencing modest growth after five years of recession. The work was guided by two concerns: first, that high quality skills are essential for achieving performance improvements, but these are in short supply; and second, that too few firms develop effective human resource strategies to meet skill needs in a changing business environment.

A previous national review of UK construction skills was carried out by the authors in 1990 and 1991 (IPRA, 1991). Since then, there has been growing concern that fundamental changes in the structure of skills and training provision are required to meet the needs of modern construction processes. Since this earlier study, patterns of employment have changed, skills registration and reforms to the taxation system restricting self-employment have been implemented. Major efforts have been made to create a climate of innovation and performance improvement following a 'technology foresight exercise' and fostered by the Construction Research and Innovation Strategy Panel (CRISP). These, together with implementation of European safety and environmental legislation and quality assurance systems, are changing the landscape within which skills are developed and deployed: 37% of fatal accidents are attributable to poor training and site working conditions (CEC, 1992).

To assess skills and training needs within this context our work began with detailed desk research of recent literature and statistics. Construction produces a wide variety of products and services ranging from those in repair and maintenance through housing and offices to

large civil engineering projects. Various processes, sets of technologies and skills are deployed across these markets. Methods of data gathering, compilation of statistics and classification of skills also vary, resulting in different categories which make it difficult to aggregate data for macro trends analysis (cf. Cannon, 1995; CITB, 1996).[3] Some of the discrepancies between these sources are inevitable because of the widely differing objectives for which data are collected: some data are collected from the construction industry specifically and some for national economic reasons. However, two issues are of particular significance. 1. Inconsistencies between different datasets and classifications make it difficult to quantify changes occurring at the boundaries between one activity and another. Changes at the interfaces between trade activities often are of most interest in providing an understanding of how skill needs are evolving: for example, when component manufacturers train specialist contractors in order to ensure new systems are installed correctly, or where electronic control systems are added to mechanical heating and ventilation technologies creating the need for multidisciplinary electro-mechanical skills. 2. Inaccurate reporting of employment and training occurs because of the casual nature of employment practices in many UK construction firms. For this reason, several datasets are unreliable. In addition to these problems, the Standard Industrial Classification and skill categories have been changed a number of times over the past 25 years, making it difficult to provide accurate time-series for analysis of trends in skills.

Interview programme

The second stage of our work involved in-depth, semi-structured interviews with key national players in positions of responsibility for training policy, personnel and employment, and industrial policy. Thirty-six interviews were conducted to ascertain the current status and future anticipated direction of the industry and the implications for recruitment, training and skills. Six interviews were carried out in training colleges and three with trade unions. These were used also to suggest topics for subsequent interviews in firms.

The main source of new empirical data was derived from 86 interviews in large, medium and small companies across the regions of England and Wales. It was not possible to take a representative sample of firms across the whole spectrum of construction for this study. We used a 'snowball' technique using contacts already identified through our key-player interviews, to find relevant people with detailed strategic knowledge about skills and training in firms. The data we accumulated provided a rich picture of general trends and an orientation on likely future activities, together with an opinion survey of hot issues where changes were most needed.

Eight sets of clustered, site-based interviews were carried out to ascertain the extent of regional differences, identifying new training initiatives and exploring the delivery of on-site training from a workplace perspective. Regional clusters included Cardiff, Exeter, Glasgow, London and the South East, the Midlands, Oxford and Yorkshire. Interviews were carried out also in The Netherlands, Germany and France.

The results were analysed, and tested in two focus groups. These were attended by about 40 people from a cross-section of firms, industry and training organizations and academia. The focus groups were used to validate findings.

Our analysis began from a market/process perspective. Starting with changes in markets for constructed products, we asked which processes are producing better performance in terms of cost, time and quality. We then examined technical innovation in the context of emerging markets and processes. We asked what operative and supervisory skills are likely to be needed to work in these environments. Finally, we evaluated the gap between current availability of skills, the types of training on offer and the likely future need.

Business process change

Business processes are activities which link firms with their customers (EPSRC/IMI, 1994; Coombs, 1996). Firms in many industries are attempting to apply principles of 'business process re-engineering' (BPR) to their operations in order to improve the delivery of goods and services to their customers (cf. Hammer and Champy, 1993). The idea has begun to stimulate changes in a few construction firms, similar to those found in many other industries in the late 1980s and 1990s.

There is nothing new in the notion of improving performance by focusing on customer requirements, but often construction firms have found it difficult to translate concepts such as customer value into meaningful processes. For many project-based firms 'the customer' is another supplier or contractor, internal to the total process. In this environment, business process changes take two forms: (a) firm level changes, relating to internal re-organization to enable firms to focus on providing better value; and (b) project level changes, including new forms of cooperation to improve performance through inter-organizational functions such as partnering, or supply chain management, which enable projects to be delivered more swiftly, at lower cost and higher quality.

These approaches are leading to a redefinition of value, and when linked with the concept of removing waste through every stage in a process they provide a powerful driver for changing current practices (Womack and Jones, 1996).

The role of clients

Clients' long-term interests are to secure the maximum benefit from the buildings they invest in, and to minimize the combined lifetime costs of purchase and occupation. Nevertheless, construction is dominated by procurement processes driven by minimum initial capital cost. Processes are geared to a least-cost, self-optimizing system in which temporary coalitions of firms have few incentives to improve value for their clients. Instead, they optimize their own interests without regard for consequences of the system as a whole. For example, if engineers specify the wrong type of concrete, even if highly skilled concreters are employed, they will still be pouring the wrong concrete. Least-cost contracting has resulted in a low quality, low skills, and often low wage business with an overdeveloped sense of cost and an underdeveloped sense of value.

In recognition of this, large private sector clients have been responsible for stimulating recent business process changes in UK construction, with significant skills implications. Large repeat customers who invest heavily in construction, such as BAA, Rover, Marks and Spencer and Tesco, use value management techniques to inform decision making during design and specification processes. This increasingly involves contractors in decisions concerning constructability and construction costs. The recent growth in private finance initiative projects, and design, build, finance and operate approaches has provided further impetus in this direction, by forcing contractors to understand the management of value throughout project lifecycles.

By the mid-1990s, some clients had become interested in the qualities and qualifications of designers and design staff, but few expressed interest in the qualifications of contractors' staff, operatives and supervisors. Client expectations and requirements vary across construction market sectors. Some are driven by the need to obtain the highest quality product which will operate safely (e.g. a nuclear installation or air traffic control centre), others require their buildings to be produced quickly (fast-food stores), whilst others wish to obtain their buildings at minimum cost (motels). Clients are increasingly putting pressure on construction to improve on all three: quality, time and cost. Large clients also form the core of the UK Deputy Prime Minister's Construction Task Force, due to report in July 1998. However, outside the repeat customer market it is not usually possible for clients to be sufficiently aware of detailed issues such as the deployment of appropriate skills.

It is possible to envisage a scenario for one-off construction customers in which firms compete in these markets on the basis of employing well trained people who understand quality and customer focus. The aim is an all-skilled workforce, substantial reductions in rework, higher productivity, faster completion, and fewer accidents. Under these conditions, it may be necessary to accept increased capital costs in order to secure higher quality buildings with lower running costs. Accreditation of skilled operatives is a key requisite in assuring customers that skills are available to deliver the service on offer. This is part of the portfolio of attributes required in quality assurance and achieving customer satisfaction.

Partnering and skills

Various forms of partnering are being adopted to improve performance, sharing the benefits as well as the risks of construction (Barlow *et al.*, 1997; Bennett and Jayes, 1995). For example, firms are developing long-term partnering with clients for successive projects or maintenance services; they may enter short-term project arrangements; or they may be involved in strategic alliances with other enterprises in supply-chains.

Our interviews illustrate skills-related issues such as those in the partnership between Thames Water and Morrison Biggs Wall (a division of Morrison Construction) which was established in 1996 to carry out maintenance work. Workers wear similar uniforms and have logos of both companies on their vans. The aim is to create a climate of cooperation and problem-solving, rather than confrontation. The partnership has already delivered measurable benefits in quality in terms of an 80% reduction in customer complaints and 10% reduction in maintenance costs. Experiences such as these have identified a number of skill needs which require specific training to achieve success:

- intra- and inter-organizational team-building and development (all employees in the above example received training on a two-day team-building programme)
- multi-skilled, cross-functional skills development; and
- negotiation and communication skills development.

Learning and skills

A second aspect of business process change involves construction firms in new learning experiences. Some

have already begun to inculcate a culture of learning from project to project within their organizations. To do this, they have fostered new relationships with their employees and changed practices and skills embedded within existing construction activities. For example, Blue Circle and the Rover Group have introduced employee partnerships to reduce perceived threats of new technology and business process changes, enabling them to pursue innovative goals. Companies like Tarmac are involving employees and junior managers in the development of innovative approaches to problem-solving on sites. Balfour Beatty and Australian contractor Civil and Civic are seeking to turn themselves into innovative learning organizations. In other industries, companies such as Rank Xerox have been able to establish learning loops within re-engineered processes. In this case, learning responsibilities were developed as individual skills within each person's role (Coulson-Thomas, 1996).

The role of manufacturers

A third aspect of business process change involves manufacturers and suppliers taking a more direct involvement in construction activities, including the development of skills. This is sometimes necessary when manufacturers and suppliers want to introduce new products into the market, but are concerned that construction skills are inadequate. A recent example includes Siemens' development of a new training school in West London for electrical engineers to be trained in the design and installation of intelligent building technologies. The course trains and accredits operatives to work with the EIBus standard and Siemens' Instabus products. Other examples include that of Hepworth, who train plumbers to work with new generations of plumbing technologies, British Gypsum in dry-lining skills and Pilkingtons in glazing products.

Table 1 summarizes the types of performance improvement required by clients and the areas of change in skills and training necessary to make these.

Technological innovation

There is a close relationship between availability of skilled labour and choice of technology. Decisions to adopt new technologies have sometimes been made because of lack of traditional craft skills. For example, in the late 1950s and early 1960s, labour shortages in carpentry and bricklaying were partly responsible for the introduction of systems building technologies in UK housing. But this technology failed because of inappropriate skills and inadequate training (McCutcheon, 1975). More recent examples of skills-related failure include UK timber-frame private residential construction in the early 1980s (Gann, 1984). During the 1980s construction boom, the UK cladding industry suffered heavily from foreign competition because of inadequate skills at all levels, including site supervisors and estimators. Often installation operatives had trained originally as carpenters, joiners or glaziers, but many lacked technical knowledge about cladding systems and related handling skills. In some cases, lack of skills and poor supervision led to potentially dangerous methods of fixing. These examples show that new technologies can be implemented effectively only by properly trained and skilled workers.

Technological change affects skills in new-build and repair and maintenance in two ways. (i) Small *ad hoc* changes and adaptations to materials and components are continually being made by skilled operatives,

Table 1 Performance improvement targets and implications for changes in skills and training

Performance improvement targets	Employment and skill implications	Training needs
1. 30% cost reduction	Increase in productivity – new skills linked to innovative approaches and possible job losses	New technology skills New business process skills
2. 20% reduction in time	Concurrent engineering skills and faster working practices	New business processes Communications and IT skills
3. 20% improvement in usability	Better links between customers and suppliers and life-cycle analysis	Communications skills (operative–client in work to existing buildings)
4. Zero defects	Reduction in rework = loss of employment – new skills in 'lean construction' techniques	Training for 'right-first-time' shift in culture

managers and professionals. These are of crucial importance in getting projects finished on time. Such changes can be made only if the workforce is sufficiently skilled. (ii) Major changes to materials, components and equipment, often resulting from planned research and development, have far-reaching consequences for the way in which the construction process is organized and for the types of skill required. In general they have brought a shift away from traditional craft practices towards more engineered and assembly methods.

A number of 'generic' technologies are affecting the type and number of construction skills required, these include:

- IT in construction processes, e.g. computerized ordering and invoicing of materials;
- IT in constructed products, e.g. electronic building controls systems;
- new materials and composites;
- new fixings;
- new types of component, including standardized and prefabricated systems;
- on-site plant and equipment, including small hand-held and programmable tools; and
- biochemical and remediation materials, including cleaning agents.

Mechanization

Increasing technical sophistication of both construction products and processes means that the need for technical, knowledge-based skills is growing. Introducing new technologies creates problems at interfaces between new and existing systems. This occurs when people lack the skills to work alongside those using new technologies. Training is needed for everyone likely to be affected and not just those working directly with new technologies. An example of this is in the development and use of global positioning systems on piling rigs. Annual turnover of the UK piling business is around £300 million, and often the work requires only short periods of activity on any particular site (many piling jobs last for just a few weeks). The workforce therefore needs to be prepared to travel large distances from one job to the next, and the industry is faced by a serious problem of ageing and difficulties attracting new, younger entrants. Yet the introduction of IT for pile installation will require new operative skills. Operatives will have to work more closely with engineers because the use of digital communications between engineering CAD systems and piling rigs will require continuous feedback. Moreover, the automation of pile positioning using these technologies could eliminate the need to use subcontractors to set out piles in the near future.

Other examples of mechanization and automation affecting skills include the use of laser levelling devices connected to programmable excavators, or the use of virtual reality control systems for crane operators. In some types of crane the control levers are extremely complicated and it can take years for an operator to become proficient. Companies such as Bechtel in the USA are experimenting with the use of data-glove control devices to enable crane operators to learn and operate machines more efficiently. Similar systems are being developed to improve safety of lifting operations.

Moreover, as construction becomes more mechanized there is increasing concern over the adequacy of maintenance skills, including knowledge of programmable machines. In spite of the use of new automated safety control features, the potential for accidents on site relating to increased use of plant and equipment is likely to grow. All construction operatives working in the vicinity of such equipment need to be aware of health and safety issues and the effects of such machinery on their own working patterns.

Pre-assembled components

Value-added in construction is increasingly being produced up-stream in the supply chain by component manufacturers, who have invested in capital-intensive production processes. Many new technologies developed by component and materials producers aim to improve the quality and/or reduce the cost of building elements. At the same time, they aim to reduce the content and time required for on-site work. Labour-saving changes in new-build and maintenance work include, for example, the use of plastic window frames, which have reduced the demand for painting and decorating work. In consequence, technological changes aimed at improving construction processes and reducing the need for on-site skills often are made away from construction sites. Firms such as plumbing manufacturer Hepworth place emphasis on developing products which are easier to install, such as self-adjusting drainage systems which reduce the possibilities of failure due to inaccurate installation.

Building services

Our interviews show that in many areas construction firms lack the skills to introduce new technologies. For example, training needs have not yet been addressed in data cabling, opto-electronics, controls, switchgear, and building management systems. There are also serious

problems with operative skills in cross-functional areas such as maintenance, in which newer technologies are operating within older systems. Building maintenance operatives need to be multi-skilled to enable them to deal with mechanical, electrical and electronic control equipment. Moreover, many cultural issues need to be resolved during training in order to create an environment in which new technologies can be implemented successfully. The training institutions appear very slow to respond to these needs. In spite of having intelligent building systems in the market for 15 years there are remarkably few courses. So far, we are aware of only one degree course which started in 1997, one intelligent building training course at an FE college and two manufacturers' training facilities for operatives.

Information technology

Among the existing operative workforce, the skills required to use IT systems would appear to be almost non-existent. This stems partly from problems of recruitment: construction often attracts only low achievers from schools. Our interviews suggest that the situation regarding recruitment is starting to change, with many potential new entrants having an intuitive feel for work using IT systems. Many more young people are receiving some education in the use of these technologies at school and therefore are responsive to the technology. It is not so clear whether construction skills trainers are yet up-to-date in this respect. If the use of IT is to penetrate construction in a meaningful way then many in supervisory roles will need to improve their skills by attending new training courses.

Craft skills usually embrace general capabilities which can be useful in tackling problems never previously encountered. However, rapid and unplanned adoption of new technologies means that construction workers may be inadequately skilled to cope with their introduction. Operatives often are confronted with having to work with new materials or components chosen by others. Working proprietors may be faced with difficult choices concerning whether to use a new material. Information about new developments is often communicated by word-of-mouth and there may be little scientific evidence to justify the choices made. New site operative skills are required. These include checking tolerances when components are delivered, the use of mechanical handling and lifting equipment, together with alignment, fixing and fitting skills. Operatives need technical knowledge to avoid causing defects during installation. Problems arising at the interface between installation and other construction work highlight the need for installation teams to understand how their work relates to that of others. Maintenance operatives require multiple skills to tackle dismantling and reassembly of fittings and finishings, together with diagnosis and overhauling of mechanical and electrical systems.

The new training infrastructure

The mechanisms for construction skills training in the UK are complex and often confusing, with several institutions involved in funding, delivery, certifying, qualifying and accrediting skills. Complexity is deepened by the technical nature of training systems, which themselves have grown into a sizeable industry, with many acronyms by which most institutions and their schemes are known. The following discussion seeks to explain the main principles at the heart of the UK system, and assess their validity in meeting the changing needs of industry described above.

Most construction skills training takes place within a national framework of qualifications governed by The National Council for Vocational Qualifications (NCVQ). This framework was created in 1986 with the aim of stimulating attainment of learning outcomes assessed against national standards. National Vocational Qualifications (NVQs) differ from academic qualifications: they are not based on success in written examinations and do not involve attendance at prespecified training courses. Standards are developed by industry, for industry. While some academic learning is involved, NVQs contain significant practical elements and are awarded to those who demonstrate evidence of competence in defined workplace tasks. The rules state that there should be no restrictions to access on grounds such as age, location, or availability of suitable learning facilities.

Individuals seeking NVQs are assessed by trained and licensed assessors. Verifiers unconnected with the candidate, assessor or training provider are supposed to ensure that the assessment system is satisfactory and correctly implemented. Performance-based assessment should be supported by relevant evidence of underpinning knowledge, and assessment should be to the same standard throughout the country.

These qualifications and standards are derived from functional analysis. This focuses on whole work roles and embodies an outcome approach, which identifies key purposes and functions. It is a top-down method which starts from a clear functional statement of the entire occupational area, breaking this into significant roles from which unit and element structures are derived. 'Occupational maps' based on 'functional analysis' are fed to 'lead bodies', who devise standards and the unit and element structure from these maps.

Awarding bodies add performance criteria and other details to turn the standards into qualifications acceptable to NCVQ (Mansfield and Mitchell, 1996).

The intention is that a good functional analyst will review a range of options and consult widely. But the analyst has to decide what functions are included in a particular occupation. Inherently, the process is largely arbitrary (Senker, 1996). Employers, typically leading members of trade associations in specific areas, dominate lead bodies and participate in awarding bodies. Employer representatives tend to suggest that people with relatively narrow skills are needed. Membership of committees has come predominantly from large companies with good training records. Qualifications tend to meet the needs of such organizations rather than those of small firms (Eraut *et al.*, 1996).

The result is that skills classifications and associated NVQs tend to be too fragmented for construction. Increasing emphasis has been placed on specific rather than generic skills, an emphasis reinforced by various specialists (Eraut *et al.*, 1996). Occupations such as 'floor, wall and ceiling tilers' which constitute a relatively minor area have been broken down into subdivisions – 'floor and wall tilers', 'floor coverers', 'ceiling fixers', and new occupations have been introduced from 'cavity wall insulation' to 'demountable partition erectors'. In practice, the NVQ system has supported and even reinforced traditional construction trade boundaries.

Most construction NVQs introduced so far have been at Level 2, with some at Level 3. A significant problem is lack of underpinning knowledge (maths, English and general science). Frequently trainees often have low academic qualifications, and NVQ requirements have failed to require these deficiencies to be addressed. Those who secure NVQ qualifications at Level 2 often possess skills which are too narrow even to meet employers' current requirements. Sometimes they meet employers' short-term needs, but more theoretical knowledge, practical on-site training and experience often are needed to achieve quality consistently.

NVQs at Level 2 can be awarded to people who have far less skills and breadth of underpinning knowledge than were acquired by craftsmen in the past, when training not only produced competent craftspeople but also laid foundations on which, with experience, competence could grow. Extensive evidence from other countries such as Germany and The Netherlands shows that the path to better vocational education and training lies through incremental improvement of bottom-up processes, rather than through the defective NVQ system. It would appear that current UK knowledge, skills and experience, especially a lack of underpinning knowledge, are inadequate for career development and progression.

NVQ assessment

NVQ assessment is based on an elaborate competence assessment model, but corners had to be cut to contain costs. A recent study found that 41% of construction assessors feel that many candidates pass who should not, and concluded that the present state of NVQ assessment is unsatisfactory. There should be flexibility in assessment, but not leniency. It was found difficult to judge when desirable flexibility degenerated into unjustifiable leniency in assessment (Eraut *et al.*, 1996).

Reservations were expressed by several companies in our study about the effectiveness of NVQs in raising standards. In addition, the Electrical Installation Engineering Industry Training Organization (EIETO) carried out a survey of its members. It found that few employers have in-depth knowledge of NVQs and most are sceptical about their value. Some described them as a 'bureaucratic nightmare'. The Engineering Services Training Trust surveyed the heating, ventilating, air-conditioning and refrigeration (HVACR) industry. Employers in this industry were very concerned by the costs, the bureaucracy and the role of Training and Enterprise Councils (TECs) and local enterprise companies (LECs), which administer funding.[4] These comments echo serious doubts expressed in reports by the National Audit Office and the House of Commons Public Accounts Committee about the cost-effectiveness of the NVQ system, including evidence that outcome-related funding has been subject to abuse.

In the light of recent criticism, a committee chaired by Gordon Beaumont reviewed the most used NVQs (Beaumont, 1995). NCVQ initiated a development plan to implement Beaumont's recommendations, which resulted in new NVQ criteria and a common accord on quality assurance. According to Baroness Blackstone, the Education and Employment Minister, this provides a sound basis for the work of the Qualifications and Curriculum Authority, which took over responsibility from NCVQ in October 1997. It is likely that as a result further changes will be made to upgrade vocational qualifications (NCVQ, 1997 a, b, c, and DfEE, 1997). There is increasing recognition of the need to break down barriers within training structures to improve pathways between different levels, creating ladders of opportunity for operatives' career progression. 'Modern apprenticeships' were established to provide a structure offering many of the elements of traditional apprenticeship schemes, integrated within the NVQ system. To date, few employers have used 'modern apprenticeships'. The low take-up is partly due to the poor image of construction as an employer, and partly because relatively few employers offer them: some recognize a need for training to Level 3, but others feel that training to Level 2 is

adequate for most workers (Gospel and Fuller, 1998). One exception has been in the electrical contracting sector, where high standards have been set. The employers and union insisted that practical tests should be retained when their scheme was converted into a 'modern apprenticeship'. One reason for success has been collective regulation by the employers' organization and the trade union (Gospel and Druker, 1998).

In summary, the NVQ system has restricted the content and scope of training programmes and led to over-emphasis on qualifications as opposed to learning processes. An elaborate, expensive and inefficient system of delivering training has developed which involves substantial funding for administration, and in particular for support of Training and Enterprise Councils (Evans *et al.*, 1997). An obsession with qualifications combined with the need to cope with complex administrative and funding procedures has diverted attention from the need to modernize training to meet the challenges of new technology and business processes which, in consequence, has been almost totally neglected. The attainment of qualifications does not guarantee valuable learning. The learning context, learning process and expertise of those providing education and training are at least as important as qualification structures in determining scheme success. Our study and interviews suggest that the current system is failing the construction sector.

Problems of obtaining work-based training and experience

A few years before introducing the NVQ system, which requires assessment to demonstrate evidence of competence in workplace tasks, the then Conservative Government encouraged the growth of self-employment, which tended to reduce the number of workplaces available for training and assessment. Problems of finding sufficient workplace training and assessment places were aggravated by recession.

Through the 1980s and early 1990s, large firms relied increasingly on subcontracting to small firms and the self-employed, who found it difficult to find time and money to invest in training. The growth in subcontracting and increasing reliance on lump-sum contracts specifying tight deadlines and stiff penalties for failure to meet them increased pressures on firms and reinforced reluctance to train. Fear of poaching skilled labour acts as a further disincentive to training. Moreover, the recent lack of training has been exacerbated by inadequate training in the late 1960s which left the industry poorly provided with skilled charge-hands and foremen competent to supervise operative training (Gann, 1988; Senker, 1989).

Evidence from our interviews indicates a new trend away from self-employment back to directly employed skilled workers, particularly in the North, where direct employment has always been more common. Nevertheless, the consequence of training in a self-employed environment has been contrary to the original intentions of NVQs in that most construction training has been delivered and assessed in colleges rather than the workplace. This has not served construction well.

Conclusions and recommendations

Although this study is based on the specific industrial and institutional conditions found in the UK construction sector, our conclusions may well be of wider interest. Many of the issues faced by UK construction are similar in other countries. For example, the workforce is ageing and the number of new recruits declining together with in-company training. Construction firms largely rely on recruiting new entrants (usually young white males) with low educational qualifications. Dangerous, dirty and unpleasant work environments contribute to a poor image which often deters higher calibre recruits. Government encouragements to recruit more women, people from ethnic minorities and older people has had little effect so far.

The main findings from our study show that many traditional occupational boundaries no longer relate to the work carried out. Craft skills have declined, particularly those associated with mixing, cutting, jointing, shaping, and adapting materials on site. But there is increasing emphasis on skills linked to positioning and alignment, measurement, fitting, assembly and planning work. Calculation skills, reading drawings and the ability to access information on computers are needed increasingly, together with knowledge about materials, site processes, health and safety, and the work of other trades. There has been a general decline in wet trade and labourer employment, but occupations related to the use of concrete, steel, drylining, prefabricated components and specialist assembly have grown. Versatile multi-skilled operatives are needed increasingly, especially in repair and maintenance.

Most training remains trade-related, rather than industry-wide as in other major European countries. It provides for skills in new building work; yet nearly half of all construction activity is in repair and maintenance where multiple skills are needed. Large areas of activity either remain without training or depend only on short courses, such as concreting or plant operation.

We conclude, therefore, that: (a) the skill structure is not sufficiently adaptable to support innovation required to sustain long-term performance improvements; and (b) a generic training programme is

required, set within a simplified framework in which the bureaucratic costs are greatly reduced.

In view of the types of business process and technological change described in this paper, more attention to further and continuing training is imperative. Performance improvements gained from skilled workers are likely to be widely beneficial, e.g. as follows.

- Clients are beginning to recognize the potential delivery, productivity and cost benefits they can derive if contractors employ more highly skilled operatives. They should therefore insist in contract conditions that contractors employ a highly qualified workforce who continue to be trained.
- A major proportion of site accidents result from poor management and lack of adequate and appropriate operative training. Moreover, the costs of accidents are greater than the necessary investment in safety equipment and training.
- Air, noise and water pollution is becoming an important issue for construction firms and changing existing practices has implications for business processes and skill requirements.
- Sophisticated construction products and processes are increasing the needs for technical knowledge and skills, which can only be implemented effectively by properly trained and skilled workers.

Construction firms themselves need to take responsibility for training in order to secure the long-term benefits from employing a skilled workforce within the emerging competitive environment in UK construction. Government needs to play its part in the face of market failure to train, particularly by smaller firms. Changes in incentive structures promoting direct employment and a more stable operating environment will assist in this.

The need for a foundation programme

Responses to our interviews suggest that changes in skill requirements can be met better if operatives are given broad foundation training initially to which additional skills can be added when and if they are required. Firms currently fill gaps in availability of appropriately trained people by employing labourers with minimal training for work which often requires considerable skill and knowledge to perform properly. Firms also require multi-skills to improve flexibility, in which workers trained in one trade acquire new skills associated with other trades. In the current skills and training environment operatives often have to acquire these skills by informal means in the absence of a sound basis of generic skills and knowledge, and with no assurance that they can do the work properly and safely.

In some respects, traditional training structures catered better for this type of flexibility. For example, bricklayers carried out brick and block work, drainlaying, tiling, plastering and screeding; carpenters and joiners needed to undertake first and second fixes, construct formwork, dry-lining, partitioning and roofing; the work of bricklayers and carpenters required them to read drawings, understand a variety of materials and to interface with different processes. The knowledge and skills they acquired often equipped them for promotion to supervisors and beyond.

In 1969, a new training plan was proposed by the CITB which attempted to meet these needs. The plan involved grouping trades into broad areas: general construction operatives, trowel trades, roofing trades, asphalting, painting and decorating, glazing, mechanical engineering services and electrical engineering services. In 1971, financial problems beset the CITB and this plan was abandoned. Subsequently, pressure from specialist firms and trade associations resulted instead in increased emphasis on specific as opposed to generic skills. We have argued above that these tendencies were encouraged by the introduction of the NVQ system.

To meet the modern challenges faced by construction we propose that all new entrants receive a common foundation training programme, intended to provide orientation on modern construction practices, technologies and work environments. A similar programme should also be made available for all existing construction operatives. Figure 1 indicates the need to identify and classify modern construction skills, the one-year common foundation programme, and subsequent core foundation skills programme. The training should be linked to a new, streamlined grouping of skills. It could include good practice guidance in business and technology management issues associated with meeting

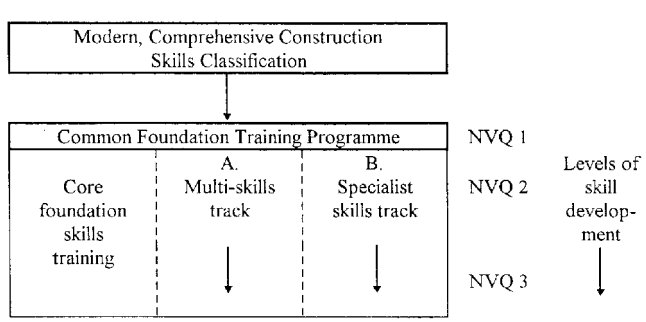

Figure 1 Foundation course and simplified training structure

modern business needs. The types of issues to be covered by the end of the third year of the programme could include:

- the structure of the industry, division of skills, organization of sites;
- general business management, interpersonal and team skills, and systemic thinking;
- general project management, time and budget control;
- understanding and managing technologies – reading drawings, measuring, aligning, placing, fitting, fixing;
- understanding and handling different materials and plant;
- working in a healthy and safe environment;
- understanding the customer, client and end-users; and
- checking work and problem-solving skills, including knowledge of rework and its costs.

Such a programme should encourage people to expect change, creating a self-awareness of the need to extend skills and helping people to move away from a 'blame' to a 'learning' culture, empowering operatives to change by helping them to develop and build their own confidence.

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Endnotes

[1]All statistics are from UK government sources and derived from the Housing and Construction Statistics published by HMSO, unless otherwise stated.
[2]The CIB is the main organization responsible for strategic leadership and guidance for UK construction. It was formed in 1994 following the Latham report, with the aim of promoting and implementing performance improvements in liaison with clients, firms, government and industry associations.
[3]The Department of the Environment Transport and the Regions (DETR) collects housing and construction output statistics. The CITB, various industry training organizations (ITOs) and industry research associations collect statistics on skills and the number of trainees, but not on a consistent basis. The Department for Education and Employment (DfEE) collects data on student numbers, and so does the Further Education Funding Council (FEFC). The national Labour Force Survey provides information on employment by occupation at quarterly intervals, but relies on people interviewed to classify their own occupations. The national Census provides data on employment, but this can be nearly four years out of date by the time it is published.
[4]TECs are chiefly a means for the Government to control the flow of funds to providers of training for the long-term unemployed and for young workforce entrants (Bennett *et al.*, 1994). TEC funding from the Department for Education and Employment (DfEE) is outcome-related. In order to secure payment from DfEE to pass on to training organizations, TECs have to insist that trainees secure qualifications and employment rapidly. These constraints can place training schemes in jeopardy, particularly in construction. Our interviews with firms revealed that few had any direct contact with local TECs. The majority of small and medium size firms interviewed either had negative attitudes towards TECs or were confused about the role they were supposed to play in relation to construction training. Moreover, national firms whose employees' homes are geographically dispersed have had problems dealing with a number of different TECs. Also the funding available for particular types of training is variable between TECs. For some this has been resolved through the Manchester Construction Partnership, which administers all their training nationally. Some large firms refer all their training needs to this one TEC, which appears to be contrary to the TEC remit to operate within a specified geographical area.