Cost vs. production: disparities in social housing construction in Britain and Germany.

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This is an electronic version of an article published in Construction Management and Economics, 22 (5). pp. 521-532, June 2004. The definitive version in Construction Management and Economics is available online at:

http://www.journalsonline.tandf.co.uk/openurl.asp?genre=article&issn=0144-6193&volume=22&issue=5&spage=521

Cost versus Production (1): Disparities in social housing construction in Britain and Germany

Running title:

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Keywords: Germany, housebuilding, skills, training, comparison

Abstract

This paper is about the qualitatively different nature of the labour process in the British construction industry compared with that in Germany. The rationale of the British system is based on controlling costs through overseeing contract relations, themselves circumscribing a range of narrow, clearly defined and priced tasks. The production process has become secondary and production expertise restricted. In contrast, in Germany cost aspects are incorporated into, rather than separated from, the production system, built on the interaction of capital and labour and on a high level of production expertise. Employment relations rather than contract relations predominate and circumscribe a set of skills drawn from the potential of the labour force and dependent on broad-based vocational education.

The paper is based on a detailed investigation of social housebuilding projects in Britain and Germany. It is the first of two papers concerned with the overriding cost rationale of the British construction process at the expense of considerations of production. The effects of this is examined here in terms of the structure of expertise and skills within firms, the nature of the subcontracting and the

composition of the construction team. The paper shows the need for more and a qualitatively different constellation of skills, professional and operative, in Britain. It thus contributes to the debate on achieving a higher skills equilibrium (Crouch et al. 1999; Brown et al. 2001), expands transnational sector comparisons (Stewart 1994) and identifies areas at which change should be directed in the UK construction industry, as promoted through the Latham, Egan and subsequent reports (Latham 1994; Construction Task Force 1998; Strategic Forum for Construction 2002).

Abstract 267 words

Main text excluding tables and references 6090 words

Introduction

For the successful operation of a construction firm – and indeed the whole construction sector – the effective combination of cost and production knowledge is of paramount importance; it is also essential for any innovation (Clarke and Herrmann 2001). The cost function is understood as comprising all the various pre- and post-contract tasks, including predicting costs, estimating, buying, invoicing from accounts, and surveying during the whole course of a construction contract. Production knowledge, on the other hand, is the totality of the expertise and experience applied on site by the personnel of the main contractor, the subcontracting firms and suppliers related to bringing together labour, material and plant in such a way as to ensure an efficient, productive, safe, healthy and socially responsible process, as well as a good quality product. This distinction between cost and production knowledge enables the nature of firms and their skill base to be understood and provides an insight into the social organisation of the work process (Wilkinson 1983). Such knowledge is, however, organised and applied in very different ways in different countries, as illustrated in this paper in the skills and expertise within construction firms in UK and Germany.

The paper draws on a study of social housing projects and the firms involved, altogether eight in Britain and four in Germany, for a few of which it was possible to obtain very detailed information.[1] The comparative method applied owes much to that developed originally by Maurice et al. (1986) and CEREQ (1991), though

[1] This was part of a larger study of social housing projects in Britain, Denmark, Germany and the Netherlands supported by the Engineering and Physical Sciences Research Council (EPSRC) and the former Department of the Environment, Transport and the Regions (DETR) and entitled 'Standardisation and skills; a transnational study of skills, education and training for prefabrication in housing.' It was conducted in partnership with researchers in each of these countries including: in Denmark Prof. Sten Bonke and Prof. Elsebet Frydendal Pedersen of the Technical University of

differs in that projects selected rather than being identical were as far as possible typical for their national setting, particularly with respect to the building methods applied. The study shows how preoccupation with costs in the British case is reflected in the different skill profiles of firms and is at the expenses of production expertise. Concomitant with the emphasis on costs in the British case is the preoccupation with contract rather than employment relations, as exhibited in the heavy reliance on subcontracting, in particular labour-only subcontracting, compared with Germany. This preoccupation carries through to the construction team, so differently constituted in the British case, as symbolised by the absence of the building engineer and the importance attached to the surveyor.

Table 1

In comparing the roles of those with production, technical and cost functions in the British and German cases and the extent to which their expertise is integrated, the paper seeks to develop comparative transnational research into the role of middle managers and engineers (Stewart et al. 1995; Winch and Campagnac 1995). Our research has shown that the concern to control costs and contract relations determines all aspects of the construction process and has contributed to a further diminution in production knowledge and skills in British construction. A second and subsequent paper shows the effects this has in terms of efficiency, productivity and the organisation of the site process, drawing out in particular differences between Britain, Scotland, Denmark and Germany in labour deployment and the sequencing of the production process.

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Cost and production divisions in British and German firms

UK1 is a medium-sized firm in the north-west of England operating through two regional companies with 85%, or about £50m, of its work in the area of social housing (Table 1). The firm is unusual only in having a relatively high proportion of directly employed operatives, at least compared with larger firms and with firms in the south of England. Its turnover per employee, at £108,333 in 1998, is as a result much smaller than the average of £287,000 per employee for the social housing divisions of the two large UK contractors in our survey. These large contractors acted mainly as managers of the building process, with all the trades employed through subcontractors. They contrast with comparable-sized German firms, including D1 in our study, a large contractor with a turnover of £292m (875m DM), with about 10% of its activities in housing, one-third of this in social housing, and a wide regional spread over the north, east and west of the country. The turnover per employee of D1 is £104,353 (313,059 DM), that is, almost identical to the UK1 and close to the average of the four German companies examined.

If we compare differences between manual and non-manual employment, especially the number of office-based staff and site staff or operatives, in these firms, in UK1 and D1 in particular but also in other firms in our study, some revealing differences are apparent. Traditionally a firm's main skill base, including in the UK, was the production department; this was always the largest department in construction firms, responsible for all operations and production

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Netherlands Dr Anneke Westerhuis of CINOP.

personnel on site (Clarke 1992, 46-60; Gruneberg and Ive 2000). For the German contractors on our case study projects this remains the case; these still have large production departments. In contrast, the role of the UK production department has been generally reduced as firms have come to rely on subcontracting and have specialised, providing only management and supervision on site.

A comparison of six of our companies, two German and four UK, highlights the different firm structure in the two countries (Table 2). In the German firms, office employees were far outnumbered by those on site: office personnel on D1 were 15% of all employees and production personnel 85%, and on D2 21% and 79% respectively. Both German firms are fairly typical examples of regional construction firms, as apparent from this and from our previous studies of German firms, and carried out all the structural part (*Rohbau*) of the building work on the case studies with their own workforce (Clarke and Wall 1996 and 2000).

Table 2

For the UK companies the division of labour between office and production employees is quite different. UK1 is most similar to the two German companies, but on its case study project the UK1 contractor operated in exactly the same way as the other UK companies, purely managing the construction process with no involvement of its directly employed operatives. With the development of management-only firms, some UK firms have come to employ very few or no operatives (Winch 1998). The housebuilding divisions of the three large national contractors in our study, UK2, 4 and 5, for example, undertook only the management and supervision functions on site and had on average only 39% of all

employees in their production departments. A considerable proportion of site staff are not included in the firms' office and production figures, as they are casually employed, agency labour or on short-term contracts.

A closer analysis of the skills employed on UK1 reveals the predominance of the cost function. 58 employees or 51% of office staff, comprising those involved in surveying, estimating and buying, have cost-related expertise (Figure 1). In contrast, the German regional division did not have a commercial department at all; this was located at head office level with nine employees providing services for four regional divisions. Four employees are permanently in the estimating department at the regional level. The composition of knowledge in the technical office shows the preponderance of technical expertis, held by 20 out of 32 personnel employed - including project management (Figure 2). The peculiarity of the German system of firm organisation is that surveying as a distinct function does not exist. It is instead integrated into the project management function in the domain of the building engineer, whilst estimating is traditionally placed within the technical and not the commercial division.

Fig. 1 and 2

A critical element accounting for the relative strength of production knowledge in German construction firms resides in the occupation of the building engineer, who provides detailed technical knowledge of the process. In the German building industry the building engineer is the main occupation: in 1999 6,818 building engineers graduated and 154,000 in total were employed in the industry, whether in architects' offices, as project managers for clients or as commercial, contracts and project managers in firms (Statistisches Bundesamt). What is notable, in

contrast, for UK industry generally and the construction industry in particular is the lack and continuing demise of engineering knowledge (Roberts 2002). As expressed in dramatic terms by the Fairclough report: ‘If the current rates of decline were to continue into the future, the number of students in the built environment would rapidly collapse. By 2009 the number of applicants to civil engineering courses would have fallen to 0, while the last applicant to building and construction courses would enter university by 2012.’ (Fairclough 2002: 16) Present figures for construction-related degree courses show that in 2001 2,480 students graduated in civil engineering with a first degree and 2,840 in building (HESA 2002). The predominance of the cost function in the UK construction industry is also substantiated through the membership figures of the professional institutions: in 2000 the Institution of Structural Engineers (IstructE) had a membership of 13,191 compared with 32,498 in 1998 for the quantity surveyor division of the RICS.

The reduction in technical engineering knowledge in the UK is especially severe within the housebuilding sector because the product has become highly standardised. Engineering input is on a one-off basis from structural engineers and from outside, instead of being part of a firm’s technical department. This outsourcing has important implications for the ability of firms in Britain to change production methods and to innovate compared with their German and other European counterparts (Winch 2000; White et al. 1988). It has also gone together with the drive for cost reduction in large construction firms, which has seen production capacity largely transferred to subcontracting firms, giving them the central role in the organisation of construction work.

The role of subcontractors

Heavy reliance on subcontracting in the British case is the logical outcome of this preoccupation with cost rather than production. Subcontracts are let out and under the control of the surveying department, that is the cost experts, and in housebuilding, particularly with the typical brick and block method of construction, are structured according to traditional occupations, with, for instance, the structural and services trades divided into groundwork, bricklaying, carpentry and joinery, electrical work and plumbing, which is further broken down into gas, water, ventilation and the fitting of sanitary ware. When the subcontracting firm does not have the skills or capacity to carry out the contract in the time period allocated in the contract programme (generally setting very tight targets), the trade packages are sometimes further split. In our case studies, for instance, the brickwork subcontract was split on both projects UK1 and 2. The subcontractor may also further subcontract work. The overall effect is to produce sharp demarcations between trade areas and to maintain traditional skill and task areas from which there is little escape, as any change in the system is seen to rely on changing contracting relations rather than centred around reorganising the production process itself.

Subcontracting in Britain is so all-pervasive that, unlike in other countries, it extends to labour-only subcontracting and even to those working for subcontractors having contracts for services as self-employed workers rather than contracts of employment. Labour-only subcontracting was widespread on the case studies examined. So too was the use of CIS cards, a system of employment

subsidy only applied in construction, whereby so-called ‘self-employed’ building workers are issued a card by Inland Revenue and entitled to pay their own (lower rate) tax and insurance unless deducted at source by the contractor. The reality of subcontracting and in particular of labour-only-subcontracting is apparent in the following quotations from interviews with site managers:

> The system of site instruction has been put in place to deal with the huge labour turnover so that someone makes good and corrects mistakes. The system makes sure that the operatives will get paid. All subcontractors are on price work.
>
> All contractors have CIS cards across the board, yet they come and go. You never know who is there as they are moved from site to site. It depends on who shouts for labour. There is no continuity so they end up finishing someone else’s work. This is very difficult. You need only look at site instructions and see how these change and have increased; this is a whole file now. These can be given for what is already in the contract, usually with the carpenters about 60-70%.

On UK1 the total subcontract value was £3,371,571 including additional instructions, that is 53% of the overall contract value. Sixteen different subcontracting firms were employed (Table 3). Apart from subcontractor no.2 and 3 all other subcontractors were registered with Companies House as small companies with a turnover of less than £1million and were thus exempt from reporting obligations.

Table 3

The size of the first subcontract at £1,414,971 was substantial and, including the brickwork package for the retaining walls and the high boundary wall, amounted to almost three times the value of the next biggest contract, the brickwork contract of £507,000 for the superstructure. The logic of the cost emphasis extends to splitting up the main elements of production – labour, material and machinery –

into separate contracts. Thus brickwork is generally contracted as labour-only, as on this site, with the main contractor providing the bricks. The scale of brickwork on this project was huge, a contract value of £969,471 split between the two subcontract firms No. 1 and No. 4. Subcontract firm No. 4 reported a turnover of £3.9m in 2000, predominantly for labour-only work and thus requiring a huge amount of labour, yet no figures on the numbers employed are available. On our site none of the bricklayers was directly employed. The other part of subcontract package 1, comprising strip foundations – all drainage, main drainage, street and house drainage – was labour and material (or supply-and-fix). This subcontract firm fell behind in its programme and much pressure had to be exerted to increase the number of operatives on site, which it eventually did by employing at the peak 30 operatives on site for 15 consecutive days.

The main characteristic of the brick-and-block low-rise building method is its low level of mechanisation; plant on site is minimal. On UK1 two forklifts and one pick-up truck were the main plant for moving and lifting materials. Forklifts reached the top lift of the scaffolding and served bricklayers with bricks, blocks and mortar and roofers with felt, battens and tiles. Mobile cranes were also required to lift the roof trusses into place for joiners to erect the roofs, and the groundwork subcontractor used excavation and loading plant for a time. The overall use of plant was however limited and high labour levels, especially of untrained labour, were in place instead, particularly on the superstructure phase. This was nowhere more evident than in the deployment of groundworkers on this site, markedly different from the situation to be observed on German sites.

It is ironic that a system that is in effect cost driven should, in production terms, appear so inefficient and labour intensive. It also gives rise to considerable problems, as evident again from UK1. Here, the main contractor had considerable difficulties regarding the groundworkers' performance and the joiners' supervision. The joinery subcontractors were labour-only subcontractors; no system of internal supervision and management of the joinery gangs was in place over a long period and 12 joiners worked many weeks without supervision, without a foreperson or manager to organise their work. The main contractor's site manager had to step in and organise the gangs. Finally, after repeated requests, the joinery subcontractor put a foreperson in charge, but this was only for the mornings. The relationship with this subcontractor was, however, already a troubled one, as explained by the project manager:

> The joinery subcontracting firm was struck off the list of approved contractors two years ago and after much pleading the firm was given the contract. However, everything went wrong that could have gone wrong. The quality of workmanship of the 12 joiners on site varies greatly; the site manager does not regard the workmanship of two joiners to be acceptable and insisted that they would not be returning to this site after their holiday. Finally the subcontracting firm agreed to move the two joiners.

The value of the labour-only subcontracts was also substantial, 42% of all subcontracts if we count 50% of subcontract one as labour-only. The value of the three subcontract packages – groundworks, brickwork and carpentry – exceeded £2m, 32% of total contract value (Table 3). The operative time input of these three subcontract packages, however, as we discovered in a detailed analysis of site diaries, was two-thirds of all operative time on site and the brickwork and groundwork subcontracts alone accounted for 57.3% of all operative input (Table 4). The discrepancy between one-third of overall contract value as against two-

thirds of operative input appears significant but reflects in part the amount of material supplied by the main contractor and the lower pay of the predominantly untrained labour employed on groundworks. The proportion of two-thirds of operative time input by a few subcontract firms is nevertheless dramatically high, resulting in the main contractor relying on two predominantly labour-only subcontract firms for well over half the labour deployed on site. With the exception of part of the groundwork, the main contractor supplied all material for these three subcontracts, though the fetching and handling of material was the task of the subcontractors. This system caused such problems that the main contractor employed its own storeperson on site to avoid material damage.

Table 4

Formal training relationships could hardly be sustained in this system of casual employment and the site diary records only 132 days of apprentice training and 144 days for the management trainee of the main contractor. Learning on the job was instead predominantly informal, for instance, on groundworks, where the largest proportion of labourers or untrained operatives are generally to be found, representing on this site an estimated 80% of the time input in this area. The majority of the ‘skilled’ operatives of the groundwork subcontractor, the bricklayers, were classified as bricklayers in the site diary, leaving the figure for labourers’ work at 6,719 days or 30% of total operative input.

A comparison of subcontracts on selected UK sites is given in Table 5. The proportion of subcontracted work varies between 44% and 69%, at a conservative estimate, as not all subcontracts were recorded. The high proportion of

subcontracting found on UK1 is, therefore, not unusual but rather typical as it is also found on UK2 and 4. Subcontractors generally are small contractors and therefore unable to carry out work on a large scale, let alone to invest in large plant and machinery. They also often act as labour-only subcontractors and tend to have a high labour turnover, thus operating with a high degree of unpredictability in terms of labour, quality and cost (Clarke and Wall 1998).

Table 5

On the German sites the situation was qualitatively different. On D1 there were 27 subcontracts, but the total value of just six of these, £926m (2,778m DM), represented a considerable proportion of all subcontracts and 27% of the total contract sum (Table 6). These six firms were all specialist: a painting and rendering firm, a roofer, electrician, tiler, locksmith, and floor layer. Three of the subcontractors were larger specialist firms – the painting and rendering firm, the window manufacturer, and the roofing and external cladding specialist – with 50, 70 and 40 direct employees and turnovers of £1.5m (4.5m DM), £3.3m (16m DM) and £2.8m (8.3m DM) respectively at the end of the 1990s. The seven smaller trade firms employed under 15 people and had turnovers under a million pounds. The screeding and floorlaying firm sub-subcontracted the work, the only instance on this contract where work was further sublet. All the specialist firms with the exception of the roofing contractor were in the finishing trades. The main contractor carried out the superstructure work with its own workforce. Therefore the nature of subcontracting differed markedly from the British cases in being associated with specialist firms directly employing mainly skilled operatives and operating on a supply-and-fix basis.

Table 6

The value of the subcontracts on D1 ranged from £123,73337 (1,200 DM), the lowest, to £204,933 (614,800 DM), the highest, and four of the six contracts were between £130,000 and £160,000 (390,000 DM and 470,000 DM), representing a relatively narrow spread of subcontract values and a more balanced system of specialist trade subcontracting than was evident on the British sites.

A more detailed analysis of the subcontract firms in the German case shows that 13 firms (Table 7) carried out 6,167 days or 60.4% of all operative input; the 14 other subcontracts only made up 5% or 515 days of operative input, covering a small part of the whole project. Three subcontracts had an operative input higher than 5%: external rendering at 9.3% of total operative input or 952 days and painting at 3% or 304 days totalling 12.3%; electrical works at 8.8% or 903 days; and internal plastering at 5.4% or 503 days.

Table 7

The services firms on D1 had a much larger share of operative input than that found for services in the UK. Heating and ventilating taken together had a 9.3% share of total operative input and electrical works 8.8% compared with the three UK projects, where the share of electrical works varied between 3% and 4% and plumbing input varied from the lowest at 4.2% on UK1 to about 7% on UK2 and UK5.

An analysis of the skill set of the subcontract gangs on the German site D1 shows the predominantly skilled labour employed by the nine specialist trade firms: in all 43 operatives were employed, 25 skilled, including two former bricklayers-turned-plasterers, one *Meister* and three forepersons (Table 6). There were also 11 semi-skilled operatives or *Fachwerker* and seven trainees. Of a total of 25 skilled operatives, therefore, over a quarter were trainees, resulting in a high skill reproduction rate of 28%. This is higher than the national figure of trainee carpenters, bricklayers and concreters to skilled workers in the respective trades of 18%, 21% and 27% on a five-year average from 1996-2000 (ZDB 1997-2002). It supports too the generally held view that small specialist trade firms in Germany carry out proportionally more training. However, of a total of 43 operatives, the 11 semi-skilled *Fachwerker* represent a figure higher than the German macro figure for unskilled work of 22% in 2001 (ZDB 2002).

As well as the level of skills employed, another key difference between UK1 and D1 lies in employment relations on site. On D1, the main contractor's directly employed workforce were responsible for 3,523 operative days or 34.5% of total operative time, mostly on building the superstructure. The main contractor directly employed skilled operatives in the main trades – bricklayers, concretors and carpenters. Stability of employment on the German site contrasts sharply, therefore, with subcontracting on the UK sites. In effect what we observe is the predominance in Britain of contract relations or contracts of service compared with employment relations or contracts of employment in Germany (Deakin 2000).

In summary, therefore, subcontracting differs dramatically, being very much less widespread in Germany than in the UK and of a qualitatively different nature. In our case study projects the subcontracted share of the main contract value in the UK, ranging between 44% and 69% (Table 5), was also significantly higher than in Germany, where on D1 it represented less than a third. But a key difference is that in Germany specialist subcontractors tend to be small and medium-sized firms, the larger of these having the resources and capacity to undertake large contracts, and are concentrated mostly in the finishing trades, such as the window and door manufacturer and installer and the roofing and cladding company on D1. Unlike in the UK, superstructure work on all four German projects was predominantly carried out by the main contractor and firms' investment in training was substantial, as apparent on D1.

Perhaps the most significant difference between subcontracting in the UK and Germany is labour-only-subcontracting. In being confined to the traditional trades, it tends to perpetuate the status quo and to fragment production knowledge through separating the control and responsibility for labour and materials (Hampshire County Council 2000). The value of materials supplied by the main contractor is often high, amounting on UK4 to 16% of the main contract value. The main contractor in effect manages and finances the material flow so as to control one of the most important aspects of project coordination and to reap the benefits of repeat bulk purchasing. But, in abdicating responsibility for the labour itself, the main contractor also loses control over improvements in productive efficiency, through, for instance, greater mechanisation. It is therefore no coincidence that in our study those activities under labour-only subcontractors

were found to be highly labour intensive, whilst in Germany in contrast they are carried out by the main contractors' own directly-employed labour.

The construction team

The preoccupation with costs rather than the organisation of production in the British case, aptly symbolised by the degree of subcontracting on sites, also carries through and is reflected in the different nature of the construction team found on German and UK sites. In Germany, all our sites had a *Bauleiter* for the whole period of the contract. *Bauleiter* are building engineers who have completed a five- to six-year higher education degree course at a university or polytechnic. *Bauleiter* employed by contractors have overall project responsibility, but can also have hands-on involvement. On one German project the *Bauleiter* spent every morning on site, having discussions with subcontractors, supervising their work and working out the details of the next work stages jointly with the site manager, the *Polier*. The *Bauleiter*'s normal range of tasks includes production, cost and technology, involving contract administration, contract programming, technical specification and the logistics of the project (the supply of material and plant), valuation and measuring as well as communicating with the client and architect. *Bauleiter* are usually site based, unless the projects are very small or they are responsible for more than one site; together with the *Polier* they form the site management team and represent an effective combination of professional and trade knowledge and experience. The *Polier* always has a trade background, having completed an apprenticeship and then undertaken either the lengthy and demanding course to qualify as a *Geprüfter Polier* or the course for a

Meister. The *Polier* also carries out various tasks of the UK site engineer and quantity surveyor.

The D1 site of 68 units and 5,727 sq.m. was of sufficient size to have a resident engineer. The firm also had its own production personnel: there were 31 operatives on site, including on average five trainees. On the professional side, the lack of specialist quantity surveying skills is striking. The cost and production function is integrated into the role of the *Bauleiter,* the building engineer, who has the central role in the construction team. Production management skills comprising programming, logistics and coordination of the project are part of the *Bauleiter's* job profile, as well as the assessment of buildability and technical standards. Most importantly, the building engineer's role, in cooperation with the *Polier*, also contains the quantity surveyor's responsibilities for preparing valuations and measuring. Larger companies employ specialist commercial expertise at headquarter level, which is at the disposal of the divisions or regions, where building engineers cover the whole range of tasks of the UK professional staff, the contracts manager and quantity surveyor. The surveying or cost function is not nearly as pronounced as in the UK. The German production system is based on the principle that construction firms have their own productive capacity, directly employed operatives and plant. This means that less of a firm's resources and effort are focused on costs than production; defining the optimum productive method becomes more important than looking for the lowest denominator of cost and quality.

In the UK, in contrast, the construction team exhibits a different division and configuration of skills in the office and in the deployment of skills between office and site. The typical skill set of a UK construction team comprises: estimator and surveyors, as the cost function pre- and post-contract; contracts manager/building or production manager as the production and contracts expert; material scheduler and buyer for the supply of material in time and on budget; and a Design-and-Build manager for coordination of the design.

In comparison with the occupational profile of the building engineer in Germany, the skill set in the UK is occupationally narrower and divided into more roles (Gann and Salter 1999). Resident engineers do not exist on UK housing sites; normally engineers are used as external consultants for structural calculations and for site setting out; none of our firms employed engineers directly with the exception of UK1, whose managing director has a civil engineering background. On one of our sites the subcontractor's engineer was employed by a labour agency to do the setting out. In the German context this task is carried out by the *Polier* and not the engineer, even when resident. There is no German equivalent of the UK contracts manager, for whom two career routes are available, either through higher or further education courses or through the trade route. Some contracts managers have completed a Higher National Certificate or Diploma on top of a craft-based training. Younger contracts managers are likely to have completed a higher degree course in construction management, but due to their lack of trade background are often less involved in site operations.

The construction team in Germany and the UK thus differs in the number of different participants, their expertise and the demarcation of their tasks. In the UK the narrow definition of tasks and deeper division of labour inevitably lead to a higher degree of friction and conflict in labour and work organisation. This is exacerbated as none of the UK contractors in our sample any longer employs skilled operatives. The German contractors on the four case studies carried out the structural part of the work themselves. In the UK the loss of the construction firm's operative base has far reaching implications for the main contractor-turned-general-or-management- contractor, as site management was traditionally recruited from trade personnel. A firm that cuts off its own trade base has lost a natural recruiting ground and career progression for experienced site managers.

The role of the cost expert

Cost expertise is a fundamental skill for all firms. Yet only in the UK is there a specialist occupation, the quantity surveyor (Gann and Salter 1999). In Germany this function is incorporated into design and technology expertise, the architect and engineer respectively. Compared with these professions, quantity surveying education has a very limited technical base. An examination of a typical quantity surveying course, for instance, at an Inner-London University revealed the low proportion of 21% of technical content; out of a total of 24 modules (eight each at levels 1, 2 and 3), only five at levels 1 and 2 specifically deal with building technology, materials, ground conditions and environmental services technology. No technical expert was employed on our construction projects, in stark contrast to the projects in Germany, which all had engineers involved. A further problem pinpointed by Winch and Campagnac (1995) is that :

> The employer's agent or quantity surveyor … responsible for appraising tenders on behalf of the client … has no technical competence [and] is, therefore, not prepared to consider variations from the contractor …

For the UK production system the separate quantity surveying cost function has created a deeper division of labour and accentuated the development of a cost-focused system. An examination of the proportion of cost personnel to the overall employment of office staff in three of the UK firms, UK1, UK2 and UK3, showed that between 42-47% of all office staff were involved in the cost function, including in the estimating and buying departments. Excluding these departments, in two companies 34% and in a third 30%, that is on average one-third of all office staff were quantity surveyors (Table 8). It emerged from our case studies that the quantity surveyor has a strong presence on site. The key question is, if UK firms apportion more importance to the cost function than German firms, how does this influence the production process?

Table 8

A detailed examination of the division of tasks of the contractor's quantity surveyor involved on the UK4 project showed that operations on this site, totalling 49% of their time input, demand their core skills: valuing instructions/variations, examining and valuing work executed for payment, and attending site and progress meetings. On another UK project 90% of the surveyors' time input was comprised as follows: subletting subcontract packages, 20%; examining and valuing work executed for payment, 40%; cost monitoring, 20%; and value instructions and preparing valuations, 10%. The tender for this contract was on the basis of approximate quantities and therefore a lot of

remeasuring was required, apart from lump sum quantities such as the carpentry and joinery package.

The conflict between surveying and production is well illustrated by an experienced project director with a trade background who spoke for the site production teams:

> The production team cannot change the buying. For instance, the fencing contractor was chosen by head office and the production side knew very well that the price was too low and the quality of the work awful. A similar case is the groundworks subcontractor; they are six weeks behind programme. The decision about the choice of subcontractors lies with the surveyors and all senior management has a quantity surveying background. In all my 13years with the company I have had a 'battle with the quantity surveyors'.

This highlights a key area where the quantity surveyor has the final say: the subletting of subcontracts. These work packages are let entirely on the basis of cost. However, the preoccupation with cost may detract from technical and quality issues and the most efficient production process. Analysis of site diaries reveals the considerable time input on the cost side. On UK1, in 51 weeks or 241 recorded days a junior quantity surveyor was 151 days on site and a senior one 114 days, a total of 265 days of surveying input. The site management team’s time input, in contrast, totalled 592 days over the same period. Taken together these total 857 days, or a time input of 31% for cost expertise and 69% for site management.

In Germany, in contrast, the cost function is integrated into technical expertise, making for an approach that considers a technically improved process to be at the same time cost effective. Technical innovation can lead to higher productivity and therefore achieve cost reduction. The German firm’s employment structure in

terms of technical and commercial staff is heavily weighted towards the technical side, with the engineer in a prominent position, reflecting the higher education system with the architect and engineer firmly in place as the two main occupations in the industry. The disaggregation of skills in the UK case illustrated in the examples of divisions between cost and production functions reveals the imbalance of a cost-driven production system, the detrimental effect of the tension and friction between cost and production, and the way in which the contractors' primary concern with costs acts as a major deterrent to improving or restructuring the production process.

Conclusions

This paper has shown how in the British case the concern to control costs and contract relations rather than to regulate production determines all aspects of the process, in particular the functions of the construction team, from the site manager and foreperson to the building engineer and architect. This is reflected in the substantial differences found in the input of production expertise and knowledge. In Germany, the high input of production expertise is evident from the extended functions of the building engineer and the architect. In Britain, nowhere is the predominance of cost more evident than in the role of the quantity surveyor, which with increased subcontracting has expanded rapidly, whilst knowledge of the production process has diminished, as evidenced by the limited or non-existent role of the building engineer. This results in a highly fragmented process where the control of materials and labour is separate and the level of investment is low, whether in labour through training or in machinery and equipment. This, in turn, is reflected in the structure of firms, with the majority of construction workers in

Britain increasingly employed in small firms, with their low investment and capacity, whilst in Germany the majority are employed in medium-sized firms. Our findings suggest that in order to transform the housebuilding process, investment in skills to enhance engineering and production expertise together with a regulated and stable employment relation offers a clear alternative to tinkering with contract relations and cost reductions.

References

Brown, P., Green, A. and Lauder, H. (2001) *High Skills, Globalisation, Competitiveness and Skill Formation,* Oxford.

CEREQ (1991) *Europe et Chantiers: Le BTP en Europe: Structure industrielles et marché travail', Acte du Colloque des 28 et 29 Septembre 1988*, Plan, Construction et Architecture, Paris.

Clarke, L. (1992*) The building labour process: problems of skills, training an employment in the British construction industry in the 1980s*, Chartered Institute of Building.

Clarke, L. and Herrmann, G. (2001) *Innovation and Skills: a transnational study of skills, education and training for prefabrication in housing*, Final Report, University of Westminster (to be published by Blackwells 2004).

Clarke, L. and Wall, C. (2000) Craft versus industry: the division of labour in European housing construction, *Construction Management and Economics*, 18, 689-98.

Clarke, L. and Wall, C. (1998) *A Blueprint for Change: construction skills training in Britain*, Policy Press.

Clarke, L. and Wall, C. (1996) *Skills and the Construction Process: a comparative study of vocational training and quality in social housebuilding*, Policy Press.

Construction Task Force (1998) *Rethinking Construction*, DETR.

Crouch, C., Finegold, F. and Sako, M. (1999) *Are Skills the Answer? The Political Economy of Skill Creation in Advanced Industrial Countries*, Oxford.

Deakin, S. (2000) Legal origins of wage labour: the evolution of the contract of employment from industrialisation to the welfare state, in Clarke, L., Janssen, J. and de Gijsel, P. (eds) *The Dynamics of Wage Relations in the New Europe*, Kluwer Academic Publishers.

Fairclough, J. (2002) *Rethinking Construction Innovation and Research, a review of government R&D policies and practices*, DTLR London.

Gann, D. and Salter, A. (1999) *Interdisciplinary Skills for Built Environment Professionals: a scoping study*, Ove Arup Foundation, London.

Gruneberg, S. and Ive, G. (2000) *The Economics of the Modern Construction Firm*, Macmillan, London.

Hampshire County Council (2000) in response to the Consultation Document of the Built Environment and Transport Panel, Building our Future, Construction Associate Programme.

Higher Education Statistics Agency (2003) *Students in Higher Education Institutions 2001/2002*, Cheltenham.

Latham, M. (1994) *Constructing the team, Final report of the joint governmental/industry review of procurement and contractual arrangements in the UK construction industry*, HMSO.

Maurice, M., Sellier, F. and Silvestre, J-J. (1986) *The Social Foundations of Industrial Power: a comparison of France and Germany*, MIT, USA.

Roberts, G. (2002) *Set for Success, the supply of people with science, technology, engineering and mathematics skills*, London.

Statistisches Bundesamt VIIC-5.12.

Stewart, R., Barsoux, J. L., Kieser, A., Ganter, H. P. and Walgenbach, P. (1994) *Managing in Britain and Germany*, Macmillan, London.

Strategic Forum for Construction (2002) *Accelerating Change*, Construction Industry Council.

White, M., Braczyk, H. J., Ghobadian, A. and Niebuhr, J. (1988) *Small Firms' Innovation, Why Regions Differ*, Policy Studies Institute, pp 24-26.

Wilkinson, F. (1983) Productive Systems, *Cambridge Journal of Economics* 7, 413-29.

Winch, G. (2000) Innovations in British and French Construction: the evidence from Trans manche-Link, *Construction Management and Economics* 18(7), 804-12.

Winch, G. (1998) The growth of self-employment in British construction, *Construction Management and Economics*, 16(5), 531-42.

Winch, G. M. and Campagnac, E. (1995) The organization of building projects: an Anglo/French comparison, *Construction Management and Economics* 13, pp 3-14, p 10.

Zentralverband des Deutschen Baugewerbes (ZDB) (2002) *Baumarkt 2001*, Ergebnisse, Entwicklungen, Tendenzen, Berlin.

ZDB (1997-2002) *Jahrbücher des Deutschen Baugewerbes*.

Table 1 Proportion of office to production employees 1999/2000

Firm	UK1	D1
Turnover group	£95m in 1998	£292m (875m DM)
Total No. of employees in group	876	2,795
Turnover per employee	£108,333	£104,353 (313,059 DM)
Turnover in housing firm	£59.5m	£30m (90m DM)
Total No. of employees in housing	478	257
Turnover per employee in housing	£124,477	£118,732 (350,195 DM)

Table 2 Proportion of office to production employees

Firms	Total employees	Office personnel	Office as % of total employees	Production personnel	Production as % of total employees
D1	269	41	15	228	85
D2	132	28	21	104	79
UK 1	478	113	24	365	76
UK 2	81	51	63	30	37
UK 4	86	54	63	32	37
UK 5	169	98	58	71	42

Figure 1 UK contractor: UK1

Office personnel							Site personnel							
Cost			Accounts	Admin	Others	Production								
Surveying	Estimating	Buying				Contracts manager	Site managers	Site management trainees/ agents	Foremen	Skilled operatives		Trainees	Unskilled personnel	Others
										Bricklayer	Carpenter			
38	10	10	11	5	23	16	35	46		49	71	22	96	46
58 = 51%			55 = 49%				365 = 76%							
478														

Figure 2 The German contractor: D1, a regional division

Office personnel										Site personnel							
Technical					Commercial					Site managers	Operatives						
											Skilled				Un/ semiskilled	Plant operators	Trainees
Project management	Estimating	Technical office (head office)	trainees (head office)	Others	Buying	Accounts	Controlling	Trainees	Others		Ass.site manager	Bricklayers	Carpenters	Concreters			
18	4	2	1	7	2	2	1	1	3	20	10	50	40	40	3	30	35
32					9 all in head office					228 = 85%							
41= 15%																	
269																	

Table 3 Subcontracting on UK1

Sub-contractor	Trade	Turnover 2000 in £ million	Total employees 2000	Subcontract value In £	Subcontract value as % of contract value
1	Groundworks	n.a.	n.a.	1.052,500	22.3
	Plumbing and drainage				
	External works				
	Brickwork (groundwork and external work)			362,471	
2	Specialist piling contractor	63.9	685	220,000	3.5
3	Scaffolding	n.a.	n.a.	46,500	0.7
4	Brickwork	3.9	n.a.	507,000	8
5	Roofing	n.a.	n.a.	90,000	1.4
6	Plumbing/ heating	n.a.	n.a.	331,000	5.2
7	Electrical	n.a.	n.a.	167,000	2.6
8	Plastering/ screeding	n.a.	n.a.	216,000	3.4
9	Carpentry	n.a.	n.a.	110,000	1.7
10	Decorating	n.a.	n.a.	68,000	1.1
11	Insulation	n.a.	n.a.	36,000	0.6
12	Fencing	n.a.	n.a.	35,500	0.6
13	Landscaping	n.a.	n.a.	68,000	1.1
14	Flooring	n.a.	n.a.	28,500	0.4
15	Tiling	n.a.	n.a.	28,000	0.4
16	Paving	n.a.	n.a.	5,100	0.1
	Total subcontract values			3.371,571	53
	Total contract value			6.348,173	100

Table 4 Operative input of subcontracting firms on UK1[1]

Sub-contractor	Trade	Operatives on site, team on site (peaks)	Total number of days	% of operative input
1	Groundworks	16 operatives (with peaks of 30)	5301	23.9
	Plumbing and drainage			
	External works			
	Brickwork (groundwork and external works)	24 (30)	7295	33
2	Brickwork			
3	Specialist piling contractor	2	257	1.2
4	Scaffolding	2	384	1.7
5	Roofing	2	388	1.87
6	Plumbing/ heating	4	890	4
7	Electrical	4	719	3.2
8	Plastering/ screeding	(14)	1604	7.2
9	Carpentry	(15)	2127	9.6
10	Decorating	(9)	744	3.4
11	Insulation	2	47	0.2
12	Fencing	2	356	1.6
13	Landscaping	2	100	0.5
14	Flooring	3	146	0.7
15	Tiling	1	148	0.7
	Others (storeman, forklift driver, cleaning etc)		1555	7
	Trainees	1	132	0.6
	Total operative input		22193	100

1. The list follows the system of recording in the site diary, which listed the functions and work stages not firms or occupations.

Table 5 Subcontracts on selected UK case studies

	Contract value	Total subcontract value[1]	Proportion of total subcontract to total contract value	Proportion of largest subcontract to total contract value	Total number of subcontract packages
UK1	£6.3m	£3.4 m	54%	22%	16
UK2	£3.6 m	£1.77 m	44%	12%	22
UK4	£6.66 m	£4.3 m	64%	13%	19

1. Complete subcontract values could only be recorded on UK4.

Table 6 Subcontract firms on D1

Sub-contractor	Trade	Turnover 1999 in £ million (DM)	Total employees 1999	Subcontract value In £ (DM)	Subcontract value as % of contract value
1	External insulation and render	1.5 (4.5)	50	154,667 (464,000)	4.6
	Painting			30,933 (92,800)	0.9
2	Electrics	0.83 (2.5)	15	123,733 (371,200)	3.6
3	Plastering	0.4 (1.2)	8	NA	
4	Ventilation and sanitary	NA	12	NA	
5	Heating	0.5 (1.5)	8	NA	
6	Screeding and floor layer 2 sub-subcontractors	1.33 (4)	0	131,467 (394,400)	3.9
7	Window manufacturer, doors, metal works	5.3 (16)	70		
8	Tiling	0.83 (2.5)	15	135,333 (406,000)	4
9	Roofing, external cladding	2.8 (8.3)	40	94,733 (284,200) 50,267 (150,800)	2.8 1.5
10	Locksmith and ironworks	0.6 (1.8)	15	204,933 (614,800)	6
	Total subcontract values			926,067 (2,778,200)	27.3
	Total contract value			3.397,986 (10,193,958)	

Table 7 Operative input of subcontracting firms on D1

Sub-contractor	Trade	Operatives on site, team on site	Total number of days	% of operative input
1	External insulation and render	1 master painter, 2 foreperson, 3 skilled, 5 labourer/semi-skilled 1 trainee	952	9.3
	Painting		304	3
2	Electrics	4 skilled electricians, 1 trainee	903	8.8
3	Plastering	2 skilled plasterers, 2 semi-killed (former bricklayers)	549	5.4
4	Ventilation and sanitary	2 skilled gas water plumbers 1 labourer, 1 trainee	503	4.9
5	Heating	1 foreperson, 1 skilled heating engineer, 1 labourer, 1 trainee	444	4.4
6	Screeding and floor layer 2 sub-subcontractors	2 sub-subcontractors, screeder and floorlayer	427	4.2
7	Window manufacturer, doors, metal works	3 skilled, 1 *Fachwerker* (joiner and locksmith)	420	4.1
8	Tiling	2 skilled tilers, 1 trainee	325	3.2
9	Roofing, external cladding	2 skilled roofers, 1 trainee, 1 semi-skilled	314	3.1
10	*Schlosser*	2 skilled metalworker, 1 trainee	238	2.3
11	Scaffolding		173	1.7
12	Doors and locksmith		123	1.2
13	External works		492	4.8
		13 trade specialist firm	6,167	60.40
		Total subcontractor input	6,682	65.4
		Total operative input	10,205	

Table 8 Cost personnel in three UK construction companies

	UK1	UK2	UK4
Cost personnel as % of office staff	47%	45%	42%
Quantity surveying as % of office staff	34%	34%	30%
Office staff as % of total staff	24%	54%	61%