Constructing Learning: Adversarial and Collaborative Working in the British Construction Industry

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This paper examines two competing systems of work organisation in the British construction industry and their consequences for learning. Under the traditional 'adversarial' system, conflict, hostility and litigation between contractors is commonplace. Such a climate actively militates against collective learning and knowledge-sharing between parties. Conversely, under 'collaborative working', contractors engage in greater risk-sharing; they pool knowledge and work together to solve problems at all points and stages in the productive system - a process conceptualised as 'knotworking' in parts of the literature. The paper argues that such learning theories and policy pressures fail to take adequately into account the heavy hand of history and the importance of understanding the nature of the productive systems in which 'knotworking' is expected to occur. Both are important in understanding the fragility of collaborative working across the construction production process which place limits on making 'knotworking' an habitual and commonplace activity.

Keywords: collaborative working; partnering; co-configuration; knotworking; construction; United Kingdom; learning

Introduction

For the last two decades, serious concerns have been voiced over the performance of the British construction industry. During the 1990s, these concerns culminated in government-commissioned publications such as the Latham Report (Latham, 1994) and the Egan Report (CTF, 1998), which highlighted low levels of client satisfaction, poor health and safety records, high accident rates, under-investment in R&D, large numbers of projects exceeding their budgets and timescales and a 'crisis in training' (CTF, 1998: 7). On this basis, construction was identified as an 'under-performing' industry.

This under-performance has most often been blamed on the ingrained patterns of work organisation that have characterised the industry for many years. 'Adversarial' forms of contracting have dominated the sector, where it is commonplace for contractors at each point in the production process to exploit each other whenever possible. This has created a hostile and litigious environment that militates against more strategic and co-ordinated modes of project management. The proposed solution to this problem has generally been a move towards more collaborative forms of working, and associated practices such as 'partnering'. These 'new' modes of project and supply chain management, already popular in manufacturing and engineering, are focussed on forming closer relationships with clients and (some) suppliers in order to facilitate the delivery of the construction project to time, to budget and to specification. Their theoretical underpinning is provided by models of work organisation such as 'co-configuration' and

'knotworking', which rely on focussed collaborative efforts, open communication, collective learning and knowledge sharing between partners (see Engeström *et al.*, 1999). A move towards more co-configured, collaborative modes of working would, claim its proponents, require and promote heightened levels of skill and knowledge transfer (e.g. De Vilbiss and Leonard, 2000; Cheng *et al.*, 2004)

However, this paper argues that these theoretical models do not adequately take into account the historical, cultural, social and economic contexts within which such 'new' practices must operate. In the construction industry, for example, the wholesale adoption of such (unfamiliar) ways of working would entail a fundamental cultural and structural shift that could not happen overnight. Not only would new skills and attitudes need to be acquired across the industry; traditional working practices, and incentive and reward structures would also be required to undergo a wide-ranging transformation. The barriers to co-configured, collaborative forms of working and learning in the construction industry are thus formidable.

The aim of this paper is twofold. First, it seeks to explore the fundamental issues faced by the construction industry in attempting to move away from adversarial modes of operation towards a more collaborative approach. Second, it assesses the implications of such a move for learning and skills development within the industry. In doing so, it offers a constructive critique of Engeström's theory of 'knotworking' by illustrating the importance of contextualising such practices within specific – and often inhospitable – productive systems (Wilkinson, 2002).

Conceptual background: co-configuration, 'knotworking' and collaborative working

As we will outline, the model of collaborative working in construction has close theoretical parallels with what Engeström, drawing on Victor and Boynton (1998), calls 'co-configuration' and associated practices of 'knotworking'. Co-configuration work is characterised by the creation of a complex and adaptive product, which is constructed through the collective efforts of multiple producers in collaboration with the customer (Engeström *et al.*, 1999). The various parties work closely together to share knowledge and learn from each other in order to improve the end product. According to Engeström, knotworking is a:

> 'form of organizing and performing work activity, connected to the emergence of new co-configuration models of production.' (Engeström *et al.*, 1999: 346).

Within co-configuration, therefore, attention is drawn to the 'knot': a temporary collective of disparate partners who come together to focus on a common 'object' of activity, such as the product or service to be created (e.g. Engeström, *et al.*, 1999; Engeström, 2000). Once their task is complete, the knot dissolves. Subsequent knots then form where the parties identify and pursue a series of actions towards the realisation of the ultimate object. These knots collaborate temporarily and then dissolve, and so it continues. This longitudinal process is known as 'knotworking' (see also Kangasoja, 2002, and Fenwick, 2007). As Engeström *et al.* observe:

> 'Knotworking is characterized by a pulsating movement of tying, untying and retying together otherwise separate threads of activity. The tying and dissolution of a knot of collaborative work is not reducible to any specific individual or fixed organizational entity as the center of control. The center does not hold' (Engeström *et al.*, 1999: 346).

For Engeström, therefore, there is no central locus of control in 'knotworking'; no fixed point that directs and co-ordinates the activities of different strands of the knot(s). Instead, each knot is organic and essentially self-regulating in its formation, operation and dissolution. As a form of co-configuration work, 'knotworking' also generates 'mutual learning from interactions between the parties involved' (Engeström *et al.*, 1999: 348), although Engeström also points out that such learning needs to be supported through the intervention of an external facilitator, for example using 'boundary crossing laboratories' (Engeström, 2001). Through encountering and collectively overcoming 'ruptures' in the collaborative working process, and with the parallel guidance provided by a facilitator, the parties learn 'expansively' from each other. That is, they develop innovative ways of working in order to accomplish the objective more efficiently or effectively – or even to re-conceptualise the objective itself. They move from a position of simple 'co-ordination' (i.e. working to occupational scripts with only minimal and restricted collaboration) to full 'co-operation' and open communication focussed on reconceptualising the shared problem (Engeström *et al.*, 1997).

Engeström provides empirical illustrations of 'knotworking' and co-configuration in healthcare and legal settings (see Engeström *et al.*, 1999 and 1997 respectively). Examples from other sectors are provided, for example, by Kangasoja (2002) in relation to public works design projects, and by Fenwick (2007) in the education system. In all of these cases, the authors provide clear instances of 'knots' of professional workers collaborating in a largely unregulated and improvised fashion in order to overcome an issue through collective knowledge-sharing and problem-solving. They often encounter difficulties in the collaboration process as, for example, in the case of healthcare workers who rarely communicated effectively due to established professional divisions (see Engeström *et al.*, 1999: 370-371). However, Engeström sees these 'ruptures' largely as functions of ingrained practices, habits and identification boundaries which inhibit attempts to move towards greater collaboration. They are, for him, apparently surmountable difficulties that can be overcome through a process of co-operation and reflection, which enables the parties to identify where the problems lie and to address them.

This is a position that has recently attracted some criticism. For example, as Young (2001) points out, Engeström tends to assume that actors can be encouraged to work together because they are essentially committed to the same object. Any problems or 'ruptures' that occur are generally attributed to a lack of agreement over the means to achieve that goal or a lacuna in common understanding. In some situations, however, actors can have very different aims and be committed to fundamentally different objects – differences that may be irreconcilable even with the intervention of an external facilitator. What, then, are the chances of encouraging them to work and learn collaboratively? This is a question also raised by Avis (2007), who posits that fundamental tensions that are embedded in the *structural* relations between actors tend to be played down in Engeström's work, as he generally views such antagonisms as positive sources of

innovation and change rather than destructive conflict (cf Konzelman and Forrant, 2000). This problem may be associated with the relatively narrow empirical base on which the concept of 'knotworking' is founded. Most studies of co-configuration and 'knotworking' have focussed on work in sectors where there can generally be a broad agreement over the fundamental object of collaboration (e.g. healthcare, education). This is where this paper aims to make a contribution. By contextualising Engeström's work in an empirical study of collaborative working in the construction industry, we can see how 'knotworking' and collective learning may struggle to find foothold within productive systems characterised by institutionalised conflict and incentivised hostility.

Research Design

The methodological approach used in this study was adopted with the aim of illuminating where and how learning occurs (or is inhibited) in adversarial and collaborative types of productive system in construction (see Felstead *et al*., 2006 and 2007). So, with work in the sector being predominantly project-based, and with the crucial involvement of (often extensive) supply chains, the construction project itself became the main unit of analysis. A large public works project was visited, and interviews conducted with representatives of the main contractor (i.e. the project management company), and subsequently with four of the subcontractors procured as part of the supply chain on that project. Such an approach allows for a 'horizontal' view of the distribution of learning across the stages involved in a single construction project and insights into the 'vertical' relations between contracting organisations. Fourteen respondents participated in this phase of the research.

Secondly, we focused on contractors and subcontractors in the mechanical and electrical (M&E) stage of the construction process. We conducted interviews with senior managers of both large and small firms. This provided valuable insights into the organisation of work and learning across a range of projects from the perspective of a particular stage in the construction process – the fitting out of buildings, and road and bridge building work. A total of 16 organisations and 26 individuals participated at this phase of the research.

Thirdly, five 'industry-level' interviews were conducted with respondents in a range of government and non-government organisations. This was designed to set our results in a 'vertical' context. In total, 49 respondents took part in the research. In accordance with standard ethical guidelines, all respondents were assured of their anonymity and the confidential treatment of interview data, and their identity is protected in the presentation of findings through the use of pseudonyms.

Adversarialism and collaborative working in construction: two productive systems

Construction work is organised around projects which can vary in length from a matter of days to several years. They can also vary in terms of scale, but the principles by which they operate are essentially the same. The basic project process is well-documented (see, for example, Briscoe *et al.*, 2001: 244). First, the client decides on their requirements. Then, they appoint a designer/architect and a contractor (known as the 'main contractor') who takes overall responsibility for managing the construction process (this selection often occurs after a competitive tendering process). The main contractor (MC) then

appoints contractors (often called 'major contractors' on larger projects) to take responsibility for completing different stages of the building work such as groundwork preparation or mechanical and electrical fit-out. These may, in turn, subcontract parts of this work to smaller organisations to supply equipment such as cranes and pile drivers, install certain electrical supplies or build particular bridges. The building, road or other facility is finally commissioned and used by the client.

The realities of construction contracting are, of course, more complex. In particular, the process of appointing subcontractors – of 'procuring the supply chain' – and engaging with them once appointed is often beset with difficulties and complications that are rooted in the structure and history of the industry. For example, there has been a tendency for construction supply chains to be 'fragmented' in the UK (see, for example, Humphreys *et al.*, 2003; Matthews *et al.*, 2000). That is, main contractors generally appoint a large number of relatively small, unrelated specialist subcontractors to deliver specific goods and services to the project (as opposed to delivering those goods and services in-house, or using a smaller number of less specialised suppliers). Conventionally, these subcontractors have little contact with each other and exist in an essentially 'arm's length' relationship with the main contractor.

A commonly observed outcome of this arrangement is that there is a high degree of disarticulation between the different parts of the supply chain, and hence a considerable problem for the main contractor, whose task is to co-ordinate and manage the chain in order to deliver the project efficiently and to schedule (see Cox and Ireland, 2002). More importantly, however, with so many 'layers' in the supply chain, there are numerous opportunities for each party to enhance their own returns by driving down the fees charged by those engaged at later stages of the process or further down the structure of production (a process known to our respondents as 'subbie bashing'). As one respondent commented, the tendency for such opportunities to be exploited sustains an habitual atmosphere of distrust:

> 'Everyone's so scared of everybody else… We just shaft each other as fast as we can. I mean obviously if you get a Quantity Surveyor, what's he employed to do? He's employed to make sure that your bill is fair. How's he going to do that? If you submit a bill for a thousand quid, he'll cut it down to 900 quid. So what do you do, you have to submit a bill for eleven hundred pounds so he can turn you down to a thousand pounds... you've got this institutionalised stupidity' (Chief Executive, large M&E specialist).

This reveals much about the prevailing culture of the construction industry. Presented with frequent opportunities to undermine and exploit – to 'shaft' – other parties (particularly subcontractors), the most common reaction is to make the most of them when they arise. As this reduces costs, there is a clear economic rationale for doing so, at least, over the short term. Furthermore, the reward structures that motivate individual behaviour within construction projects often actively support this antagonistic culture. As the engineering director of another M&E subcontractor observed, while senior managers may espouse a commitment to collaborative principles, project managers on site are actually incentivised to work quite differently:

> ‘Once you get to the middle tier of the management… Their bonus is measured on profitability. Their success within the business, their standing within the business, is based largely on profitability ... Unless they can make some money out of you [the subcontractor], then they go somewhere else.’ (Engineering Director, large M&E specialist).

Thus, adversarialism is an endemic feature of the construction industry (see also, for example, Latham, 1994; CTF, 1998; Mason, 2006). The productive system of construction work effectively institutionalises hostility and foments a culture of distrust. From the inception of the project through to its completion, the different parties involved at each stage and level of the production process spend considerable time and effort in exploiting others and/or in taking legal action against them in order to extract a return when the terms of contract have arguably been infringed. The parties collaborate only minimally and only when absolutely necessary. They restrict themselves to simple ‘co-ordination’ in accordance with occupational scripts. This, on the face of it, is an environment that does little to support genuine collaboration, knowledge-sharing or the organic formation of self-organising ‘knots’ (Engeström *et al*., 1997).

Yet moving towards a more co-configured, collaborative way of working, based on extensive co-operation, is exactly what policy-makers have advocated for a number of years. Collaborative working and ‘partnering’, as presented in the Latham and Egan reports, undoubtedly hold the promise of a fundamental shift in working patterns in construction. They also present the possibility of a productive system that relies on and cultivates increased levels of skill and knowledge through collective efforts. There is still a little definitional imprecision surrounding these concepts however (Bresnen and Marshall, 2001). Broadly speaking, the terms ‘collaborative working’ and ‘partnering’ are used interchangeably to describe a particular mindset or style of project management. For example, Bresnen and Marshall describe it as ‘a determination to move away from adversarialism and litigation and to resolve problems jointly and informally through more effective forms of inter-firm collaboration’ (2000: 230). Comparable definitions have referred to ‘an informal relationship for the purpose of accomplishing mutually agreed goals and objectives’ (Cheng and Li, 2001: 294). In a similar vein, our respondents tended to see collaborative working as:

> ‘Where you operate with a mutual benefit both for partners … It’s a matching of culture and objectives’ (Engineering Director, Large M&E specialist).

The emphasis in these definitions tends to fall upon the active involvement and joint, concerted effort of construction clients, contractors and subcontractors to effect the efficient accomplishment of the (supposedly) shared object; the completed construction project, within time and to budget. Moving towards an acceptance of this shared object, as opposed to the pursuit of individualised and conflicting goals (i.e. profiteering at the expense of others) is generally taken to be the key characteristic of collaborative working. This is underpinned by a shift away from lump-sum contracts, which apportion the liability for unexpected extra costs, to target price contacts in which contractors share with clients the pain and gain of budget overshoots and undershoots.

Collaborative approaches appear to have several benefits over traditional, adversarial modes of operation. These include a higher level of integration and communication

between the various parties, and the early involvement of (some) subcontractors, which in turn improves articulation between the various stages of the project (see, for example, Constructing Excellence, 2004; Larson, 1997). Other commonly cited benefits of this approach include the increased capacity to develop trust between organisations (Matthews *et al.*, 2000) and the potential for inter-organisational (and inter-project) knowledge transfer and collective learning (Constructing Excellence, 2003; CTF, 1998).

The parallels between such ideal-type models of collaborative working, on the one hand, and co-configuration and 'knotworking', on the other, are clear to see. For example, both involve a complex product, requiring the collective contribution of a range of normally unrelated actors as well as input from the customer/end-user (a characteristic of configuration). In construction, teams of individuals from different trades and professions (e.g. carpenters, plumbers, scaffolders, electricians, architects, design consultants, clients, project managers and so on) coalesce around particular activities and problems over the course of the project and, once the activity is complete and the problem solved, go their separate ways. During their collaboration, these diverse actors converge in ephemeral groups, cross occupational and professional boundaries, share knowledge and engage in mutual learning – at least in theory. Furthermore, where collaborative working is extended to include more formal multi-project partnering arrangements between contractors, there is a ready framework to support the repetition of improvised 'knots' through continued collaboration (see, for example, Bennett and Peace, 2006).

This, in essence, is the theory behind collaborative working. How closely does it match the reality of construction work? To date, empirical studies of co-configuration and 'knotworking' have tended to focus upon work in sectors that are very different to construction (e.g. Engeström *et al.*, 1997, 1999; Fenwick, 2007), where fragmented supply chains and long-established relations of exploitation do not normally characterise the productive system (although Kangasoja's study of 'knotworking' on large design projects does provide a comparable setting to construction). How useful are these concepts in understanding the adoption of collaborative working in construction? Can they take root in an industry where powerful incentives drive actors apart rather than together?

Adversarialism and collaborative working: the consequences for learning

As the previous section illustrates, the structure of the construction industry promotes distrust, antagonism and a pervasive spirit of adversarialism. This is an environment that does not encourage collective learning and knowledge-sharing between parties. With each contractor having their own goals, and keen to maximise their gains at the expense of others, knowledge becomes a weapon to be hoarded, guarded and used to 'shaft' others.

An example of this is the way in which contractors make frequent use of 're-measure' clauses within standard-form construction contracts. These clauses allow contractors to claim that unexpected developments during the course of the project have resulted in increased costs and are therefore used as justification for raising their charges above the tender price. Many respondents commented that it is common practice among contractors to abuse this provision by deliberately underestimating their costs in the bid for tender (thus appearing an attractive option to clients), safe in the knowledge that they

can recoup any shortcomings later using the re-measure clause. Those in the industry have become highly adept at this practice, using prior knowledge of the circumstances of each construction project and any potential problems to make 'loss leader' quotations profitable. As one respondent commented, this practice has become a 'game' to be played, with some players becoming skilled in keeping the 'real' cost of a project hidden from clients:

> 'You'd adjust the rates [in your tender]… so that when you put the tender in it would come out at a cheap price knowing that when the job was remeasured you actually got what you needed. And so it was clever mechanisms like that which everybody played' (Project Manager, large construction contractor).

Thus, under adversarialism, knowledge becomes an important resource to be hoarded, kept from others and used to further one's own goals while undermining others. Contractors learn to become adept in using knowledge in this way. This is in clear conflict with the suggestion that knowledge is best used when it is shared between parties. Without a common object or goal to work collectively towards, such a suggestion can have little impact, hence a 'restrictive learning environment' is formed (Fuller and Unwin, 2004). There is no impetus to communicate or share knowledge across organisational or even functional boundaries, and 'skill', 'learning' and 'training' are determined by occupational rather than project requirements.

In contrast to this, it is often argued, collaborative working promotes an 'expansive' learning environment, in Fuller and Unwins's terms. It encourages collective learning and knowledge-sharing by advancing a set of values and beliefs that support trust, allow discretion and experimentation, and create a collective ethos within which individuals feel comfortable collaborating and sharing knowledge with each other (see, for example, Thomas and Thomas, 2005; Davey *et al.*, 2001; Barlow and Jahaspara, 1998). Such benefits may be even greater within formalised multi-project or 'strategic' collaborative arrangements, where the same team of clients and contractors (and, perhaps, subcontractors) work on a series of projects together; as Prencipe and Tell (2001) observe, the capacity to transfer knowledge and lessons learned is often under-developed in situations where teams are typically disbanded after each project. Much of their accumulated collective knowledge and experience is lost. This was echoed by one of our respondents:

> 'every time we do a job, we're setting up a new company, so it's not like manufacturing baked beans … you can tweak things, but by the time we've tweaked things, we've finished' (Project Manager, large construction company).

As Bennett and Peace (2006) argue, strategic, long-term partnering may offer a solution to this problem. As the Egan Report points out, retaining the same team over a number of projects potentially enables:

> 'teams of designers, constructors and suppliers [to] work together … continuously developing the product and the supply chain; eliminating waste in the delivery process, innovating and learning from experience' (CTF, 1998: 19).

Thus, by establishing a framework that supports the ongoing formation and operation of innovative 'knots' over time, collaborative working can promote collective learning. In addition to creating a climate in which learning can flourish, participants are also required to learn a range of skills and acquire the requisite knowledge. For example, some writers have observed that a concerted, industry-wide effort will be required in order to foster a range of cultural values and attitudes that support collaboration and teamworking (see, for example Thomas and Thomas, 2005; Humphreys *et al*., 2003). Others have emphasised the need for a process of learning throughout the industry in order to engender the skills that support effective partnering and teamworking. For example, Briscoe *et al.* (2001) point in particular to communication skills, systems awareness, problem-solving and empathy with suppliers and customers (2001: 246-248). This resonates with Fenwick's assessment that effective 'knotworking' relies on skills and abilities such as 'spanning boundaries among discursive communities and generally becoming attuned to shifting discursive patterns that emerge in negotiations among different constituents' (2007: 151).

As such accounts indicate, there may be significant benefits to partnering and collaboration in terms of the increased capacity for learning it enables and requires. However, some writers have urged caution in this regard, suggesting that not only is genuine collaborative working extremely difficult to achieve and rarely observed in construction (e.g. Cheng and Li, 2001), but that the benefits achieved in terms of learning and knowledge transfer are often exaggerated. What benefits, we might ask, in terms of learning and skills does collaborative working actually promote over more conventional forms of work? Is the rhetoric of collaborative working, and its purported promotion of learning, borne out in reality?

Our findings indicate that, where implemented in practice, collaborative working does indeed have the potential to promote learning and knowledge transfer in a number of ways. For example, many respondents spoke of the benefits brought by long-term, multi-project collaborative relationships with customers. These relationships had proven consistent and reliable sources of work over time, and were of considerable value in lending greater transparency to business planning; knowing that work was guaranteed (or at least probable) over the next year or so afforded the opportunity to make investment in capacity. As one respondent commented:

> 'You can start making plans on the basis that you know you're going to get return. If you're at risk people don't commit. If you tell somebody [they're] going to make bridges from now to kingdom come and they're going to get a return of even 3% or 4% on it they'll set up a factory and bring on new staff, increase their skills … It's long term. It allows investment. It allows training.' (Commercial Manager, large construction contractor).

Another participant expressed the same view in a different way:

> 'You can slaughter a cow and eat it once or you can milk it every day' (Managing Director, small M&E specialist).

This highlights the potential benefits of long-term, continuous collaborative working, as opposed to the more conventional, hostile, single-project relationships that have traditionally been prevalent in construction. As most participants pointed out, there are

potentially considerable one-off profits to be made through adversarial modes of contracting, as money can be extracted from other parties to a project through aggressive exploitation of the supply chain or through litigation against other contractors. However, in 'slaughtering the cow' in this way, bridges are burned in terms of repeat business and closer co-operation between organisations, as the hostile contractor develops a reputation for being difficult to work with. The result is a business cycle characterised by extreme peaks and troughs, making long-term investments difficult. 'Milking' the cow, on the other hand (i.e. accepting potentially lower but more sustained profit margins by pursuing closer and more durable 'knotworking' relationships with partners), enables greater strategic investment in skills and employee development.

Yet it was not just in terms of a more stable business environment that collaborative working approaches promoted increased levels of learning. Some respondents observed that 'true' collaborative working inevitably entails a much closer relationship between partners over a longer period, relative to more traditional modes of contracting. Communication becomes more rapid and extensive between organisations and information systems become increasingly entwined. This, in turn, lays the ground for knowledge sharing and collective learning between collaborating firms:

> 'True partnering to me would be … true sharing… So in other words sharing IT systems ... It's systems. It's supply chain. It's intellect. It's all sorts of things. It's learning. It's education. It's everything' (Procurement & Supply Chain Manager, Large Construction Contractor).

In the majority of cases, this integration between collaborating firms was not particularly formalised, tending instead to be left to individuals at the point of contact on site; these were spontaneous relationships where interactions, in true 'knotworking' style, did not hinge on a central locus of control. As a result, collective learning and knowledge-sharing occurred in a largely informal, ad-hoc fashion such as that described in the following extract:

> [When working collaboratively with another contractor] we might see a working practice that they have as well that we'll think 'that's a good idea' … Even with technology, receiving emails and drawings from A. N. Other, you might see something that's been done on the computer and think 'bloody hell, what's that?', and that'll link you into finding out how that's been done and next thing we're using that same method in here' (Contracts Manager and MD, small M&E specialist).

Knowledge transfer tends to occur in a relatively informal manner under these collaborative modes of working. Most organisations, therefore, had no formal mechanism for capturing and retaining any 'new' knowledge that emerged or was shared as a product of these relationships. In a few instances, however, attempts were made to achieve just this – effectively to establish some kind of centre to the collective learning that occurred within the knots. In the following extract, for example, the respondents explain the role of a facility within their organisation that is dedicated to the development of new products in collaboration with suppliers:

> 'We've invested heavily in that over the last three years, four years ... we are looking at products, we are looking at hand tools, we're looking at systems and calling suppliers who are part of our supply chain to say look how can we do this differently, can we design instead of just for the cable tray, we have the cable tray, the cable ties, the supports that go with it, and buy it as a module … A number of [our suppliers] see it as an adjunct to their R&D department. (Commercial and HR Directors, large construction contractor).

Not only does this illustrate how an organisation can strive to capture the knowledge transfer that happens between partners under collaborative working, it also represents an instance of 'knotworking' (albeit 'knotworking' with a 'centre'). That is, groups of relatively disparate actors working together, temporarily and across functional boundaries to solve a particular problem or effect a particular performance improvement. A few other respondents spoke of similar attempts to centralise collective learning processes within the construction process. One, for example, described the functioning of a 'labour improvement team' within his nation-wide organisation, which had a roaming brief to ensure that lessons were learned and captured from each project and transferred to others, not simply hoarded at one isolated point within the organisation. Such examples highlight the significant potential for learning-intensive working arrangements under collaborative approaches. They also emphasise the fact that some organisations are not content to leave learning to the ad hoc, improvised interactions that occur within 'knots'. Instead, they seek to formalise and standardise this process by providing a focal point for learning and development that it activates.

Yet collaborative working does not just have the capacity to promote learning, it may also *require* it. Most respondents were of the firm conviction that effective collaboration and partnering is reliant on each party possessing certain 'hard' and 'soft' skills. In terms of hard skills, for example, several respondents remarked that working closely with design consultants in a partnership arrangement is made easier if the contractor possesses a high level of technical design skill. In terms of soft skills, it was frequently observed that, in a collaborative working environment, it is important for engineers and project managers to have a broader range of, for example, communication, client-facing and teamwork skills ('briefcase' skills, as one respondent put it). Several individuals emphasised that negotiation and 'influencing' skills are crucial in terms of making the most of early collaborative involvement:

> 'What I find is that there is a growing involvement… at the earlier stage than perhaps in more traditional contracts. Our ability to influence the design, the build-ability etc. comes to the fore because we're able to do that. We're a bit more proactive and less reactive. So in terms of the skills that engineers would have on [larger partnered projects] that approach [developing 'briefcase' skills] is well developed' (HR Director, large construction contractor).

In such an environment, where the ability to influence the design of a project at an early stage is crucial client relations and relationship-building skills – at all levels, not just management – were viewed as indispensable to effective partnering. This echoes Fenwick's (2007) assertion that 'knotworking' relies on individuals possessing skills that allow them to span discursive boundaries and communicate with a wide range of partners. However, while communication and teamworking skills seem particularly

important in a partnering context, some respondents emphasised the need to switch back and forth between different discursive mindsets in order to cope with the demands of more traditional, commercial-style projects:

> 'Sometimes you need them to be the opposite. So, they'll be on one job where everybody is putting their arms around one another and, yes, you're doing really well and the next job they'll take the chair away so you'll fall over just to get some sort of competitive advantage… There are jobs where you've got to stand your corner … Some days they'll have one hat on and the next day they'll have another hat on. You might get a senior project manager one day having to rant and rave to get something done, but the next day he might be out trying to build a relationship with another client (Engineering Director and HR Manager, large M&E specialist).

This extract raises an obvious yet fundamental point; that shifting from a productive system based on adversarialism to one based on collaboration is not an easy or instantaneous process. While most respondents claimed that the proportion of collaborative work on their books was increasing, they also emphasised that more traditional modes of contracting – commercial, exploitative and often hostile – were still important and in many cases central to their income. The findings suggest that some of the rhetoric surrounding collaborative approaches in construction may hide a slightly less favourable reality. Respondents raised questions about the actual extent of genuinely collaborative relationships within the industry, particularly in terms of relations between the larger contractors and their supply chains. They also hinted at structural disincentives to collaborative working within the sector, and furthermore, some individuals identified intractable barriers to knowledge transfer between organisations, even within collaborative relationships. Within such a context, what are the prospects for 'knotworking' and collective learning? It is to such issues that we now turn.

Barriers to the movement away from adversarialism and towards collaborative working

While our findings paint a broadly positive picture of the impact of collaborative working and 'knotworking' in construction, they also provide a powerful note of caution. Crucially, they support the view that the institutional framework of the construction industry does little to encourage collaboration and the sharing of knowledge and information between organisational actors. In fact, its entrenched practices, institutional arrangements and incentive systems are at odds with such a mode of working and instead generate adversarialism, distrust and mutual exploitation (Cox and Ireland, 2002; Hughes and Maeda, 2002; Ng *et al.*, 2002; Wood, 2005). Many organisations are firmly of the belief that the fundamental 'object' of working on a construction project is not to contribute to the completion of that project; rather, it is to ensure a profit at the expense of others. Thus, the established productive system of the industry actually undermines collaboration and makes co-operative 'knotworking' economically irrational. It is against the background and history of this generally unfavourable environment that Engeström's concept of 'knotworking', and the adoption of collaborative working and learning practices must be understood.

The first major barrier to collaborative working identified by most respondents lies at the very start of the productive process, namely the attitude of clients. On all construction projects the client wields considerable power through setting and letting of contracts. Consequently, a persistent theme in the interviews was that for collaborative working to function properly on a project basis the client must be able and willing to encourage and incentivise this way of working. However, many respondents observed that, on the whole, clients were at best lukewarm towards a genuine collaborative approach. Most still worked on the principle that the 'best' (that is, the cheapest) strategy is to adopt a more conventional, arm's length, commercial relationship with contractors and subcontractors, which can drive down costs through the competitive bidding process. If the partnering concept is used, it is generally as little more than a rhetorical tool, which (as they see it) allows them to avoid some of their more onerous responsibilities:

> 'I think some clients see it as an easy option because if you partner with somebody generally you get an easier ride as a client because you've been taken on knowing… what the cost parameters are. What the profit parameters are… there's an element of comfort in the relationship. So therefore clients… think if we get into this I can sit back and I can go home a bit earlier because I've got a partner here. I haven't got somebody that I've got to keep an eye on all the time.' (Engineering Director, large M&E specialist).

Most respondents cited the client as one of the greatest obstacles to the expansion of collaborative practices; while the majority of clients still continue to pursue 'traditional' modes of procurement that are purely designed to reduce costs (i.e. through competitive bidding processes based mostly or completely on price criteria), attempts by contractors, suppliers or external agencies to seek collaborative relations are unlikely to be successful. Any project that begins with, and is dominated by, an obsession with reducing costs inevitably encourages a system of incentives that actively undermines a collaborative approach at all levels. As highlighted above, for example, middle managers/project managers who are judged and assessed from the outset solely on the basis of cost and profitability are not incentivised to work in a collaborative manner, even where there is rhetorical commitment to do so from those above them in the vertical chain.

A further barrier to collaborative 'knotworking' in construction is the type of work that is currently available in the industry. For example, the number of clients able to offer the regular, large-scale work that supports multi-project partnering arrangements is limited, and this inevitably constrains the ability to pursue a long-term partnering approach. Furthermore, the volume and type of work available at any one time is not entirely stable, but is instead prone to market fluctuation. These macro-level economic circumstances are crucial in generating an environment that either supports or discourages the pursuit of collective endeavours or the formation of co-operative 'knots'. Several respondents observed that the economic cycle and prevailing market conditions have an important impact upon the feasibility of a collaborative approach. Some were concerned that, if the recessionary conditions of the early 1990s were repeated, as now seems inevitable, there would be a reversion to more adversarial contracting:

> 'We went through a cycle then in the '80s, late '80s and '90's, where it was highly competitive onerous terms and conditions and we now see it going back towards this

> collaborative working… but I think if a recession bites, that's the time that people then strike harder bargains and my people will then chase turnover, taking on jobs that perhaps they shouldn't have done on onerous terms and conditions' (Commercial Director, large construction contractor).

This echoes Ng *et al*.'s (2002) observation that collaborative working is often a fair-weather activity; when profit margins tighten, clients and contractors revert to the more conventional practice of squeezing value from each stage and structure of the production process.

Yet perhaps the most frequently cited barrier to collaborative working was the general and pervasive culture of distrust that characterises the construction industry. With hostile and adversarial modes of working having persisted for so long, this is perhaps no surprise. Contractors have, over decades and centuries, developed ingrained practices and habits based on the assumption that, even if they do not exploit and undermine others in the earlier or later in the horizontal chain of production, they are unlikely to be treated in a similar manner by others. This history weighs heavy in the sector, and casts a long shadow over attempts to establish co-operation or the spontaneous emergence of 'knots'. Opportunism at the expense of others is rife, and indeed is the means on which some firms rely for much of their income. While this adversarial culture – which clearly does nothing to support collaboration – may be changing slowly, it is clear that its effects are still felt throughout the industry. For example, as one respondent observed:

> 'The difficulty with construction is that we are a bit "Neanderthal". There's too much testosterone in construction … Construction is almost universally a male dominated sector and because it's a male dominated sector it reacts like kids do in the playground. It reacts to bullying… and it's even got a little bit more sophisticated in that we let someone in called lawyers who say well yes you can be bullied and by the way you'll sign to say you can be bullied' (Managing Director, small M&E specialist).

As noted above, contractors are often simply too afraid to risk working or sharing knowledge with others, since any knowledge they share is often simply used to 'shaft' them. Within such a context, collaborative 'knots' rarely have a chance to form, let alone to operate effectively or generate 'expansive' learning (i.e. learning that occurs collectively and which generates innovative ways of approaching shared problems; Engeström, 2001).

For smaller subcontractors in particular, being 'shafted' by those higher up 'the food chain' (i.e. by their customers in the vertical structure of production) was a common experience. For these firms, working on a project or with a customer in a genuinely collaborative manner was the exception rather than the rule (a trend also observed by Greenwood, 2001; Mason, 2006). Most were used to being treated poorly and also to being kept in the dark by those higher up the chain – thus they are excluded from the 'knot'. This is illustrated in the following extract:

> 'It was on a project in [the north of England] and the builder wasn't pulling his weight, what he wasn't doing was forming the holes for us in the walls… to enable our installation… Our client [the mechanical contractor] was pressurising us to finish because the job was behind… but the builder wasn't performing. We ended up

> taking the bull by the horns as it were and cut our own holes out. We put in [an additional fee to the mechanical contractor] for cutting the holes cos it's not part of our contract and… their attitude was well you shouldn't have cut the holes because it's builders' work, why would you do that… So we didn't get paid for it and the attitude from our client at that time was don't do it again' (Contracts Manager, small M&E specialist).

Such encounters made subcontractors sceptical of concepts such as 'partnering', which they tended to see as an empty rhetorical device employed by clients and those close to them (i.e. main contractors). For some, it meant:

> 'Sod all to anybody [laughs] basically… it's a come-on from the main contractors to come into my [web], you know, kind of spider beckoning you on, it's all partnering, it's all fantastic, it's all wonderful, it's all friendly, and now we're going to stitch you up' (Chief Executive, large M&E specialist).

Such poor experiences of partnering – which were commonly reported – and the persistent lack of trust clearly do little to promote collaboration. Moreover, it became increasingly clear that, while many large contractors profess to 'partner the supply chain', the reality is that only a few select suppliers and subcontractors are accorded this 'privilege'. For example, one of the larger contractors interviewed claimed to engage in supply chain partnering, but, when probed, revealed that:

> 'It's being selective ... We're going to look for the [subcontractors] that we can operate best with and share benefits with rather than having a scatter gun approach that will never lead to any relationships' (Supply Chain & Procurement Manager, large construction contractor).

This highlights the crucial point that, from the perspective of construction clients and main contractors, there is more incentive to collaborate with certain types of supplier and subcontractor, such as those who deliver a highly specialised product or service or account for a significant part of the project. In these circumstances, there is a clear incentive for those earlier in the chain to co-ordinate and communicate with those who supply work or come on site later in the process.

'Partnering the supply chain' (as extolled in the Egan Report of 1998) is therefore a more complex issue than is sometimes assumed. The benefits of working collaboratively with some suppliers are likely to be different or simply greater than with others. Moreover, some will be more willing and/or able to work collaboratively than others. As a consequence, any benefits in terms of collective learning will be restricted to certain parts of the supply chain. For example, specialist sub-contractors are more likely to be involved in designing and planning the build, but this rarely extends to general sub-contractors typified by the 'white vans' often seen on sites:

> 'If, for example… there's a specialist control system, it's helpful to have them onboard early … we need to make sure that we have all the messages he wishes to deliver at the right time, so that we design it and develop the working drawings once and once only … However, there's a law of diminishing returns and, in some cases,

> no return [in partnering the supply chain] beyond the key players.' (Business Development Director, large M&E contractor).

As this section has illustrated, the barriers to collaborative forms of working in construction are considerable. Co-configured modes of organisation, such as 'knotworking' and partnering, are undermined by long-established habits, practices, cultures and incentives, all of which have a long history which promotes exploitation and conflict. Such conditions militate against the identification of shared objects that make 'knotworking' possible. More specifically, there may be further implications of this environment for learning and knowledge sharing. As outlined in earlier sections, collaborative approaches do indeed have the potential to create an environment in which learning flourishes and knowledge is shared freely between partners. However, given that the construction industry has a long history of distrust, information hoarding and poor communication between the different parties, it may be easier said than done to institute relationships that facilitate collective learning and inter-organisational knowledge transfer.

Conclusion

The findings presented here go some way towards confirming that 'new' forms of collaborative ('co-configured') work organisation can enhance the quantity and quality of learning in construction, relative to more traditional, adversarial ways of working. By enabling greater strategic investment in capacity, promoting a more co-operative ethos, and demanding an expanded set of skills from co-operating parties, collaborative approaches potentially enable and require an increased level of skill and knowledge sharing. As such, there is some support for Engeström's theory of 'knotworking' as a mode of organisation that promotes and relies on knowledge-sharing and collective learning.

However, the evidence presented here also demonstrates the need to add empirical weight to Engeström's work, and emphasises that models of 'knotworking' and collaborative working more broadly need to be contextualised within specific historical and institutional settings. In reality, the fabric of the productive system in construction militates against collaboration and undermines collective learning. Decades of conflict and mistrust, alongside a reward structure that in many cases encourages cynicism and exploitation all contribute to an unfavourable environment for co-operation and knowledge sharing. These structural disincentives mean that, very often, contractors and subcontractors simply do not share the same 'object': the object is to maximise their own profit at the expense of 'the other side'. In this zero-sum situation there is no solid common ground for collaboration, even with the intervention of an outside facilitator. It is therefore perhaps no surprise that, while some collaboration and partnering does occur in parts of the industry and indeed in some cases has apparently been instrumental in raising levels of skill (Love, 1997), the evidence continues to suggest that relatively little has changed in recent years (see also, for example, Mason, 2006, and Greenwood, 2001).

This is the reality of work in a competitive capitalist productive system dominated by exploitative relations. Yet this is precisely the environment in which moves towards collaborative, co-configured models of work organisation and collective learning must be contextualised. What the findings of the paper emphasise is the importance of

understanding 'new', supposedly learning-intensive models of work organisation, within the context of specific and established productive systems. So, while Engeström's work undoubtedly advances our understanding of some of the processes through which performance-enhancing collective learning can occur, there is a pressing need to add greater empirical weight to his analysis. As this study has demonstrated, productive systems may not support genuine collaboration or knowledge-sharing between parties. Indeed they can actively undermine it. Only when the specific characteristics of such systems are illuminated can we begin to understand how, if at all, new ways of working and learning can be successfully promoted within them.

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