Creating and using knowledge: an analysis of the differentiated nature of workplace learning environments

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ABSTRACT

This paper argues that contemporary workplaces give rise to many different forms of knowledge creation and use, and, as a consequence to different forms of learning and pedagogical approaches. Some of these are utilised to the benefit of the organisation and employees (though not, necessarily, in a reciprocal manner), but others are buried within everyday workplace activity. The discussion builds on earlier work where it was argued that organisations differ in the way they create and manage themselves as learning environments, with some conceptualised as 'expansive' in the sense that their employees experience diverse forms of participation and, hence, are more likely to foster learning at work. By studying the way in which work is organised (including the organisation of physical and virtual spaces), this research is suggesting that it is possible to expose some of this learning activity as well as to identify examples where new (or refined) knowledge has been created. In this regard, it is argued that it is important to break down conceptual hierarchies that presuppose that learning is restricted to certain types of employee and/or parts of an organisation and to re-examine knowledge as applied to the workplace. The conclusion focuses on how such an approach, and in particular the use of a productive system analysis, is strengthening the concept of expansive and restrictive learning environments.

Introduction

This article argues that the productive systems of contemporary workplaces give rise to many different forms of knowledge creation and use, and, as a consequence, to different forms of learning and pedagogical approaches. Some of these approaches are utilised to the benefit of the organisation and employees (though not, necessarily, in a reciprocal manner), but others are buried within everyday workplace activity (see Billett, 2001). Our analysis draws on evidence from research in public and private sector organisations in the UK and uses data from three case-study sectors (food processing, retail, and software engineering) to illustrate its arguments.[1] It also draws on previous research in the steel and metals sector, from which Fuller and Unwin (2003, 2004) argued that organisations differ in the ways they create and manage themselves as learning environments. In that study, Fuller and Unwin used a range of data collection methods (including interviews, observations and weekly learning logs) to investigate learning and workforce development in diverse organisational contexts. The evidence underpinned the development of a conceptual framework which identified a range of pedagogical and organisational factors, each locatable on what was termed the expansive–restrictive continuum. The research concluded that expansive rather than restrictive environments fostered learning at work and the integration of personal and organisational development. It was noted too that individuals differed in the extent to which they engaged in learning. Their responses to opportunities were shaped, at least to some degree, by their personal backgrounds, prior educational experiences, and aspirations, which were referred to as their 'learning territory' (Fuller & Unwin, 2004; see also Evans et al., 2006. It was also recognised that organisations might adopt more restrictive approaches to workforce

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development as a deliberate strategy for supporting models of work organisation which were based on limiting the learning of at least some groups of employees. Figure 1 represents Fuller and Unwin's initial (rather than an exhaustive) attempt to suggest the range of factors (pedagogical, organisational and cultural) that contribute to approaches to workforce development and the creation of learning environments, and to put them into a single conceptual framework.

In the current project, we are attempting to probe more deeply into the framework's characteristics in order to connect the role of learning with the ways in which work is organised together with the ways in which performance is conceived and measured. Our research indicates the need for a sharp focus on the dynamic context in which workplace learning takes place, including wider regulatory, sectoral and organisational characteristics (see Unwin et al., 2007). It is also showing that where people are positioned in the political economy of the workplace affects not only the types of learning in which they engage and the types of knowledge they can acquire, but the extent to, and manner in which, their learning and knowledge are recognised. As a result, we are trying to understand the nature of the productive systems (Wilkinson, 2002) operating within organisations to understand the underlying phenomena that drive (or impede) learning and the creation, refinement and management of knowledge (Felstead et al., 2006). As such, we are using the image of the Russian doll to capture the multilayered nature of contemporary organisations and sectors (see Unwin et al., 2007). The article is structured in two main sections. The first outlines ways of conceptualising knowledge and their relevance to exploring who learns what at work. The second uses the case-study examples to (re-)examine the concept and role of knowledge(s) and knowing, as applied to contrasting workplaces and workforces. We conclude by arguing that developing empirically and contextually grounded understandings of 'knowing' in the workplace can contribute to theoretical debates about types of knowledge as well as providing a basis for critiquing assumptions about knowledge and skills of employees at different levels, with diverse job roles and from various sectors.

Figure 1. Expansive - Restrictive Continuum (Workforce Development)

EXPANSIVE	RESTRICTIVE
Participation in multiple communities of practice inside and outside the workplace	Restricted participation in multiple communities of practice
Primary community of practice has shared 'participative memory': cultural inheritance of workforce development	Primary community of practice has little or no 'participative memory': no or little tradition of apprenticeship
Breadth: access to learning fostered by cross-company experiences	Narrow: access to learning restricted in terms of tasks/knowledge/location
Access to range of qualifications including knowledge-based VQ	Little or no access to qualifications
Planned time off-the-job including for knowledge-based courses, and for reflection	Virtually all-on-job: limited opportunities for reflection
Gradual transition to full, rounded participation	Fast – transition as quick as possible
Vision of workplace learning: progression for career	Vision of workplace learning: static for job
Organisational recognition of, and support for employees as learners	Lack of organisational recognition of, and support for employees as learners

Workforce development is used as a vehicle for aligning the goals of developing the individual and organisational capability	Workforce development is used to tailor individual capability to organisational need
Workforce development fosters opportunities to extend identity through boundary crossing	Workforce development limits opportunities to extend identity: little boundary crossing experienced
Reification of 'workplace curriculum' highly developed (eg through documents, symbols, language, tools) and accessible to apprentices	Limited reification of 'workplace curriculum' patchy access to reificatory aspects of practice
Widely distributed skills	Polarised distribution of skills
Technical skills valued	Technical skills taken for granted
Knowledge and skills of whole workforce developed and valued	Knowledge and skills of key workers/groups developed and valued
Team work valued	Rigid specialist roles
Cross-boundary communication encouraged	Bounded communication
Managers as facilitators of workforce and individual development	Managers as controllers of workforce and individual development
Chances to learn new skills/jobs	Barriers to learning new skills/jobs
Innovation important	Innovation unimportant
Multi-dimensional view of expertise	Uni-dimensional top-down view of expertise

Unlocking the nature of knowledge at work

Survey evidence has revealed the uneven distribution of learning opportunities across UK workplaces (see Felstead et al., 2005). Research has also questioned the access that employees have to learning opportunities given that (global) economic drivers are underpinning employers' attempts to 'sweat' more productivity from their human resources (see Fenwick, 2000; Lloyd & Payne, 2004). Employees in weak labour market positions are likely to have limited job roles and little access to training and career development, and to work within what Fuller and Unwin (2004) have elsewhere called 'restrictive' workplace learning environments. In contrast, others suggest that the emergence of the 'new economy', high performance and employee involvement practices (see, inter alia, Whitfield, 2000; Ashton & Sung, 2002) can give rise to more 'learning intensive' workplaces (Skule, 2004). The inclusion of diverse sectoral, organisational, and individual participants in our study is enabling us to investigate the empirical reality of competing perspectives. Our recent survey work (Felstead et al., 2005) has enabled us to make connections between informal and formal sources of learning and their perceived helpfulness (in terms of doing the job better) to groups at different occupational levels. The findings confirmed that those at the top had the greatest access to courses and qualifications (Felstead et al., 2000), but also revealed that employees at all levels perceived that learning through 'everyday' productive activity at work is the most helpful for doing the job. However, those at the higher end of the occupational hierarchy were more likely to perceive their participation in formal sources of learning as useful. This implies that there is a relationship between the context and characteristics of work settings, the opportunities to learn to which they give rise, and the types of knowledge

resources needed for workers to do their jobs effectively. To examine this further, we are looking closely at what constitutes the nature of knowledge in use and in context.

Conceptions of knowledge tend to relate to whether an individual or social perspective is taken (Eraut, 2004). Sfard (1998) has used the metaphor of 'learning as acquisition', whereby individuals acquire and store context-independent knowledge products in the 'stock room' of their minds (Beckett & Hager, 2002). In contrast, Sfard (1998) used the 'learning as participation' metaphor to capture the social perspective which regards knowledge (and knowing) as being embedded in and created through participation in the social relations which constitute practice (Lave & Wenger, 1991). The idea that knowledge is constructed is consistent with an emphasis on 'knowing' as an active concept (Blackler, 1995). The 'sociality of knowledge' (Muller, 2000) originates in the idea that (all) knowledge is social, because it is constructed through the social relations operating in particular socio-economic and cultural contexts. 'Social constructivism' represents one form of the sociality of knowledge, 'social realism' another (Young, 2004). From the social constructivist perspective, scientific, disciplinary knowledge can be seen to have high currency because it is created by high-status groups; is acquired through participation in high-status settings (such as universities); and because it, or its symbols (certificates), can be exchanged for high-status positions in the socio-economic pecking order. Its strong currency is based on its social construction and not on any putative objectivity or efficacy that makes it intrinsically superior to other forms of knowledge (Young, 2004).

However, as Young (2004) argues, the social constructivist approach does not help differentiate the extent to which some types of knowledge are more situated than others. For those seeking to understand what people learn at work, why and how, this perspective has limitations as it tends to foreclose analysis of the different types and sources of knowledge on which different groups in different settings might be drawing. The social realist approach, however, allows that there are different types and sources of knowledge and that some are more situated than others (Young, 2004). Fuller and Unwin (2003, 2004) showed, for example, how engineering apprentices who had opportunities to participate in a broad range of activities, including the acquisition of theoretical concepts, both on and off the job, were in a stronger position to progress within and between firms than those who only had access to on-the-job learning experiences. Put another way, these young people had been given the chance to participate fully in the various parts of the productive system.

Eraut (2004) identifies two broad types of knowledge: cultural and personal. He links the former to the social perspective and the latter to the individual perspective. Whilst Eraut acknowledges that both perspectives are important, evidence from our case studies is causing us to question his separation of the social and individual. Our research is suggesting that an (ontological) approach which conceives the personal and collective as mutually constitutive is more fruitful and in keeping with our 'Russian doll' metaphor. The importance of Eraut's analysis is that he reminds us to take account of what employees bring to the workplace from their past experience and that aspects of both cultural and personal knowledge can be 'codified' or 'noncodified'. The territory covered by non-codified knowledge is broad and varied and needs to be uncovered and elaborated to illuminate the nature of knowing in the workplace. There is a tendency to bracket non-codified cultural and personal knowledge with the notion of tacit knowledge, that which is taken for granted and hard to articulate. Researching the tacit certainly constitutes a methodological challenge, but the evidence being generated in our project is suggesting that whilst there may be some areas of workers' knowledge which are hard to uncover, respondents are often able to articulate a good deal

about what they and others need to know in order to do their jobs. Boreham et al.'s (2002) concept of work process knowledge, through which employees gain a more holistic understanding of the production process, is relevant here. Workplaces organised along Taylorist lines limit workers' learning to gaining the knowledge they need to perform specific and narrow tasks, whereas more flexible, less hierarchical models of work organisation, associated with the use of information and communication technologies, encourage employee involvement through team working, employee discretion and wider knowledge distribution. Our project is analysing a range of work environments (productive systems) to bring to the surface the nature of their social and technical relations, and to identify who is involved, and in what ways they cope with continuity, disruption and change.
In addition, the tools and artefacts which mediate organisational activity provide an important lens on how knowledge is actively constructed, distributed and created.

Illustrating who learns what at work

In this section, we draw on transcribed interviews (with employees at all levels) and field notes taken during observation in the workplace in three companies in the food processing, retailing, and software engineering sectors. For each setting, we focus on the different types of knowledge developed and applied by participants.

Company A: food processing
Company A is part of the pre-packed sandwich-making industry, which is worth approximately £3 billion to the UK economy. It was founded 10 years ago by two friends and currently employees 30 people in the English East Midlands. It now operates as a limited company, with the founders employed as joint managing directors (MDs), and produces around 25,000 sandwiches a week for neighbourhood shops and garage forecourts. Most employees are employed as either sandwich makers/assemblers (17) or van drivers (9).
The main challenge for the MDs is how to take the business forward in terms of expansion, capital investment in automated machinery, and bringing in specialist personnel. The data reveal the extent and nature of the cultural and personal knowledge being applied in this workplace context and the essential role this is playing in day-to-day decision making and activities. In the following extract, one MD reflects on the possible advantages of employing an experienced production manager in order to give him more time to develop the business:
The time I'm there sticking labels on etc., sort of doing the quality control at the end of the line, I just think to myself 'what else could I be doing with my time in terms of perhaps getting new business, looking at new markets, looking at new product lines' etc., etc., etc.'

The MDs 'know' that their management style is critical to the success of the business. It is characterised by: (a) a highly hands-on approach—they can and often do perform all the workplace tasks; and (b) an approachable and friendly relationship with staff. Below, a van driver refers to the importance of daily interaction and information exchange between van drivers and managers. This takes the form of knowledge sharing, swapping experiences and ideas and, importantly, having their suggestions acted upon:

> Every day we come in and talk. Can I have five minutes with you? Yeah, no problem. They've [managers] always got time for you…they will listen to you. One day you go in and there haven't been many salads today … next day … all your trays are full salads.

The MDs' observations reveal the simultaneous use of cultural knowledge about business (e.g. the relationship between capital and labour, product market and quality) and what Eraut calls, 'everyday knowledge of people and situations' (2004, p. 202). Their evidence highlights the challenge of reconciling strategic issues relating to the long-term development of a small business with day-to-day workload demands.

Evidence from van drivers in Company A provides a telling reminder of the importance of collecting the 'voices' of employees at all levels of the occupational hierarchy and of not making assumptions about the relationship between what workers know and the social and occupational status of particular groups. The occupational label 'van driver' implies a narrow job role. However, the interviews contradict this by revealing the breadth and complexity of what the company's van drivers actually do and the centrality of their involvement in the relations of production. Each driver is responsible for a 'delivery round' comprising deliveries to 50 plus different outlets ('drops'). By going out on drops, we observed them engaging in the following areas of activity:

- working out the most efficient route;
- knowing what types and prices of sandwiches sell to what type of outlet, in what type of location;
- collating (in 'the book') and communicating 'field intelligence' (e.g. on sales,
- customer performance, waste) to managers to enable changes in production;
- knowing how to vary prices on particular products to optimise sales;
- seeking and securing new customers and maintaining good relations;
- applying aesthetic knowledge to present products on outlet shelves to maximise sales;
- calculating and collecting the correct amount of money owed by customers.

The following quotation illustrates the van drivers' centrality to organisational performance, and how the different sorts of knowledge they possess are embedded in the social relations of production:

> It's down to us [van drivers] at the end of the day. He's [MD] blind. We're like his eyes. We have to go out there and we come back with information. Can you change this, can you change that and come back to [MD] and he makes them [sandwiches]. That's how it is.

The evidence from Company A indicates the situated and contextualised nature of the knowledge created and distributed across the social relations which constitute this organisation. This is not to say that less context-dependent knowledge is absent from the workplace. Issues relating to environmental health are critical to a food processing and handling business. If the company were subject to a complaint about the safety of its products, it would have to be able to demonstrate 'due diligence' in relation to such matters. Therefore, products are sent to a laboratory for testing to establish their 'safe' shelf life, and the appropriate use by date. Some employees have developed significant codified (scientific) knowledge in this area.

The key findings from this case study relate to the significant level of discretion associated with the van driver role and the involvement of the MDs in production. This permits intensive development of what is manifested as tacit knowledge, but which may actually consist of a variety of knowledge types. It is not clear to us that Eraut's distinction between 'personal' and 'cultural' is sufficient to capture the type of collective, co-constructed knowledge

creation and ability to make ‘hot decisions’ (Beckett & Hager, 2002) embedded in the performance of both managers and van drivers. In particular, the context of activity means that collective knowledge(s) are being employed and created through dynamic interaction between colleagues and customers. Customers as well as differently positioned workers are part of the network of social relations that characterise this productive system. The van drivers have an interdependent peer relationship with their managers that enables new knowledge to be co-constructed. This relationship, however, is invisible in structural terms in that the business’s organisational chart depicts a typical status hierarchy in which the van drivers are subordinate. The example here contrasts with Eraut et al.’s (2004) case studies of professional sectors where organisations are more likely to be based on knowledge hierarchies. In such settings, managers can be presumed to be capable of providing support and mentoring (and teaching) to those at the preliminary stages in their professional careers and where there is shared recognition that the novice–expert dimension is an integral aspect of the employee–manager relationship. Whilst the Eraut model is helpful for describing and explaining professional situations, the extent of its generalisability to other groups and settings is questionable.

The concept of work process knowledge is of some help in understanding the food processing case, but our case study is different to Boreham et al.’s (2002) examples of organisations that have introduced new flexible forms of working (often facilitated by information and communications technology [ICT]). The approach to work organisation adopted by company A is characteristic of the sectoral context and the size of the firm rather than any historical break with past ways of working. It represents a category of company that encourages high levels of employee involvement due to the everyday struggle to improve and survive.

Company B: retail—supermarket

Company B runs a nationwide chain of supermarkets, employing over 50,000 staff and with a turnover of more than £4 billion. For the purposes of our research, we have conducted interviews with personnel at all levels in two similarly sized stores, as well as with the area manager who has overall responsibility for several outlets. Each store has a manager, several department managers and supervisors, and ‘shop floor operatives’. New technology, such as electronic point of sale systems, has facilitated the centralisation of the buying, stock control and marketing/presentation functions.This has limited the extent to which individual stores can plan their own stockprofiles and the way in which their stock is presented to customers. Stock Store Management (SSM) is implemented via a device called a ‘symbol gun’, which is used to check that the physical stock available on the shelves accords with what ‘the computer’ states the store should have; to collate data on availability; and to write off stock. In terms of ‘actor network theory’ (Law, 1994; Mutch, 2002), which conceives networks as consisting of human and non-human elements, the symbol gun can be seen as an important ‘member’ of the social relations of production in this firm. One store manager observed:

> ...these little guns obviously are controlling … obviously we’re putting all the information in to that which takes it to the computers, so I mean without these in this store, we wouldn’t know what our stock levels were and we’d be in a bit of a mess, we do rely on those.

Generally, departments with fresh produce have more discretion over stock ordering than those such as grocery, which have a relatively long shelf life. Dairy and meat are seen as particularly critical sections for store performance because they combine relatively high turnover with the risk of high wastage if the ordering levels are inaccurate. It is the

departmental manager's responsibility to maintain the integrity of stock levels (i.e. to ensure that the physical and computer stock levels match). Knowledge of local conditions and patterns of demand can have a significant impact on departmental and store performance, and this leads to a tension over how much discretion to give departmental managers to alter their centrally determined stock levels. Offering more discretion can lead to positive pay-offs, when the manager's reading of local demand proves accurate, or be negative when the store is left with high levels of spoiled produce. We concentrate here, therefore, on what departmental managers need to know, focusing in particular on an account provided by one dairy and meat manager.

The first quotation confirms that the degree of discretion accorded to department managers differs according to the fragility of the produce and how they use their cultural and personal knowledge to alter what the system suggests should be ordered:

> ...what you had is grocery where they can't amend very much, but on dairy [I] mean fresh [food], you can amend everything, so you change it as much as you want. And the system, I don't know why, but it tends to order say too much and you just know from knowledge yourself, you sort of look at it, you get a sort of record in your own head. (Dairy and meat department manager)

The manager also explained that the computerised ordering system has the capacity to learn: 'say we've got one product, say it's ordering five cases, I think that's not going to sell, I'll take one, the system sort of resets itself every time you do that'. There is, therefore, interdependency between the computer and employee, with both influencing each other's behaviour. The performance of the department is assessed on three indicators: sales, availability and waste. Optimum success is achieved when the most profitable balance between the three is reached, as the dairy and meat manager explained:

> It's hard to get [to hit targets on all three indicators at the same time], you can normally get one without the other, get brilliant waste, cos you've cut back a lot and you haven't got the sales there. To get sales you need to spend more money, which goes … more waste, but if you want to meet your waste, you've got to try and get a happy medium, which is very difficult. Availability comes with getting sales and waste.

This respondent spoke about the importance of experience in enabling people to achieve their targets and also about the need to 'be in rhythm' with patterns of demand. He said, 'when you come back off two weeks holiday say … what you think is right is no longer right to what it was when you left'. Department managers are also responsible for employees in their 'teams'. The dairy and meat manager explained what he needs to know in order to manage people effectively:

> ...being able to be a friend but yet be a boss, step away when you need to and yeah just like casual and friendly. You need to be able to separate them too if you need to, if you're too nice all the time you'll get nowhere, always be fair.

His approach to people management has been strongly influenced by the style promoted by the store manager, who is an avid reader of populist management texts such as Blanchard and Johnson's (1981) One Minute Manager. Such books focus on the idea that 'your people are your most important asset' and on ways of motivating and empowering them. The store

manager makes this literature available to his management team as required reading. This provides an example of codified cultural knowledge that goes beyond the expected organisational documentation available in a supermarket.

Whilst the technology in both case study stores is the same, the way in which it is used and perceived is influenced by the organisational culture generated by contrasting management styles. When asked how he would characterise the store manager's role, the manager of one store talked a lot about the importance of employee development, including his capacity to alter and 'teach' the system. In contrast, the other store manager perceived the introduction of new ICT as decreasing individual discretion and autonomy. She observed that 'most of the job really is policing as it were and checking that things are being done. I mean the system checks I carry out, tells me whether they're doing their job right'. The computerised stock system clearly has an important effect on employees' roles, and can both limit and change what they need to know. The introduction of the tools and devices of the SSM system is reconfiguring the network of relations embedded in this productive system. This case study provides an example of an organisation which is trying to improve its performance by introducing new ways of working based on new technology.

The company's head office has not sought to impose a preferred management style or organisational culture. Attention is focused on performance outcomes rather than attempts to micro-manage how stores operate and employees are utilised. The relationship between the corporate centre and the stores is mediated through the computerised SSM system, but it is apparent that senior managers are not always best placed to know how the system might be used most appropriately. This leaves open the possibility that the system can become all-powerful or it can be manipulated and subverted. The challenge here would appear to be to design a productive system which facilitates knowledge sharing. This will involve an analysis of the work process as a whole, that is, across departments at the local level and between these and the 'centre'.

Company C—software engineering

Company C provides a contrast to the other two companies discussed in this paper as it has the characteristics of a 'knowledge intensive' organisation where the vast majority of employees are university graduates. The company, based in the southeast of England, develops cutting-edge software and hardware products and solutions for a wide range of customers including the US and UK military and several multinationals. It employs 350 people, including 50 sales staff in the United States, where 90% of the company's sales are generated. Some 30 people are based in Edinburgh and a small number of people work from home. A profit share scheme, involving all employees (including cleaning and catering staff) and determined through twice yearly reviews of individual performance, plays a key role in cementing employee 'buy-in' to the corporate goals. The largest group of employees consists of software engineers recruited from Oxford and Cambridge and a small number of other top UK universities at the age of 21 or 22. They are nearly all male, reflecting the gender balance across the company where, currently, 69 out of 350 employees are female.

This company comes across as a strong community whose members are 'signed up' to the expectations in terms of performance, but also to the social ethos. A company director referred to the head office as the 'Mother Ship':

> All people who move to this company have been in [head office], have been in the mother ship if you like, and have got to know everybody else, have been brought up if you like with all the fundamentals of the mother ship and then they go out to the frontline offices.

Similarly, the chairman emphasises the family atmosphere in which people are cared for and where the social life of the 'family' is seen as key to the company's success. The director of Internet operations added to this by stressing that this is a 'long lasting career driven company' in which people's careers are seen as the driving force. The company's physical environment, and devices such as a 'Morale Fund', which pays for company outings, help to sustain and enhance a strong spirit of collegiality. There is, then, an explicit management focus on developing and shaping the social relations of this productive system.
Many of the software engineers told us they had been attracted to the company because it would give them the chance to move from university to become a member of another community of 'bright people'. There seems to be a close alignment between their personal knowledge and the cultural knowledge of their occupation.

The organisation of work, including the management practices, further sustained and enhanced that alignment. This relates to Baldry et al.'s (2005) argument (see also, Marks & Lockyer, 2004) that software workers demonstrate greater commitment to organisational goals in companies that respect their professional identity as software engineers and create working conditions that value worker discretion and autonomy. The engineers rotate around project teams established for up to approximately nine months at a time. Knowledge and expertise are captured within the teams, as in Boreham et al.'s (2002) concept of work process knowledge, and disseminated through everyday interaction in the form of discussions and consultation across the teams. The performance review system acts as the main mechanism for capturing ideas, and for facilitating what Boud et al. (2006) call 'productive reflection'. The review takes the form of a written report (around 10 pages), compiled by the employee and their immediate manager, detailing the employee's strengths and weaknesses over the period in question. The reports are reviewed and graded by the chairman and senior managers in order for the profit share to be allocated. At the heart of the process is a commitment to individual career development and the role of the manager as the key facilitator of learning, as advocated by Eraut et al. (2004). In this company, however, the concept of who is a manager and what form management should take has moved well beyond conventional notions of the management function. The vast majority of employees are expected to have a management role. The concept of 'managing' relates much more to a social relational model than the standard concept of managers as monitors of performance. In terms of the software engineers, once they have acquired the necessary technical competences, they are assigned a newcomer to manage, a process that is closely supervised by a team manager. The engineer has to show they can 'teach' their trainee as well as instil the corporate values, and this is recorded through the review process.

The growth and nurturing of managers reflects the company's privileging of on-the-job training and learning. Employees can, if they wish, participate in off-the-job training, but this is very rare. Knowledge is acquired and distributed throughout the company through the use of teams and the central role played by everyday interaction within and between teams and clients. This again reveals a much more dynamic fusion of the personal and the cultural than is perhaps envisaged by Eraut, and also the importance of identifying the full range of knowledge producers (with clients seen as key actors in the co-construction of knowledge and ideas. Senior managers lead workshops and seminars on specific topics and software

engineers are encouraged to organise ad hoc presentations to colleagues when they want to get feedback on new ideas or long-standing problems. Many of the interviewees stressed that there was little need for off-the-job training, as illustrated by this comment:

> The kind of people we have, this will sound arrogant and elitist, but they're sort of, a long way above the average you might encounter if you go on a 'how to program course'. The people working on that course generally would be of a lot lower ability than the people here.

A small number of engineers, however, were concerned that the lack of off-the-job training meant that they were not able to acquire further work-related qualifications. Although they had no plans to leave the company and stressed that having worked there would probably impress another employer more than formal qualifications, they were aware that labour market conditions might change (see Marks & Lockyer, 2004). Engineers spend 50 days of their first year learning the core technologies of the business from their mentor and manager. They become deeply immersed in real-work tasks and, hence, are involved in what Polanyi (1962) called 'participation through indwelling'. As ideas are developed and problems solved, engineers place this information in a series of 'public folders' on the company's intranet. This relates to Nonaka et al.'s (2005) concept of 'knowledge conversion' whereby tacit knowledge is 'externalised' and turned into an explicit form, then expanded, and then reinternalised through practice. In the case of Company C, the public folders also reflect Kerosuo and Engestrom's (2003) requirements that such tools are powerful resources when they emerge from being part of an organisation's collective routines, and when they are interconnected with and implemented within workplace activity.

The metaphor of the 'mother ship' used by one of the directors is particularly apt when considering both the strengths and weaknesses of this company. The company's creative and sustained management of its physical, virtual and mental space reflects Nonaka et al.'s (2005) concept of *ba*, one that potentially adapts the concept of communities of practice to reflect contemporary organisational realities. On the one hand, the company has created a very prosperous, stable and stimulating environment for its highly qualified crew. Cook and Brown's (2005) metaphor of the 'generative dance' between knowledge and 'knowing' is relevant here as the company has developed ways of working that produce a constant interaction between the engineers' expertise and the everyday problems they have to work on. This 'dance' occurs in all workplaces, and, hence, in all our case studies, but it varies in nature from the highly formalised and controlling to the haphazard. Some organisations, such as Company B, have centralised their knowledge management systems to the extent that, in some stores, employee knowledge is positively disregarded. In contrast, Company A relies on informal verbal exchanges to capture the knowledge of its van drivers. Company C has arrived at a potential 'tipping point' in terms of its size and its ability to innovate. The issue of size is significant, because the review process makes considerable demands on senior managers, including the chairman. The problem of innovation strikes at the heart of the belief that the generation and reproduction of skills and knowledge within the community of practice is sufficient. One of the directors voiced his concern about the propensity of the engineers, whom he referred to as 'propeller heads', to be too inward looking and not interested in the business side of the company. It appears, then, that to maintain the success of this company, the continual ordering and organising of the social relations of production needs to be extended to include the introduction of new actors and tools, with attendant effects on the development of the existing workforce.

Conclusion

We have argued that there is no easy 'read-across' between types of knowledge and their availability and distribution across particular organisational settings, or occupational groups. For example, depending on the occupational or professional context, scientific concepts or theoretical knowledge may or may not be just as crucial a resource in the workplace as in the educational institution. What is learned in what sorts of productive systems, how this is mediated and applied through the social relations of production, is highly relevant not only to gaining a better understanding of workplace learning, knowledge(s) and knowing, but also to their relationship with the organisation and distribution of work and organisational outcomes. We are using this insight in order to strengthen the analytical capacity of the expansive–restrictive framework in two particular ways: firstly, in terms of its ability to conceptualise the significance of, and relationship between, forms of workplace learning and knowing, and forms of learning undertaken in 'specialist educational settings' (Young, 1998); and secondly, in terms of its ability to draw attention to the range and configuration of sources and types of knowledge in use in particular workplaces and by particular (groups of) employees.

We have also suggested that empirically grounded case studies are vital in order to: (a) avoid making easy assumptions about the complexity and value of workplace learning based on employees' structural position in organisations, or the sectors in which they work; (b) expose the range of knowledge sources available (and not available) in the workplace; and (c) understand the relationship between personal and collective knowing, the social and technical relations of production (including job design and work organisation), and organisational outcomes. Our research shows that, as learning environments, workplaces have expansive and restrictive features. Their restrictive elements surface in factors such as the lack of opportunity for off-the job-learning, where employees might be exposed to new concepts and given the time to reflect critically on their practice. Their expansive elements can be detected in types of work organisation which provide opportunities for discretion, exposure to a range of work processes, and a management style which encourages the creation and distribution of knowledge. Expansive and restrictive learning environments need to be viewed in two dimensions, that is, in terms of breadth and depth. This type of focus enables analyses which characterise environments in terms of their particular configurations of narrowness, breadth, depth, and shallowness, as well as the availability and location of different knowledge sources. Insights generated from such an approach could be developed to provide messages for skills policy as well as practitioners supporting employee development.

The case study evidence highlights the 'art' involved in applying knowledge effectively to fulfil occupational roles in diverse productive systems. For the department manager in Company B, there appeared to be an art to knowing how to manipulate the ordering system to continually hit three competing and dynamic performance targets. In Company A, the van drivers' complex job role, which contradicts stereotypical assumptions about what 'low-grade' employees know and can do, was shown to allow for considerable discretion and autonomy. It played a pivotal part in the network of relations which made up the productive process. Management of a small business, such as Company A, called for 'knowledgeability' in everyday tasks as well as in how to manage for longer-term success. Having 'the art' (the knowing) to achieve this balance appeared critical to the sustainability of the firm. In contrast, Company C showed how organisations can construct powerful learning environments that suit the needs and circumstances of a given period in the life cycle of a business. For this company, the challenge will be to take risks with the current community

structure in order to adapt to changing market conditions, and will require a reassessment of the inward-looking approach to learning and knowing that has been fostered hitherto. The aim of such a process would be the production of a more elastic 'community boundary' (see Fuller et al., 2005), allowing for the sorts of critical perspectives and external ideas associated with Engestrom's (2001) concept of expansive organisational learning.

Finally, the illustrative material provides evidence of the different ways in which knowledge (of all types) is constructed, distributed and put to use within the context of a productive system. This has implications for methodology. We would argue that case study researchers investigating workplace knowledge need to begin with an examination of the productive systems that underpin their research sites. As the research progresses, we are probing deeper into our case study organisations to create more detailed pictures of the learning and knowledge environments they are creating and recreating.

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