

Redefining Firm Competencies, Innovation and Labour Mobility: A Case Study of R&D in British Telecom*

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Resumen

Este artículo trata acerca de cómo las instituciones del mercado laboral y, más específicamente, los cambios en las prácticas de la movilidad laboral, moldean la manera en la cual las empresas establecidas de tecnología intensiva redefinen sus competencias tecnológicas.

A través de un estudio detallado llevado a cabo en BT, el argumento central propuesto es que la habilidad de las empresas en implementar cambios estratégicos importantes en I+D, involucrando cambios de flexibilidad laboral, estarán fuertemente influenciada por las estrategias de los propios empleados en cuanto a formación de habilidades y estructura profesional. Esto, a su vez, está influido por el modo específico en el cual las instituciones del mercado laboral se definen y se regulan. Se presenta un marco el cual integra la cuestión de mercado laboral y la innovación, especificando las contribuciones distintas que tal mercado hace hacia el proceso de innovación.

Palabras clave

Innovación, movilidad laboral, telecomunicaciones, empresa, competencias.

I. Introduction

It is widely acknowledged that over the past decade and a half, radical new forms of production have emerged with the pervasive expansion of information and communication technology (ICT) (Freeman and Perez 1988, Best 1990). This has acted as a catalyst for deep-seated changes in the process by which innovations are conceived and have caused important dislocations with the institutional structures within which innovations were traditionally generated. Long standing organisations such as British Telecom (BT), that routinely were considered technological leaders and innovators in their industries, have therefore faced enormous challenges to restructure

competencies and generate greater dynamism into their organisational routines. This paper contributes to this debate around organisational and institutional change by looking at how labour market institutions and more specifically changing practices of labour mobility in an R&D environment can shape the manner in which large established technology intensive firms redefine their technological competencies. The central argument posed is that the ability of firms to implement important strategic changes in R&D, involving new forms of labour flexibility and mobility amongst knowledge workers, will be strongly influenced by the employees' own strategies of skill formation and career structure. This in turn is influenced by the specific manner in which the labour market institutions are defined and regulated.

The concept of the co-evolution and mutual shaping of firm organisation and labour market institutions is addressed using a framework developed in the paper that interfaces elements of two typologies drawn from, up until now, relatively disparate literatures in the areas of

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organizational change and labour markets. Inherent in the framework's proposition lies the notion that the coherence between the innovation strategy of a firm and the labour market institutions will underpin the ability of firms to carry out successful strategies of innovation.

2. Re-positioning BT in the Industry and Labour Mobility

The telecommunications industry has been at the heart of the technological and institutional transformations that have underpinned the ICT paradigm. In terms of technological change, the so-called intelligent telecommunications network, whereby software based computerised functions support the electronic processing of digital signals, has been the radical breakthrough that has transformed how communications is organised (Mansell, 1993). Powerful customer premises equipment (CPE) in particular represent a paradigmatic rupture in the evolution of the industry, creating the possibility for users to shape the process of innovation through design configurations based on more open networks (Kavassalis et al. 1996). These developments have laid the basis for an infinite range of diversified services to suit different customer needs.

For firms such as BT, the new technological regime has posed acute opportunities and challenges. The danger for incumbent telecoms firms is that by relying on the traditional source of income; voice telephony and the ownership of the network, the organisation in effect is reduced to becoming a mere *bit transporter* for the value added services of other low cost competitors. As table 1 shows, up to 1999, BT was still far more reliant on its traditional voice business than in value added services. Developing technological and organisational competencies in the area of network solutions therefore represents a key challenge. Technologically this has meant creating expertise in a whole new series of areas such as wireless Internet access, directories and search engines, Internet TV, electronic payment systems, advertising, education and training (Analysis, 1997).

The second major development, opening the industry to competition, emerged as a consequence of a change in regulation policy by governments, which over much of the last century had supported the monopoly status of service suppliers. The UK government in particular adopted what is generally known as a "fast track" privatisation programme (Batt and Darbshire, 1997). With the shorter life cycle of products, BT has been heavily criticised for being unable to keep up with the newer, more agile and more entrepreneurial new entrants. *The Economist* for example lamented, "despite BT's experience in running networks, it lacks entrepreneurial agility, the speed of decision making and the gung-ho culture of investment to match the moves of companies like WorldCom" (4/4/1999).

This criticism emerges from the fact that one of the characteristics of the giant telecommunications monopoly firms in the past was that the routines that arose from the monopoly period were shaped by the overriding objective to provide an efficient universal service rather than a fast roll out of differentiated services. As a consequence, monopoly public telephone operators (PTOs) developed effective but highly bureaucratised routines that upheld detailed operational protocols (Batt, 1995). Hence one of the main problems for the large PTOs such as BT has been to overcome the bureaucratic nature of the former large monopolies.

Incumbent high-technology firms such as BT have therefore faced two main challenges. The first has been to position themselves strategically in the key areas of business growth by developing or acquiring competencies that will generate new streams of revenue through product innovations. The second challenge relates to the changes in organisational structures to speed up the rate at which products are rolled out in response to competition and the faster pace of innovation. Hence, being ahead of competitors is associated not only with devising new sources of innovations, but also having the organisational structures and management capability to ensure rapid deployment and roll out of new products and services.

Labour markets can play a central role in this process of structural change. In particular, the institutions shaping skill formation, industrial relations and labour mobility can facilitate or create obstacles to structural change (Lazonick 1998, Bassanini *et al.*, 2002, Saxenian 1996). This poses the need for a specific analysis of labour markets in the telecommunications industry. Yet over the 1990s labour markets in the telecommunications sector also experienced important changes. As a consequence of the convergence of technologies and the fragmentation of

Table 1 BT turnover 3rd quarter 1999

Fixed voice service	£2.7bn
Mobile services	£1bn
Data Services	£ 597m
Internet Services	£230m

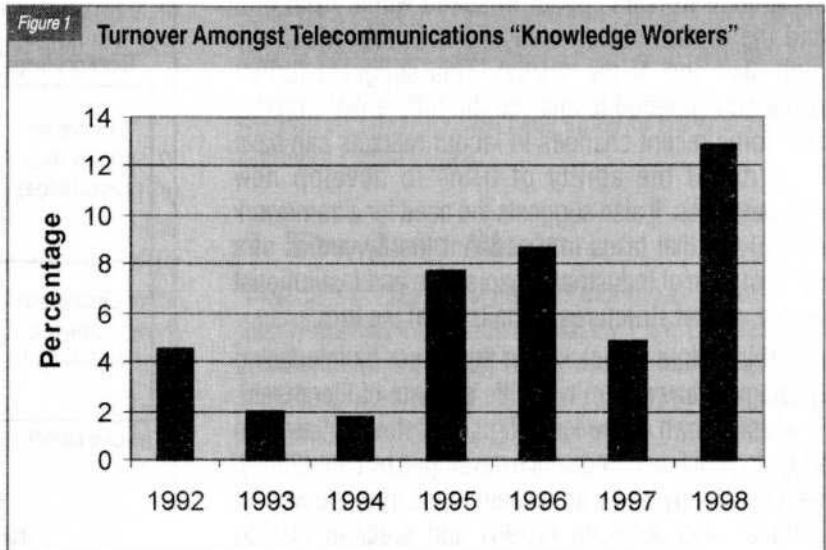
Source: Financial Times, 3/2/2000

employment following the entry of multiple firms into the industry, skills have become more transferable and this has fomented profound changes in the institutional structures regulating recruitment and retention of labour. Various skill types emerging as increasingly key to the industry, for example in the area of software development, are also associated with career structures that emphasize inter firm mobility and more flexible non-standard employment contracts, as evidenced by the growing use of contractors in research and development environments (CWU, 1997). This may have a critical impact on knowledge transfer in the industry. From the point of view of the analysis, it also suggests that institutional change in labour markets may shape the type of structure firms are able to adopt at a given point in time. For example, one of the principal ways in which entry barriers have been reduced in telecommunications is through labour markets by means of hiring staff that have accumulated knowledge of how to operate the network equipment from specialist suppliers (Fransman, 1998).

This example can be added to a burgeoning literature that suggests that labour mobility can be a vital means by which firms and technology systems can expand their competencies through the transfer of tacit knowledge (Saxenian 1996, OECD 2001). However, some studies have also suggested that policy recommendations encouraging inter-firm mobility as a means to advance knowledge flows can be a double-edged sword, particularly if this leads to a very high turnover of specialised labour for firms. Blackler (1995) for example has argued that an institutional structure is required for occupational labour markets to exist so that investment in training for skills is undertaken. Organisations may be less willing to invest in training for niche skills if they are not guaranteed a return from the investment. Hence, a high degree of mobility for employees in vocational education and training can lead to a shortage of investment in training. It has also been suggested that knowledge workers that undertake a great deal of inter firm mobility may "learn" less than those that have longer tenure (Tomlinson *et al.*, 1999). This focuses on the fact that the learning base of firms is largely made up of routines that emerge from learning-by-doing and learning-by-interacting between employees. The difficulty

of transferring tacit knowledge that is not embedded in networks using common protocols and codes of communication is thus emphasized.

The issue of labour mobility is particularly relevant for BT. While a labour market monopsony, BT had no choice but to undertake its own investment programme to acquire new skills. Nevertheless, with the entry of multiple firms into the market, today this is no longer the case and organisations can hunt within a broader national and international labour market for both general and niche skills. Specifying the degree of turnover amongst highly skilled employees in the telecommunications sector is difficult to estimate accurately. However, an approximate calculation using data from the UK Labour Force Survey is illustrated in figure 1. This shows that between 1992 and 1998 turnover amongst telecommunications knowledge workers grew considerably¹.



Source: Developed from the UK Labour Force Survey

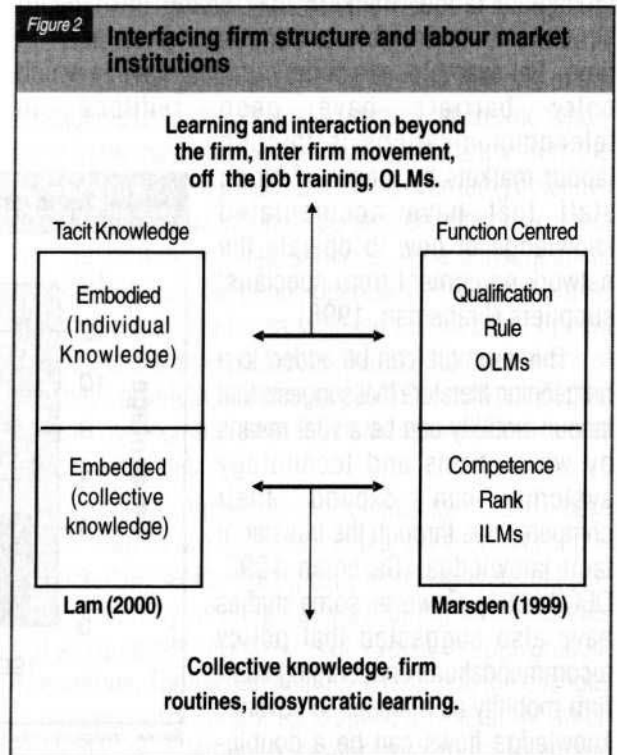
1. The data were collated from the first quarter of the quarterly UK Labour Force Survey for each year. The following criteria were used:
 - a. Includes only individuals that answered that they were Managers, Technical Workers or other Professionals at the time when they were surveyed
 - b. Includes only individuals that indicated that they were currently working in a firm in the telecommunications industry.
 - c. Includes only individuals that answered "NO" when asked if they had been working in the same firm one year ago.
 - d. All missing values were discarded.
 - e. The sample average of knowledge workers in telecommunication for each year was 150. Hence the conclusions are tentative and need to be analyzed in conjunction with other indicators that show evidence of mobility.

3. A framework for changing industry and labour market dynamics

The above discussion has emphasised the need for a reinvention of BT in order to remain competitive. This includes the need to generate new organisational routines that place greater emphasis on product innovation and the faster roll out of new products and services. From a labour market perspective, emphasis is therefore placed upon bringing in new skills and developing more dynamic methods of managing employees, covering areas such as recruitment and knowledge flows. Yet, as has been mentioned, the institutions defining the nature labour markets are also in a state of flux. In particular, increased mobility of knowledge workers can be associated both with the opportunity to expand firm competencies relatively quickly, but also with shorter time some knowledge workers appear to spend within each firm and the growth of non-standard contracts within the high skill end of the market. This suggests further research is needed to analyse the differential impacts that some recent changes in labour markets can have in terms of the ability of firms to develop new competencies. It also suggests the need for a framework of analysis that takes into account the dynamics of a co-evolution of industrial organisation and institutional labour market structures at the level of the firm.

This task is undertaken in this paper by interfacing typologies drawn from two different sets of literatures². The first, shown on the left of figure 2 below, is based on a typology of firm competence developed by Lam (2000). Lam's typology draws some inspiration from the work of Lundvall and Johnson (1994) and Blackler (1995) among others. It is based on the idea that knowledge in the firm can be analysed along an epistemological dimension i.e. tacit vs explicit knowledge and an ontological dimension i.e. at the level of the individual or the collective firm. For the purposes of this paper, two knowledge environments are highlighted. An *embodied knowledge* environment is one where tacit, action-orientated skill predominates. This type of knowledge provides an environment where there is little standardisation of knowledge or work practice. Knowledge therefore remains within the individual rather than within an organisation and relies to a great extent on market know-how and skills that are potentially transferable. This can breed instability within an organisation, as high movement of labour can create

problems of knowledge retention. Organisations reliant on *embodied* type knowledge could well characterise some network type forms of organisation such as Silicon Valley in the US, where there are few institutional limits to labour mobility and the nature of the work in the area relies on rapid problem solving skills. In an *embedded knowledge* environment on the other hand, firm organisation is underlined by systemic routines and a strong common culture. Knowledge is tacit in nature, but it resides in organisational capabilities, combining stability and flexibility of team dynamics. The stability and formality of the structures permits continual and incremental innovations.



Source: Developed from the UK Labour Force Survey

While Lam's (2000) typology focuses predominantly on the firm as a learning agent, Marsden's (1999) typology, on the right of figure 2 draws on a theory of micro labour market institutions and focuses on the role of labour market institutions in influencing work organisation and skill acquisition at the level of the firm. At the core of Marsden's argument lies the notion of the employment contract as a stable means of aligning job demands to worker capabilities and identifying certain rules that can be applied in a wide variety of work environments³. For the purposes of this paper, two distinct

² A fuller version of this framework is outlined in Ramirez (2002),

³ Lam (2000) herself broadened her typology to encompass internal and occupational labour markets.

work environments are of interest. On the one hand there is an environment where the tasks that employees undertake are grouped according to technical requirements arising out of the production needs. Because of the idiosyncratic nature of jobs, qualifications are not a good guide to assignments, hence jobs are often decided according to some sort of internal ranking system, such as seniority, where status depends upon the range and depth of skills of individuals. Hence internal labour markets (ILMs) play an important role in determining the type of training employees receive. Similarly career paths are often based on promotions within the firm and associated to firm-specific skills gained within the firm. Marsden (1999) calls this a *competence rank* rule. On the other hand, in a work environment defined by Marsden as *qualification* rules, assignments are set by identifying competencies required for certain kinds of work and assigning them on the basis of recognised qualifications. Work is organised according to skill requirements and around functions. In this environment, off-the-job training and qualifications are important, hence training is backed up by developed occupational labour markets (OLMs).

The discussion has emphasised that a degree of coherence is necessary between firm organisation and the rules defining the employment system in the firm. The implication is that if, as was discussed for the case of BT, the firm wants to fundamentally restructure its operations, there are likely to be necessary implications for how work rules are defined in terms of job descriptions and how individuals skill sets are developed. This relationship can be illustrated by juxtaposing Marsden's with Lam's typology of firm competence. Figure 2 places Lam's (2000) and Marsden's (1999) matrices side by side and the arrows illustrates the links that would be expected to emerge. The following points outline the basis on which these links are made:

- In organisations reliant on an *embodied* knowledge environment, skill development needs to be dynamic and highly flexible. Firms in this environment will often not have the time to develop in-house skills in new areas. Hence there is a need for institutions that will create clear guidelines within which inter-firm movement of labour can take place, such as recognised qualifications or well developed information peer group networks that can vouch for individual skills. In Marsden's typology, this flexibility is afforded by developed occupational labour markets as described by the *qualification* rule.
- Organisations that rely on collective sources of knowledge and informal non-written tacit type

knowledge structures can be expected to rely on some form of firm specific training structure to develop common dialogues and understanding of firm routines. This would reflect a *competence rank* rule with flexible internal labour markets.

There are three important implications that follow from the framework described in figure 2. The first is that in this case we can define two distinct types of firm organisation that have quite different logics in terms of knowledge flows and institutional structures supporting them. Secondly, a specific form of industrial organisation as described by the left hand typology in figure 2 will be more stable and from the point of view of knowledge transfer, more effective, when supported by a specific labour market institutional structure. Thirdly, the logic of figure 2 is that a change in the dominant firm structure, say from *embedded* to *embodied*, as a consequence of change in the technological paradigm, would also imply the need for a change in the supporting institutional labour market structures. Otherwise a mismatch between firm and institutional structures may emerge. The following section will develop the case study of BT to shed light on these propositions.

4. The Case Study

Most of the data presented in this paper is based on interviews that took place at Adastral Park, BT's research and development (R&D) laboratories in Martlesham. Ten interviews were carried out, the earliest in 1999, with BT employees in the R&D department. Five follow-up interviews were also undertaken. The paper firstly presents a discussion emerging from interviews undertaken with senior managers holding strategic decision-making responsibilities. These provide an overall view of firm level policy and thinking on strategy and human resource policy (HR). This is followed by a discussion of the data collected from interviews conducted with non-supervisory R&D employees, principally developers, designers and engineers on the impact of company level HR policies on their own career prospects and innovation in BT. Material was also collected, including the "Investors in People" document from a leading research department and a series of executive presentation notes from a senior manager describing aspects of BT's research strategy. Data were also collected from *The Manager*, an internal BT journal. It was agreed to keep the identities of all individuals interviewed and department names confidential, so will remain anonymous.

The methods for interrogating the data followed the "Coding" process described by Strauss (1987). This is a

methodology whereby codes or subheadings are formed to link raw data fragments such as paragraphs, phrases or sentences from the interviews and documentary evidence to key concepts and themes. The identification of codes and themes was based on the theoretical propositions laid out in the framework presented in figure 2. The next step involved outlining a description of changes in the innovation process, including changes in industrial organisation over time, using evidence from interview data with managers and documentary evidence. Subsequently detailed information was analysed relating to the nature of changing work organisation, career development patterns and firm level employment systems in BT. Documentary evidence and descriptions of labour market institutions was also provided.

Accelerating product life cycles and intra-firm mobility

Although today it is a private corporation, BT's strength in the market place still lies to a great extent on its tradition of providing an efficient, reliable service and the scaling up of technology for its giant communications network. However, as was discussed earlier and as a senior manager in BT's research department below points out, the routines BT developed to maximise performance in the context of predictable changes in technology during much of the 20th century, have become totally unsuitable for the nature of technological change today where, as well as reliability, speed and diversity in the roll out of innovations are of essence:

"the average time to launch something at the minimum was 18 months to 2 years. It was nonsense, because by the time you finished launching it, the thing was obsolete. So internally there is a view that we had to have a radical rethinking in our systems".

BT responded to the demand for faster roll out of new technology by adopting a series of organisational innovations in an attempt to reduce the bureaucracies and long drawn out processes that characterised its routines in the past. As far as research and development is concerned, these initiatives included focussing on the design rather than the building of goods and increasing the synergies between developers and designers at different stages in the development lifecycle of the product. These measures mirror initiatives that have been adopted in a wide range of industry environments, that break away from developing products and services sequentially and adopt an iterative method, with permanent exchanges of information between the relevant actors, starting from the

stage of conception⁴. In this sense, the first significant organisational innovation that emerged from the interviews relates to an attempt by BT to encourage designers and developers to follow their ideas out of the confines of the laboratories via secondments and exposure to other departments of the company. The manager cited above points out:

"It's one of our policies to push people through the business. If someone has an idea, we would like that person to do the research, take that idea into development, take that idea into field trials and deployment and then come back perhaps for the next generation of the product. If this worked they would be so valuable to the business because they know something from beginning to the end, they know what's it's like to try and launch science and support things".

The effort to encourage the spillover of knowledge between different areas of the firm through intra firm movement of labour aims to leverage the vision and experience of researchers throughout the organisation. Individuals following through the development of services act as key co-ordinating agents of knowledge, sharing the tacit knowledge of different departments. However, given the firm specific context in which the dissemination and exchange of knowledge exists, the tacit knowledge generated from the exchange of information also improves existing firm routines. Using the terminology of Lam (2000), this emphasises firm specific knowledge and can be related to an *embedded* type of knowledge environment.

Broader innovation and inter-firm mobility

A second significant organisational change picked up in the interviews, arose as a direct consequence of the more diverse technological structure of the telecommunications industry. The fragmentation of technologies and the emergence of multiple specialised equipment and software suppliers have enlarged the technological choices and options for the introduction of the same basic service. The R&D process has in consequence become less predictable and the "make or buy" decision more complex, with greater emphasis placed on understanding and transferring knowledge from suppliers rather than

⁴ See for example Chapter Three in Kline and Rosenberg (1986) and Aoki (1998).

necessarily developing new knowledge in-house (Fransman, 1998).

Firms such as BT that own large networks made up of mixed generation technologies are therefore being forced to develop broader competencies to keep up-to-date with a rapidly accelerating range of technological options. As a consequence, the labour supply for advanced telecommunication services draws in a broader scope of skills from that traditionally developed within the ranks of the core researchers. BT has undertaken a series of human resource initiatives to develop these broader competencies. The first of these involves direct recruitment of highly skilled scientists and engineers into the company. A senior manager in the research department comments:

"We need as many perspectives on what is possible. Some we can get from within the company, but they are shaped by company culture and thinking. So we get people in from across the industry and business, short-term fellow schemes of people to work with researchers. This is a relatively new policy. The reason is because the skills were becoming out of date. We believe the half-life of a degree is 3 years".

Similarly, a senior HR manager in the research and development department comments:

"The speed with which the market moves sometimes means you cannot re-orientate people sufficiently in that time. To suddenly switch that number of people is very hard and you don't get advance warning that it's coming. When you go into a new market area where we haven't been in before you may need expertise in that particular area, that you can buy in, use and once you're in there you decide. Maybe you will leave there".

BT therefore is recruiting a greater number of knowledge workers directly into high grades from outside the firm. This is because scientists and experts based on disciplines beyond those traditionally linked to telecommunications, i.e. physics or chemistry, are being drawn into telecommunications. A second factor is that outside recruitment can bring a new "vision" and wider perspective to the firm of how to develop products and to combine this with the skills and thinking of internal people. A third issue is that in some cases the speed of change, in terms of new markets and technologies is so fast and unpredictable that the organisation does not have the time to re-train to develop competencies from existing employees. Significantly, the risky nature of some of these new ventures leads the firm to favour a looser relationship

with employees, who can easily come off the pay roll if an investment proves to be short-lived. Finally, there is an indication that the shorter product life cycle can leave knowledge and skills out of date. Hence greater labour turnover and movement of individuals in and out of the firm is not as damaging as it might have been in a period where projects were of a longer duration.

The discussion so far has highlighted two broad challenges facing BT. One is to speed up the pace in the roll out of new products and services, the second to develop the competencies necessary to generate valued added services. Two broad initiatives involving changes in the division of labour have been referred to. Encouraging employees leading innovations to follow through their new projects between different departments in the firm aims to encourage synergies in the initial phases of development. As mentioned earlier, this very closely describes an *embedded* knowledge environment. On the other hand, senior managers have suggested that a greater movement in and out of the firm of high skilled employees may be an important means by which BT can acquire the flexibility and broad competencies to generate new products and services. This type of structure mirrors that described by an *embodied* knowledge environment.

These twin pressures are consistent with the previous discussion regarding BT's role in the telecommunications industry. On the one hand, BT has to cater for a mass market that focuses on organisational synergies to speed up the rollout of new goods and services, product resilience and system wide process innovations. On the other hand, BT is facing an enormous challenge to shift the focus of its R&D operations, from product resilience to customisation of value added services. This can best be achieved by introducing and continually renewing new sets of skills and entrepreneurial talent.

Following the logic of the framework illustrated in figure 3, this almost schizophrenic role of BT, where it has to adopt different strategies, and as a consequence different structures within the same departments to cater for different types of markets, has a number of important implications. BT appears to be attempting to work with quite different organisational structures, that as figure 2 suggests, have contrasting implications for labour markets in the firm. While an *embedded* knowledge environment is supported by internal labour markets and firm specific knowledge, an *embodied* knowledge environment requires the institutional support of occupational labour markets to encourage knowledge flows of labour between firms. The question that arises is how well can a large firm such as BT accommodate these tensions and support different

incentive structures, if indeed they do exist? The discussion therefore turns to the labour market institutions and the experience of R&D workers themselves.

Combining Incentive Structures in BT

The scenario of intra firm labour mobility and temporary secondment of R&D staff within the internal BT supply chain was raised as part and parcel of the attempt to increase the degree of communication and sharing of tacit knowledge between different departments. However, although secondment was identified as a major company initiative, when the idea of temporary secondment of developers and designers was raised with a number of project managers in R&D, there appeared to be a great deal of scepticism as regards its viability. One project manager in a department rolling out new telemarketing products commented:

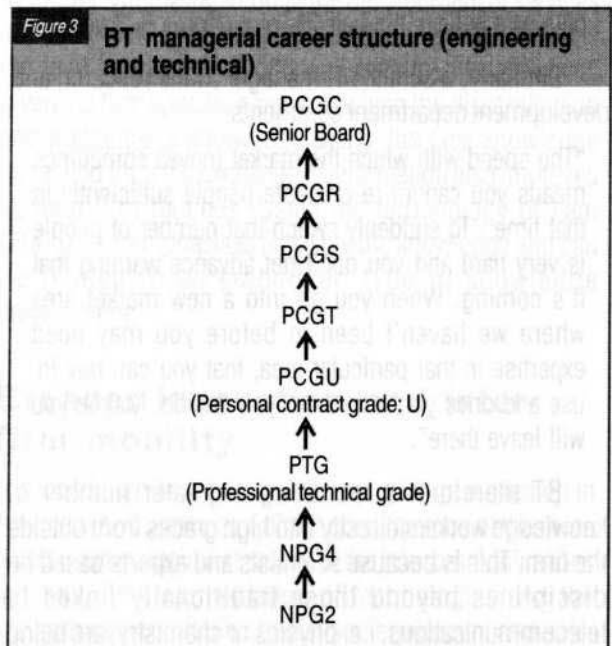
“Secondment is a nice theory and there is a lot of talk about secondment, in practice it rarely works. Typically a project will last 6 months, you take somebody out for 3 months and things have changed a lot. Things are moving too quickly so that it doesn't quite work, its such a schism, that there's an awful lot of re-building that has to go on afterward to synchronise the person back into the team. Plus individuals aren't keen to do it unless they are far sighted enough to see it as enhancing their career; it's just a nuisance. I know of very few cases where it has been done” (emphasis added).

Secondment is an important concept that has clearly been discussed, but appears to face two problems. Firstly there is the short-term nature of projects. The concept of *embedded* knowledge emphasised the importance of stable teams, the knowledge of which is imbued with a wider company culture. However, in firms moving rapidly between products and projects, although teams play a key role in problem solving, the most important knowledge agent is the individual, that can move rapidly between teams, contexts and even workplaces. This provides the firm the flexibility to move resources into new projects as and when required. In the case of BT, despite the attempt to provide longer-term support for products, the relatively short nature of each project and the pressure to move on to new areas makes it difficult to provide longer-term resources for each new products and service.

The second obstacle lies in the apparent lack of enthusiasm of individuals to embrace secondment, because intra-firm mobility is not seen as furthering

employee's career paths. This suggests that there is a high opportunity cost for employees to long-term support for products and the development of firm specific skills that this implies. Consequently the discussion focuses on the career structures of employees and in particular the incentives for progressing through internal labour markets and building firm specific skills.

The apparent absence of a career path for R&D employees willing to develop and follow through innovations in BT appears contradictory at first glance. The BT managerial grade structure is shown in figure 3⁵. It reveals both technical (up to PTG) and supervisory steps of a hierarchical promotion structure through which management grades can climb as part of their career development. This structure is in fact very similar to the internal labour market inherited from the old monopoly civil service, where direct recruitment to high grades seldom occurred. Opportunities still clearly exist for career advancement within the firm. In fact R&D employees with long tenure in BT interviewed confirmed that they had worked in many different departments within the company.



Source: Interview with Society of Telecom Executives (STE) official⁶

Nevertheless, the limitations of the BT career path in the current technological paradigm become clear when seen in relation to how it impacts individuals developing technologies and innovations. The vast majority of

5. All BT permanent R&D employees are on management grades, irrespective of supervisory responsibilities.
 6. The STE, the BT manager's union, changed its name to "Connect" after the interview was conducted.

employees at BT's R&D facilities lie on the grades of NPG2 and NPG4. These are essentially technical scales. PCGU and above are managerial grades in the sense that they involve supervision over other staff and responsibility for projects. This means that the prospects of promotion along a technical career path are a great deal more restricted than the supervisory path. A part of the pay award is determined by performance rating. However, given the promotion structures, most employees with 10 years in Adastral Park will have reached the top of the technical scale. Largely in response to this and to stop employees with advanced technical computing skills leaving the company, BT set up the professional technical grade (PTG) grade in the late 1990s that increased salaries by roughly 20%. This was in recognition of the importance of retaining technical skills in the company. Nonetheless, the more limited career opportunities for purely technical grades suggests that it is the supervisory, managerial and organisational skills that the firm considers as the key firm specific knowledge agents in contrast to the technical grades.

Numerous comments regarding the limitations of the BT career grade structure were provided by those knowledge workers interviewed. These views highlight the increasing difficulty BT has had in attracting a layer of younger employees to commit themselves to a longer run career in the organisation at the time of the interviews. A young telemarketing software designer with 5 years experience in BT makes the point:

"There is a clearly defined career path, but it's managerial. The next step up is to manage more people, but not doing any technical work, so if you want to do technical work there is no career path there. I think there is just too much emphasis on being a manager, there's no career path if you want to be good technically, you'd soon come to an end on that path. When you have a corporate review of your performance, innovation is on there, but it's not very high. What is really rated is communication skill, how much can you convince everyone else in the unit how good you are, if you do that you get a high mark".

Similarly an Internet expert comments:

"There is a career ladder in that there are grades that one can be promoted to, it doesn't in that there are no specific processes that if you go through will get you promoted. We don't have something that says once your performance in these particular areas is competent, then you're promoted".

However the appeal of internal labour market structures for career development is influenced not only by the nature of the internal promotion ladder. It is also influenced by the opportunity costs, i.e. the risks and rewards inherent in developing a career outside of the firm through inter-firm mobility. Particularly during the height of the telecommunications boom in the late 1990s, this option became increasingly viable and attractive for the best skilled staff. This can be illustrated firstly in relation to pay grades amongst peers. Salary ranges for management grades⁷ in BT lie between £18,000 and £38,000⁸. Yet this is well below the wages both contractors receive and competitors in the software, telecoms and banking industry were offering in terms of remuneration. In this context BT will clearly struggle to lock in its younger and best skilled R&D staff, particularly as skills appear to be highly transferable. Underlining the impact that mobility of knowledge workers can have in the firm, a senior manager in the Research department comments:

"We're tending to lose (in research) about 2% a year through turnover. At meta-level, the organisations BT looks at are old suppliers, Marconi, GEC, big technology companies and here our benchmark pays well. But in R&D, our competitors aren't those people any more, they are Silicon Graphics, Nortel, Banks and we lose people hand over fist to start-up companies. Our guys who developed the best in the IP world all left and trebled their pay. Our best security guys went to a bank, doubled their pay and got a free house. BT cannot match that. You have to accept two realities. Firstly you have to have a more short-term view, which to some extent is not a problem, half-life of a degree is about three years. On the other hand the movement out does create problems. A lot of the guys that come from university now are very keen on their CVs. BT gives training but we are not converting so much of it into product now" (my emphasis).

A career option for employees interested in developing innovations outside of the normal BT career path has also emerged through the so-called *Bright-star incubator*. This initiative was aimed at providing promising employees an incentive to develop product innovations emerging from BT patents through the creation of a start-up firm linked to BT. During the course of the interviews it was reported that BT had some 1200 patents laying on

⁷ All BT contracted R&D employees are formally on management grades, even if they have no supervisory responsibilities.

⁸ Based on 1999 figures.

the shelf not being exploited, suggesting some stifling of entrepreneurial talent within the organisation. The so-called *Brightstar* Incubator⁹ was set up by BT as an attempt to overcome this problem by tapping into the skills and initiatives of R&D employees. Ostensibly the initiative provides the opportunity for groups or individuals with promising projects to create start-up firms on-site and attract outside venture capital. In so doing the normal BT supply chain process is detoured and individuals who are willing to take the risk are given the opportunity to reap large rewards by creating a new firm. While in the incubation period, BT continues to fund the researchers' salaries. However, after the start up is launched, it becomes independent, although BT retains a stake in the new company of between 25% and 50%. *Brightstar* therefore represents an institutional innovation that aims to encourage a more diverse industrial structure and a more entrepreneurial culture of innovation around the company. However this process also ties in to providing a career option for the most talented and promising skills in BT. As one of the BT employees involved in a *Brightstar* initiative comments:

"The Brightstar incubator is based on the recognition that maybe the traditional routes of trying to get the technology downstream weren't working. So this was a way of avoiding the normal rules of BT product development. So you have to give up your secure day job with steady pay to become the part owner of the new company with a technology you are passionate about and potentially make millions".

Commenting on his career prospects within BT prior to the launch of *Brightstar*, the above researcher made the point:

"Number one priority for my job has to be something I get motivated on, something I'm interested in. But also very much how useful those skills are going to be to me in my career progression. A year ago I was trying to progress up the technical career ladder. For me the problem in BT has always been that once you get to PCGU you have to leave the technical side and move on to the managerial career. Becoming a PTG is slightly higher profile but that's about as far as I can go on the technical grades. I became an NPG2 9 years ago, and that's typically how long it would take people to work their way up to, almost to PCGU"¹⁰.

⁹ Incubators of the sort set up by BT have been previously established by firms such as Hewlett Packard to encourage entrepreneurial skills.

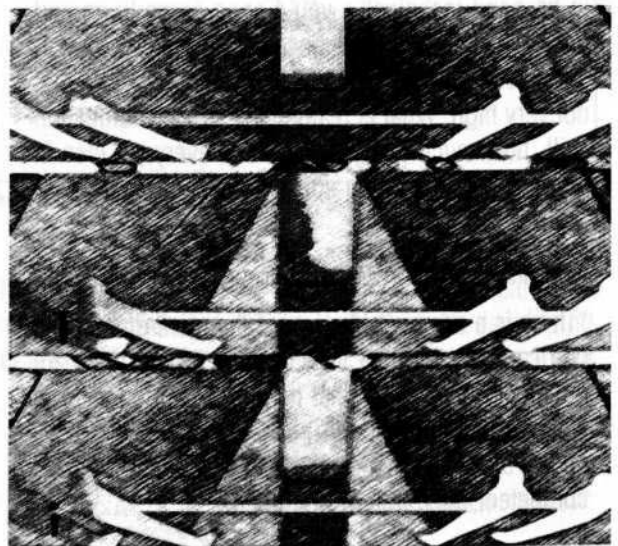
¹⁰ See figure 4 for BT career grades,

Clearly *Brightstar* offers an alternative career path for the brightest individuals. Although this option may involve a long term separation of BT with some of its best technical staff, by maintaining the new spin-offs on site, BT can potentially tap into the tacit knowledge of its ex-BT staff and raise the profile of Adastral Park as a high technology centre, attracting other knowledge workers and innovative ventures. This suggests that the Incubator has a dual role. One is to by-pass the normal, longer and more bureaucratic route of product development. Secondly, to encourage the most talented researchers to develop innovations that are in some way linked to BT in the context of the limited career opportunities for individuals developing potentially important technological innovations in BT.

Although this initiative can be seen as a means to inject some new radical ideas and innovations into the organisation, the incubator represents a completely different organisational structure, restricting knowledge spillovers into BT. The following point was made regarding the move to the incubator:

"One of the things that changed upon moving to the incubator (was that) the free flow of ideas on site has been restricted, now we don't really want to talk to people as much as before. There is a vested interest in making sure you keep the ideas to yourself because in this environment it is the ideas that are the driver, while before the currency was good relations with the rest of the business, which was based on an inter-flow of ideas".

The implications are that the release of entrepreneurial talent involves creating a different structure of organisation with separate rewards and incentives for the best talents. This is best met outside of rather than within the firm.



Widening the use of contract labour in R&D

As mentioned earlier, changing labour market structures is also associated with the growing use of contract labour in high skilled environments. Overall the number of contract and agency staff in BT increased from 1000 in 1980 to 21727 in 1997 (CWU, 1997). BT's policy has been not to use contract labour in the Research department. However in the Development department their use has become more widespread. Contract labour, by its very nature, would tend to be associated with a relatively narrow set of clearly definable skills. The ability of contractors to offer clearly recognisable and transferable sets of skills determines their relative position and strength within the labour market. Given their relatively narrow set of skill sets, it would be reasonable to assume that contractors would be brought into BT's R&D area to undertake a set of very specific technical tasks requiring less firm specific knowledge, particularly when there is surge of demand that cannot be covered by permanent labour.

Conventional wisdom would also indicate that the nature of the employment contract creates a different set of incentives for the contractor than the permanent employee. Permanent staff may well be encouraged to improve product quality in order to enhance their promotion opportunities and general standing in the firm. The temporary nature of the employment contract for contract staff might be expected to encourage contractors to meet deadlines rather than improving product quality and at a personal level to follow a career strategy based on acquiring new skills.

It appears however that this is not always the case. The view of the line manager interviewed clearly indicates that contract labour does not negatively impinge on any aspect of innovation output. If anything, there appears to be advantage to using contract workers to carry out even those jobs traditionally associated to permanent labour. The line manager comments:

"There are 40 contractors in at the moment in this area. The main advantages lie firstly in that some of these people are very good, to be honest a lot of the contractors are better than a lot of our permanent staff. Part of the reason for this is that, well, they became contractors because they had enough "get up and go" and they must have courage and fortitude. You also have to bear in mind that a lot of our contractors have been with us for quite a long time, they tend to get involved in the work for years on end, and they

earn fat salaries. So many are longer term and have put down roots. I don't have problems with the use of contractors, except that they're pretty expensive, the idea of using a resource centre that is systematically managed works fine for me. They give me flexibility that I can hire and fire from a managed pool".

Significantly, both the formal skill profile and more tacit firm specific knowledge of the contract workers was not judged to be a great deal different from that of permanent staff. Many of the contractors had BT specific skills because they had been on the BT payroll in the past.

Nevertheless interviews with permanent contract BT designers working on projects with contractors cast some doubt on this managerial view. Responding to a question on whether in his experience the project teams were affected by working with contractors, a designer comments:

I've worked in teams where I have been the only permanent member of staff, and that has not worked well. The difference is that at the end of the day the contractor is motivated by the next contract he can get, and that is determined by the skills he's got and so he's more interested in developing skills than products. A lot of contractors, if they're stuck on a job for six months, they can find themselves pigeon holed and they wouldn't be able to get a job doing anything else but that. So you find if you get a lot of contractors en masse, trying to deliver software by a certain time to a certain standard can be extremely difficult. The other factor is that there is no performance review for contractors, no pressure to say you've done a good job, we're going to give you more money or promotion. Contractors give the company flexibility to get rid of people quickly, but it doesn't mean you will get better software because there are these motivation problems, where they have an interest in developing skills that are not necessarily related to the project, because you can put it down on your CV and it will get you that next contract".

These comments highlight the dangers of relying too greatly on short-term labour at this level. Clearly the incentive mechanisms associated with the employment contract play a key role, although it is significant that in spite of repeated questioning on the same theme, the problems signalled by the above employee were not picked up by the more senior project manager interviewed earlier. In fact it appears that BT is considering the more widespread use of numerically flexible labour, including in particular contractors.

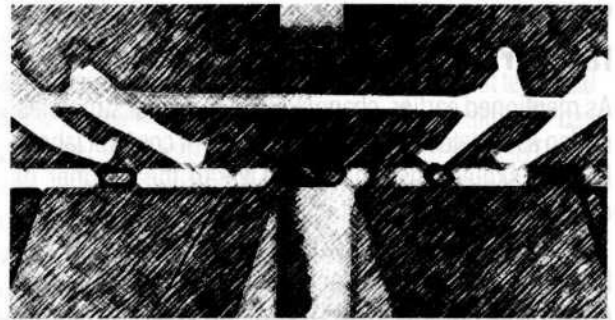
Summary

The discussion has highlighted two contrasting trends apparent in BTs organisational structure. The first trend emphasises the development of specific routines and synergies to speed up the pace in the roll-out of new products and services. In Lam's (2000) typology it emphasises an *embedded* knowledge environment. Hence the importance of collective or firm specific forms of knowledge needed to enhance firm competencies and speeding up the roll out of new services for a mass customer base was emphasized. The interviews also confirmed the view from managers that organisational innovations that resemble the *competence rank* rules in Marsden's matrix were being introduced. This stressed intra-firm mobility and secondments of employees within the firm to follow through specific innovations.

A second distinct and dominant trend was underlined by a move to an *embodied* knowledge environment. This was associated with rapidly broadening firm competencies and combining firm specific with market knowledge. Investment in the re-training of researchers in new knowledge areas was accompanied with a policy encouraging outside recruitment. This allowed competencies to be developed more quickly than internal re-training permitted. More flexible options to encourage employees with marketable innovations to set up their own firms outside of, but linked to, BT were also encouraged through the Incubator. Similarly, the growing use of contract labour in innovation projects underlines the more arms length relationship a growing number of employees are having with the firm.

The discussion however also emphasised the difficulty BT was experiencing in developing these dual organisational structures, partly because of the contrasting incentives this implies for employees. In particular, the opportunities for inter firm mobility of labour amongst the highest skilled knowledge workers was such, that BT initiatives directed towards reinforcing firm specific skills, such as secondment of researchers to follow through innovations, were not generally taken up by the most talented and skilled staff. BTs difficulties in locking in the best entrepreneurial talents were reinforced by the limited promotion opportunities for technical as opposed to supervisory management grades. This emerges from the formal hierarchical grade structure that large firms such as BT inherited from the past and are required in such large organisations.

The discussion therefore underlined the difficulty in exploiting fully firm synergies and organisation learning associated to an *embedded* system of firm organisation,



because of the un-viability of, using Marsden's terminology, the *competence rank* system amongst the best skilled employees. By contrast, the trend towards establishing looser and more flexible ties between the workforce, as evidenced by the higher turnover and use employees on non-standard contracts, appears to be in the ascendancy. This emphasises the dominance of a *qualification rule* environment in Marsden's typology, linked to an *embodied* organisational structure.

Conclusions

Overall the case study and framework emphasised the important role that labour markets can play in shaping firm competencies. In particular, the case study supported a key proposition that flowed from the framework, that in the current technological paradigm, firms embarking on new strategies to change the nature of their competencies, require changes not only in the division of labour, but also that the labour market institutions within and outside of the firm are coherent with the type of knowledge transfer associated to particular firm structures. In particular, strategic changes in innovation strategy need to take into account how they implicate employees' own strategies of skills and career formation to be effective.

The need for BT to maintain a stable and committed workforce imbued with the knowledge of the organisation and its ways of functioning is acknowledged by managers and many existing employees have been re-trained and are highly respected in the new knowledge areas in which they work. Nevertheless, it is also apparent that labour mobility is a growing trend, particularly amongst the most skilled and younger entrants to the labour market. This is a phenomenon over which even large firms such as BT have little control.

The key question that emerges is what impact might this trend towards looser and more flexible ties with the workforce have for the ability of firms to develop different types of innovation? As has been discussed, the greater movement of researchers in and out of firms, far from

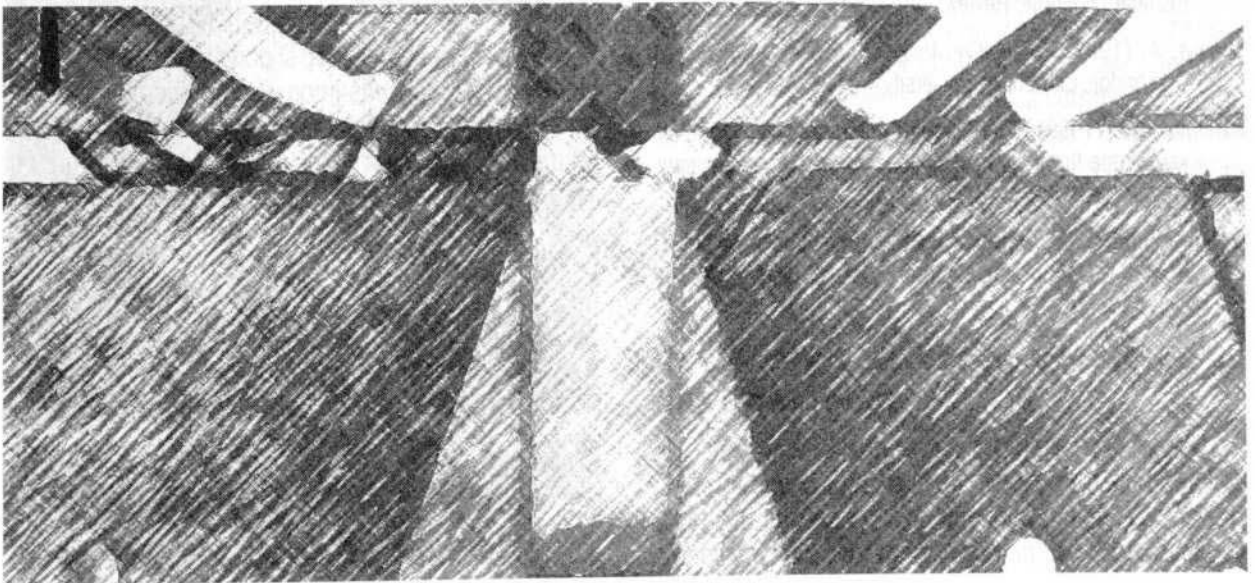
debilitating the firm's knowledge base, can act as a means to diversify a firm's knowledge base, allowing firms such as BT to be more responsive to rapid changes in the market in the context of the shorter life span of technologies. In particular, if BT is able to attract more start up ventures around Adastral Park, it may be able to create a dynamic network of skills around which it can renovate its competencies, much in the same way that for example Intel was able to do in Massachusetts around route 128 in the USA during the 1990s. Hence the labour market can help to redefine firm competencies.

Nevertheless, the implication of the case study is also that BT's ability to develop essential competencies reliant on long-term team building and firm specific knowledge may be undermined by the greater mobility of labour and shorter time that skilled staff spends on each project. This is highly relevant for process-type innovations associated with product support and product resilience that still play an important role in the telecommunications service sector.

Thus from a broader policy point of view, the deregulated nature of the UK labour market, the absence of a common apprenticeship programme accepted by employers and employee bodies and the highly transferable nature of skills may have some negative long-term consequences. This issue has been flagged up by a number of authors such as Prais (1995), Walker (1993) and Steedman and Wagner (1989) as a major weakness of the UK economic system. This emphasises the importance of seeing labour markets as an integral element of the national system of innovation and the developing the policy implications that flow from this.

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