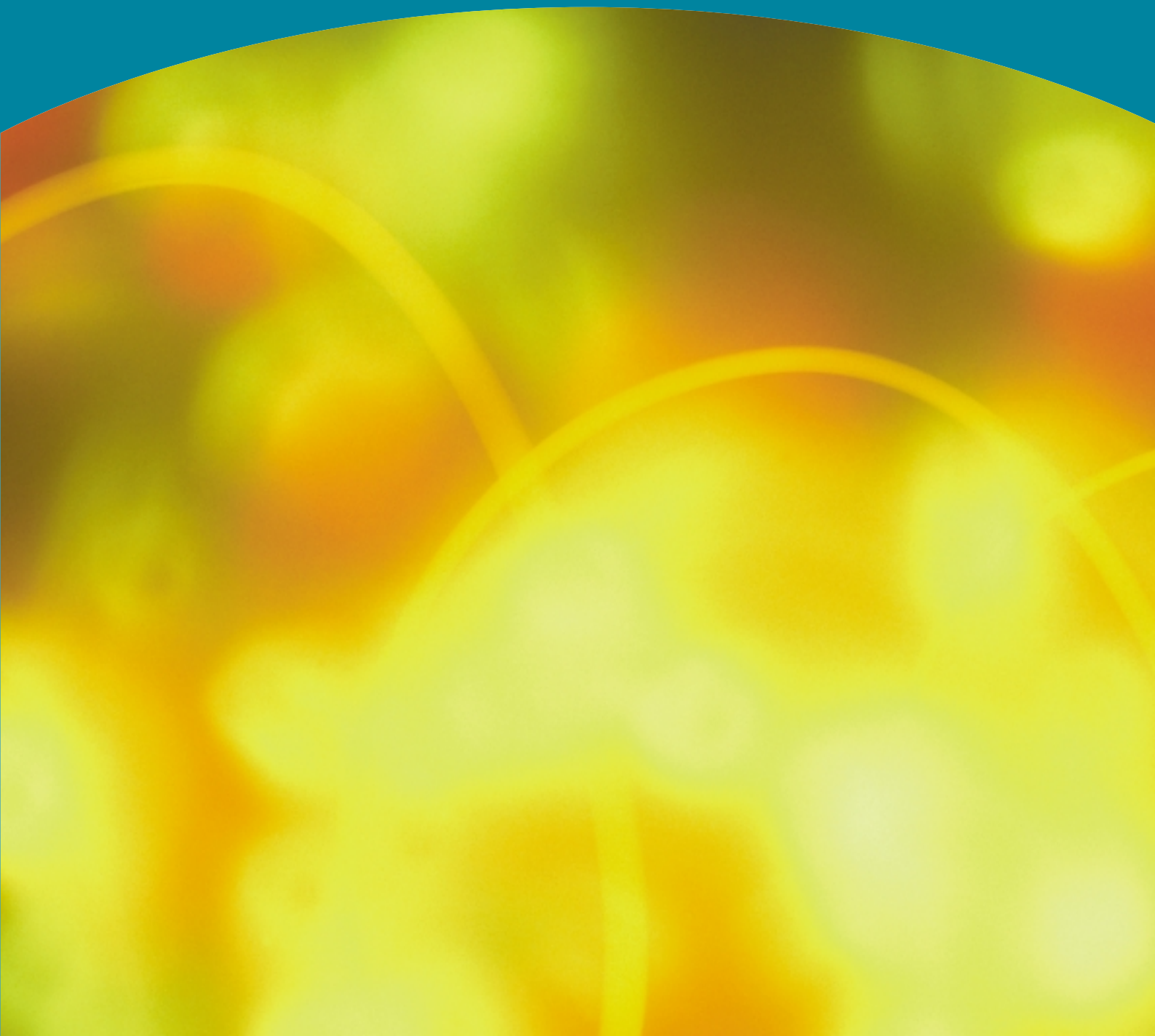
Employers Skill Survey:
Case Study
Telecommunications Sector



EMPLOYERS SKILL SURVEY

Case Study - Telecommunications Sector

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FOREWORD

The Secretary of State for Education and Employment established the Skills Task Force to assist him in developing a National Skills Agenda. An important part of this remit was to provide evidence on the nature, extent and pattern of skill needs and shortages and their likely future development. The research evidence assembled by the Task Force was summarised in *"Skills for all: Research Report from the National Skills Task Force"*, published in June 2000.

An important contribution to the evidence was made by a major programme of new research. This included two employer surveys, detailed case studies in seven different industries and a review of existing surveys. We are grateful to all those who participated in this research and so contributed to the work of the task force. This report provides more detailed information on one element of this research. Details of associated reports are listed in the rear of this publication.

It should be noted that the views expressed, and any recommendations made, within this report are those of the individual authors only. Publication does not necessarily mean that either the Skills Task Force or DfEE endorse the views expressed.

Contents

EXECUTIVE SUMMARY

Overview

This report aims to provide a detailed assessment of skill needs and the extent and impact of skill deficiencies within the UK telecommunications sector.

Telecommunications is a global industry, in which firms are forced to operate at the leading-edge of developments, and upgrade products and services constantly to the highest world standards. In this industry, there is no room for laggards, and firms could not survive for long, by under-performing and lowering their aspirations to accommodate a low skills base.

Nevertheless, firms have significant skill problems. The industry is changing rapidly under the combined impact of technological and market change, and the effects of deregulation. This has led to a reconfiguring of the industry value chain, in which:

- The basis of competition, and what constitutes successful performance, has changed.
- The idea of a 'high added value' strategy has shifted.
- The skills to deliver a successful strategy have changed, as the product-market rapidly evolves.
- Skills themselves are migrating between segments along the value-chain.

The result is a series of 'skill gaps', in which the transformations wrought by technology and shifting markets require different skill-sets. Firms have 'legacy' or 'inherited' skill-sets, which do not match current needs. Such 'gaps' are widespread among firms, since the new combinations of skill ('hybrid skills') are not commonly found within the labour market. Many basic technical skills are also in short supply. Thus, although firms aim to develop 'hybrid skills' among their existing workforce, it is also an industry problem that transcends the individual firm.

The problem is compounded by the fact that it is impossible for firms to be sure what a 'winning strategy' will look like. Major firms are competing to deliver the same services in different ways through alternative technologies, and to deliver competing services whose eventual relative uptake is uncertain. Timing investments in skills is therefore fraught with uncertainty. As a result, firms are emphasizing speed and flexibility in developing skills and how they deploy them.

Three things, therefore, mark out telecommunications from other sectors - the high level of skills; the fact that 'recruitment difficulties' are a real, inescapable part of the industry 'story'; and the fact that 'skill gaps' are industry-wide.

Product-Market Strategies

The ten cases provide a cross-section of the telecommunications sector - from hardware equipment suppliers, through fixed network carriers and organisations supporting these (such as installers), specialist service providers (including Internet service providers (ISPs)), and mobile telephony. This vertically integrated supply/service chain is fundamental when considering products and markets in the sector, and the skill needs and issues that flow from this. Developments in one part have major impacts on firms in other parts, and knock-on effects on how firms configure themselves and the skill-sets they need.

The three principal drivers for change - technology, changes in markets, and deregulation - result in an emphasis on the following:

- Open Solutions (to build on 'legacy' systems, and allow for the future convergence of technologies).
- Falling technology costs (which mean price is not enough to compete on).
- Reduced employment in running networks.
- Constant innovation.
- Speed.
- Turnkey solutions (from equipment suppliers to network operators).
- The importance of marketing.
- Building customer volume.
- Customer service.

Firms, in all parts of the value-chain, face moderate-to-high market uncertainty. At the same time, hardware suppliers and installers, and those providing specialist services, are also faced with high product complexity, since they offer customised solutions and problem solving. For network operators, on the other hand, product/service complexity is lower, because they provide a service in which reliability and simplicity are basic requirements. However, the increase in their range of services raises their overall level of product complexity, while niche operators target services at specialist user-groups.

All firms also work with a high level of technical skill. Market uncertainty and product/service complexity, however, mean technical skills need to be broader and more flexible, with more awareness of market need. The overall effect of these competitive pressures and product-market strategies is that:

- Firms need hybrid skills that combine different areas of technical expertise.
- Firms need hybrid skills that combine technical expertise, an understanding of the telecommunications market, the business acumen to know what products have market potential, and customer-relations skills.
- Changing sets of activities and the changing roles of firms vis-à-vis one another mean that new skill-sets are necessary and cannot be easily bought off the shelf from the education system.
- There is increasing demand for some of the more specialised technical skills.
- Computing-related (software) skills are paramount and becoming ever more important.
- Speed of change means individuals need to be flexible and open to continuous learning.
- Organisation structures and cultures need to be flexible and responsive to facilitate learning.
- The rate of growth of the industry means that more skills of all kinds will be needed, and quickly.
- 'Soft skills, such as communication and team-working, have become increasingly important in highly technical environments, where specialists need to work across boundaries, and also in businesses that have a strong customer interface.

These requirements are consistent across the sector, although emphasis does vary between firms in the different segments. In addition, the evolution of the sector, through the emergence of new small firms and the growth of broad-based multinationals, creates special competitive dynamics and generates size-specific skill requirements. Successful small firms grow rapidly, putting pressure on their internal systems and their ability to recruit and train. Management skills then become critical. For large multinationals, the effect of increasing scale and internal complexity means a wide range of skills in increasing numbers. This puts a premium on skills that involve working across boundaries, whether inside the firm (project management) or with outside partners (alliance management).

Nevertheless, it remains impossible to evaluate strategies in terms of 'sustainability', other than in general terms. The world's multinationals are themselves engaged in elaborate alliances and investments to hedge their bets on technologies and how customer markets will evolve. It is reasonably clear there will be significant convergence, and the winners among the network operators will be those who establish seamless worldwide connectivity. But how far this means inter-connectivity between fixed and mobile networks and with the worldwide web, and the timing of this, is a matter of intense debate. The 'business model' that will deliver sustainable success is therefore as yet uncertain.

Within this overall context of change, most of our case companies appear to be developing strategies that are on the right lines. In the case of the relatively large population of small installers, the variety of technological solutions and different kinds of customers and applications allows considerable scope for installers to pursue niche, specialist strategies. This is their strength, and their weakness.

More generally, the future of UK telecommunications, as an indigenous industry, is likely to be determined by the success of incumbent firms in forming powerful alliances, or themselves pursuing aggressive acquisition strategies.

Production Processes

Skills need not only to be adapted to the requirements of product-market strategy, but also managed and organised well to make effective use of them. The emphasis on hybrid and broader skills suggests that successful firms will be those that organize people effectively in teams, encourage teamwork through their culture, and develop team skills. Consequently, we find that:

- Large companies are shaking up their corporate structures to create greater flexibility, improve speed of response in uncertain markets, and develop integrated solutions for complex design problems.
- The supervisor/first line managers role has changed in many of the large firms, with an emphasis on teamwork, particularly in technical/professional areas:
- People generally are expected to have broader skills, and, in particular, flexible attitudes and a willingness to learn.

While large firms and new small start-ups are increasingly built round multi-skill and team-working principles, older small firms, however, have often yet to move beyond a basic functional structure and a more old-fashioned management model. This inhibits their speed of response and limits their market focus.

Much of the criticism of skill deficiencies centres on attitudinal factors that are an important element in 'hybrid skills'. 'Soft skills', like communication and teamworking, have become increasingly important in technical environments, where specialists need to work across boundaries, and in businesses that have a strong customer interface. Similarly, attitudes are important in start-up and fast-growing firms where 'fit', flexibility, risk-taking, and willingness to learn are essential. The emphasis on non-credentialed aspects of skill reflects this, especially among firms that are closest to the market, where changes are most rapid.

Skill Needs, Recruitment and Skill Deficiencies

In a situation of rapid change, firms find it impossible to plan their business strategies with any confidence beyond 2-3 years. This means **skill requirements** need to be managed in broad terms, not in detail. Nevertheless, the character of these skills is reasonably clear. Knowledge of the industry, and the implications for skills, is well disseminated. The problem is one of predicting volume, managing timing, and delivering the required skills in sufficient quantity.

The report makes a broad distinction between critical skills, high-level traditional skills, and volume skills, and focuses particularly on critical skills. These are classified in terms of (a) specialist technical skills, (b) cross-disciplinary, hybrid technical skills, (c) software skills, as a pervasive, underlying component of both these, (d) hybrid skills, combining technical and business elements, and (e) business and management skills.

While the research focus is on 'skill deficiencies', firms clearly face considerable **recruitment difficulties**, and have substantial requirements to recruit additional skills, which are not being met. Demand, in a booming market, is far outstripping the supply of skills. This derives in part from the supply from universities, where insufficient students (according to the companies) are taking appropriate courses, and courses themselves find it difficult to be sufficiently up-to-date where companies are at the leading-edge of developments. The real problem, however, is the entry of many new firms, in a short space of time, because of market growth opportunities. While this raises the overall skill level in the long-term, the short-term effect is poaching, job-hopping, and spiralling wage costs. Among other factors affecting their ability to recruit, companies are acutely aware of the effect of company image.

Companies are pursuing a wide range of solutions to deal with recruitment difficulties, the most common and important of which are:

- Increased graduate recruitment.
- Building better links with the Higher Education system.
- Improving company image.
- More flexible pay structures.
- Emphasising the whole employment package, to preserve existing pay structures.
- Employing contract labour (at premium rates).
- Recruiting abroad, and in other industries than telecommunications.

The list of initiatives suggests a high degree of pro-activity across the sector - more especially among the large firms. The majority of companies see high quality recruitment as an imperative at all levels, as the basis for enhancing skills, and pursuing high added value product strategies.

However, the threat of multinationals relocating key areas of technology because of difficult-to-recruit skills is a concern. Where multinationals are organised around worldwide centres of expertise, they make assessments about the local availability of skills, and decide where to locate on the basis of skills, not whether to compete.

Skill gaps can be conceptualised in three ways, according to the life-cycle of firms and the sector - (i) changes in technology and markets can create a general need for new skills which are not immediately available, either in the firm or market; (ii) older firms can have a problem of obsolete specialist skills; and (iii) younger firms often have to develop more formal management processes and new management skills, as they move from an entrepreneurial to mature stage.

Our sample comprises older large firms, older small firms, and young new firms, and the industry has a high proportion of relatively new firms. While changes in technology and markets create common problems, other skill gaps can be related to the development trajectories of firms. There is a big difference between fast-growth new firms, who face the pressures of rapid expansion in employee numbers, and the small firm that simply lacks a long-term perspective and the management skills to take the business further. A large number of the SMEs in the sector, set up to exploit niche markets, are of this latter kind. The successful new firm, on the other hand, is not facing a skill gap as such, but the effects of rapid recruitment. Their management issues are also not the same as in larger firms. The smaller firm needs managers who can bring discipline, through functional and job-specific skills, whereas the larger firm needs to turn specialised technical staff into broader business managers.

These differences aside, the big issue for the sector is the requirement for new skills and new combinations of skill, which neither firms nor the education system can readily supply. The real 'skill gaps' lie with hybrid technical skills, hybrid technical/business skills, and business/management skills. All imply broadening experience by in-company training and career development moves, and as such are a company responsibility, although recruitment philosophy and the education system can make some impact on them. All our companies acknowledge significant skill gaps in relation to these hybrid technical and business skills, along with a continuing need to upgrade software skills. Most are addressing these actively through:

- High quality recruitment as the basis for enhancing skills.
- More extensive liaison with universities and with the education system generally.
- Extensive training of graduates (in large firms).
- Extensive training of professional employees.
- 'Crash' courses for existing employees in new skills.
- Use of certificated training.
- A culture of continuous development and learning.
- Use of commercial HR packages to give improved information for monitoring and reacting to skill gaps.

Because of the uncertainty over developments in the industry, however, the fundamental problem, in addressing skill needs through training, is timing the development of new skills, and knowing whether those skills will be needed at all. As one respondent put it:

> "Why haven't we begun retraining earlier? It's not so much a question of cost, but what do you retrain for? As an industry, we are entering a market that is not defined. It's not like designing a new car where you know its requirements. Our industry is changing day-by-day, month-by-month."

Skill Gaps: An Assessment

This study suggests the ten case companies generally have a very clear perception of what is necessary to compete successfully in the rapidly changing world of telecommunications. Their perceptions of the skills needed to deliver these strategies, and the changes these mean in occupational and generic skills, and in employee attitudes, also seem highly appropriate. Nevertheless, all clearly acknowledge significant skill gaps. The range of responses to develop skills would also indicate they are serious in addressing these gaps.

Is there any evidence, however, of performance differences on account of skill deficiencies and skills strategies? While many of the cases are leading firms internationally and in the UK, it is difficult to say there is a correlation between their business performance and their skill strategies, or that some firms have 'sustainable strategies' and others do not, even though there are strong *prima facie* reasons for believing this is so. The reasons for this lie in the present state of change in the industry, where the success of even the most admired firms is not assured.

For most commentators, the major difference between firms in telecommunications, as in many other sectors, is between large and small firms. The problem of a 'sustainable' strategy for the older small firm is a result of the very thing that ensured initial success - concentration on establishing a niche. The skill gap is about not having a broad enough management base. Technical skills recruitment and training may be excellent. But the perception of the market and the ability to influence it is limited by size and, often, by preoccupation with its own technology.

Ultimately, the 'low skills equilibrium' argument sees the UK's skills problem originating in the quality of recruitment, which provides a poor basis for continuing upgrading of skills. The attitude of the case companies is very positive on recruitment, and high quality recruitment is seen as an imperative for enhancing skills as the industry continues to move on.

The interaction between recruitment strategy and skills is, therefore, in general very positive. Almost all firms have raised their entry requirements, and consequently have a better base to build new skills on. What they emphasize is the need for a partnership between firms, education, and government as the basis for an effective skills strategy, to ensure students are attracted into the industry, and that university curricula adapt quickly.

1. AIMS AND CONTEXT

1.1 Aims of the Study

The overall aim of the research programme is:

> **"to provide a detailed assessment of skill needs and the extent and impact of skill deficiencies in key sectors of the British economy".**

There is a presumption underlying this, that parts of the UK economy have under-performed over the years, because they have lacked skills and have adapted by pursuing commercial strategies which are low added value, or sub-optimal. In consequence (according to this hypothesis), some firms and some sectors have got locked into a low-skills equilibrium. Such firms/sectors may, as a result, have skill deficiencies of which they are almost unaware.

An assessment of skill deficiencies, therefore, needs to consider firms' strategies in the light of trends within the markets in which they operate, and how they define, resource and deploy skills, which allows some firms to pursue leading-edge business strategies. A counter-hypothesis can therefore be stated along the following lines:

> **Better performing firms will have identified sustainable product strategies, and developed effective skill strategies for resourcing these.**

However, there is a problem with the 'under-performing' firms hypothesis in that the language and assumptions largely derive from established sectors. In this model, the terms of competition are known; winning strategies can be defined in terms of 'low added value' and 'high added value'; and the requirement for competing in high added value markets is assumed to be higher levels of skill of a known kind. In new emerging sectors, a more dynamic model is needed to explain the processes of skill formation (Finegold, 1999).

This is especially true of the telecommunications sector, where the basis of competition has changed and continues to change, and with it the notion of what constitutes successful performance, and where the market is undergoing radical reconfiguration, so that what is 'high added value' is shifting. The result is that the skills to deliver a successful strategy are changing as the product-market rapidly evolves. As these shifts happen, skills themselves migrate. This raises questions about the appropriate unit of analysis. Should it be the firm, or the sector (or even inter-sector, as skills in many sectors overlap)? A preoccupation with individual firms pursuing high skill strategies risks ignoring systemic effects, which affect the migration of both high-level and low-level skills. These issues can be illustrated with examples from the telecommunications firms in this study:

- **The basis of competition, and the criteria for successful performance, have changed.**

  > "We have always had a reputation for building equipment to 120% specification. Quality has been a watchword. But the world moves on, and what the world is looking for now is equipment that will do the job, but is provided in double-quick time." (Director of Learning Strategy, Telco 2)

  Is this - one of the world's top firms - going down-market? Clearly not - it simply means other performance criteria have come to the fore.

- **The market and value-chain have been significantly reconfigured.** This affects firms all the way along the value-chain. It undermines previously effective strategies, and creates opportunities for new firms that are not encumbered by existing cultures, mind-sets and skill-sets. At the hardware end of the chain, firms are moving forward to provide 'total solutions':

  > "Under the renewal programme, our objective is to proceed up the value chain to provide total solutions. Our customers have told us they want to see both competition and cooperation among their suppliers and partners, as they do not wish to become trapped in an inflexible relationship, nor with a particular technological form." (Telco 1)

  This puts pressure on firms elsewhere in the chain. Telco 10, for example, built a leading position in the UK and world markets, selling call centre monitoring and management information system software to equipment manufacturers (such as Siemens and Ericsson), for incorporation in their products. The manufacturers have now started to develop their own software, however. Telco 10 has therefore had to change its strategy and deal directly with call centre operations, in order to understand their emerging needs, develop new products, and sell to them as end-users.

  Both examples require new ways of working through project teams; engineers with commercial skills, who are less technologically-driven; and stronger specialist marketing skills. These, though, are not 'higher' skills, but different skill-sets.

- **The product-market is rapidly evolving, and an effective strategy may have a short life.** Telcos 6 and 8 are among the new breed of firms that are creating new fixed infrastructures for telecommunications. Both recognize they have a short 'window of opportunity' to lay down the physical capacity (in the one case, radio, in the other, fibre optics), before they have to develop 'product' and services through these networks to generate continuing revenue in the future. The skills strategy which got them started - a focus on technical skills (in Telco 6's case, among the highest in the industry) - will have to give way to business management and marketing skills, and a more structured business culture. The mobile phone company, Telco 7, has already gone through a similar transition. Again, it is not an issue of 'higher' skills, but different skill-sets.

  The first firms to market were quick to assemble skills by external recruitment. Those who survive - that is, have 'sustainable product strategies' - will now need to develop skills that are not necessarily 'higher' or more sophisticated, but appropriate for their stage of development.

  A successful firm, moreover, may not even be one that survives as an independent entity. Many of the developments closest to the end-user are being pioneered by small new firms. It is very likely that large established firms will acquire such firms, in order to buy their way into these markets and acquire the skills that have been built up by these pioneers.

- **Skills migrate across firms.** In a vertically integrated industry, there is migration of both high-level and low-level skills. This is a normal learning process, but is especially marked when technology is evolving rapidly. It is a characteristic of sectors like telecommunications and engineering, but less so we suggest, of hotel and catering, the public sector, and food manufacture. For example:

> "In three years time, 50% of the work we are currently doing as a unique service, which is absolutely cutting-edge and for which we are charging the earth, will be old hat, and handled by junior programmers in our customers' IT departments. You could say they are outsourcing their own skill problem to us. Our core capability is helping them to do so." (Telco 9)

Conversely, as large equipment manufacturers, like Telcos 2 and 3, "proceed up the value chain", they are increasingly outsourcing lower added value component production, as the industry matures and such production becomes more reliable. With this, however, comes a recognition that "we have to manage the skill-sets outside our business, in order to fill the deficiencies there" (Telco 3). The notion of 'skill deficiencies' or 'skill gaps' is, therefore, not a simple matter of firms' failing to invest in skills, but an industry systemic issue. If attention focuses on individual firms that pursue high skill strategies internally, it risks ignoring these systemic effects.

A 'sustainable' strategy needs, therefore, to be understood as a dynamic concept that takes account of sectoral change and the life-cycle of the firm. Clearly, in every example quoted, there are 'skill gaps', as firms need to adjust to change. But it would be a mistake to assess these solely in terms of firms' own shortcomings, without constant reference to the forces reshaping the whole industry.

Part of the problem in telecommunications is that it is impossible to be sure what a 'winning strategy' will look like. Major firms are competing to deliver the same services in different ways through competing technologies, and to deliver competing services whose eventual relative uptake is uncertain. As a result, the emphasis is on speed and flexibility, in both the skills to be developed and in how they are deployed. In these circumstances, what differentiates the better-performing firms are their processes for identifying skill requirements, how imaginative and comprehensive their responses are, and their ability to function as learning organisations. We need to apply process measures of performance, rather than simply measuring them by the 'quality' of their skills.

1.2 The Telecommunications Sector: Key Product and Labour Market Issues

This report is concerned with the UK telecommunications sector. This is a global market, and will become even more so as other countries follow the path of deregulation pioneered by Britain in Europe. Total industry revenue is growing at twice the rate of the world economy, and was predicted to increase from $650 billion to $1 trillion during 1998 (BT, 1998). Telecommunications is fast becoming the largest, most competitive and dynamic market in the world. Europe has the largest share of this, with an estimated 31% of revenues generated, compared with 27% for the USA, and 12% for Japan.

This story of growth and exploding competition on a global scale points to two factors that immediately mark the sector out from many others. It is a global industry, and firms know they need to operate at the leading-edge of developments.

Throughout, in our case studies, there is a strong awareness of the need to upgrade products and services constantly to the highest world standards. There is no room for laggards, and in this industry the notion that firms could under-perform by lowering their aspirations to accommodate a low skills base is untenable. As Ian Lorimer, MD of the Telecommunications Vocational Standards Council (TVSC), put it, "such firms would go out of business very quickly in this industry". The rate of change

in products and services is so rapid, that any firm lacking ambition and innovativeness would be found out within months, not years. For example, the product life-cycle of mobile phone handsets is currently reckoned to be just seven months (Walcot, 1999). In other words, we are unlikely to find firms operating with a 'low skills/low added value strategy', since they would be unable to sustain this for long in some kind of equilibrium state isolated from other firms.

Nevertheless, in such circumstances of growth and change, firms do have significant skill problems. The transformations wrought by technology and shifting markets require different skill-sets, and generate 'skill gaps'. These **'skill gaps' arise within firms as 'legacy' or 'inherited' skill-sets, which do not match current needs.** This affects in particular the traditional public telephone operators, with their fixed line telephone networks that are slow-growing, costly to maintain, and under threat from new channels such as mobile telephones. There cannot be a network operator worldwide, though, who does not appreciate this problem, and it is a constant subject of consultants' reports and the regular *Financial Times'* reviews of the sector.

Many such operators have sought to adapt by developing other forms of network (such as mobile telephony), and running other services through their fixed networks in addition to voice by enhancing the carrying capacity of the network. Telco 5 has done both. The fact that it still has a 'legacy' skills problem is in part dictated by regulatory obligations on it to provide a national fixed network, and restrictions preventing it entering certain new markets, in the interests of competition. Arguably, then, this is not a skills issue, but a problem of market positioning, due to regulation, technological change, and new markets opening up.

For many years, Telco 5 has recruited and trained people at a high level of skill relative to the industry, and many others have fed off the skills it has produced. It therefore does not lack skills, but has had to acquire skills in new areas, whilst maintaining large numbers of traditional skills to deliver its core business. This balancing act is exacerbated by having to generate sufficient revenues from a relatively protected core business, in order to please shareholders and invest in new technologies and services (Doward, 2000). If it is perceived as being slow to innovate, it may not be because of skills, but because it naturally wants to time the introduction of new services to suit its commercial interests. Elsewhere in this report, other companies highlight this problem of timing in innovation and shifting focus, with all the costs entailed, as the critical strategic issue.

Alongside 'legacy' skill gaps, there are other 'systemic' gaps, which transcend the individual firm. Such gaps are widespread throughout the telecommunications labour market, where firms need new combinations of technical skills ('hybrid technical skills'), which are not commonly found within the labour market, and where the basic building blocks for many of these new skills (such as IT, radio telephony, and photonics) are themselves in short supply. Consequently, most firms are preoccupied with 'recruitment difficulties' that are impossible to ignore. At the same time, 'hybrid technical skill' gaps reflect an industry-wide issue that could be said to transcend the individual firm, even though all firms in the sample recognize the problem and are tackling it in some degree (mostly by developing the skills of their existing workforce).

Three things, therefore, mark out telecommunications from other sectors - the high level of skills; the fact that 'recruitment difficulties' are a real, inescapable part of the industry 'story'; and the fact that 'skill gaps' are industry-wide and, to some extent, can also be considered systemic.

2. INDUSTRY CONTEXT, CASE STUDIES AND METHODOLOGY

2.1 Industry Structure, Occupations and Employment

The following facts and figures are derived from a report in March 1999 by the TVSC - the Telecommunications National Training Organisation. SIC Code 64.20 lists 31 areas of activity relevant to telecommunications. Drawing on the Business Database 1998, the TVSC estimates there were 4,051 companies in the UK, employing 225,100 people, with a further 18,000 employed in the Armed Forces. Another 1.5million people are estimated to operate telecommunications equipment as a major part of their job.

The largest number of companies in this total is 'mobile telephones' (with 892 companies). As there were only four major operators with national licenses, there is clearly a vast hinterland of small companies supporting their activities in various ways, which inflates the overall total. The next largest group is 'telecommunications equipment' (877 firms), followed by 'telecommunications consultants' (694) and 'telecommunications engineers' (476). The equipment manufacturers and consultants/engineers are each represented by three case firms in the study, with data communications systems (at 307 firms) represented by a seventh firm.

Inevitably, the vast majority of such firms are SMEs, and the rapid growth in type and sophistication of services has increased their number. On the other hand, employment is dominated by BT, with 119,000 employees - over half of all civilian employees. The choice of case studies needs to reflect both ends of the scale.

SOC codes do not break down into specific telecommunications activities. A mapping exercise of jobs commissioned by the TVSC produced an alternative list of six key technical job areas, and distribution of employment among these:

Job sector	Employees	% of total
Fixed wire public and private communications	70,000	29.0
CATV (cable TV)	38,000	15.6
Mobile public and private communications	50,000	20.5
Military and marine communications	18,000	7.5
Information technology	40,000	16.4
Information technology services	27,100	11.0

The bulk of jobs in the first category (fixed wire public and private communications) can be assumed to be in BT, while 'mobile' is the fastest-growing area of employment, in an industry growing at 10% a year across Europe. The pace of change in employment and skill categories can be gauged from the fact that, for half of all listed occupations, there are no staff who have been in post for more than five years (TVSC, 1999:16), and 50% of all employees are under 30 years of age.

2.2 Case Studies and Methodology

This report is based on ten in-depth cases studies, of UK firms and UK operations of foreign multinationals, plus background interviews and an extensive reading of the literature on the sector. For the case studies, the research team used a common interview schedule, derived from the overall research programme, covering the following areas:

- product-market strategy and competition
- knowledge and skill needs
- skill availability and external recruitment difficulties
- internal skill gaps and skill development
- future developments likely to impact on skills

This structure was used in writing up the cases, and the report follows broadly the same format.

The number of people interviewed ranged from four in the smallest organisation to fifteen in the largest. In multi-site organisations, interviews were conducted at corporate HQ (including the R&D centre) and at one or more major operating sites. These were widely distributed around the UK. Interviews typically included staff from a range of business functions (including marketing, engineering, operations, research, and HRM) and at different levels in the hierarchy. At Telco 7, for example, six interviews were conducted at one call centre with three customer services managers at different levels, a team supervisor and a help-desk manager, and other staff were interviewed in HR, engineering and customer services at three other sites.

The length of finished cases averaged around 40 pages. Negotiating access and setting up company visits from April 1999 onwards was time-consuming (but not untypical for this kind of work), and fieldwork was conducted in June, through July and September 1999.

The ten cases provide a good cross-section of the whole telecommunications sector, and ensure a wide-ranging picture of skill needs and issues. They cover the whole gamut of activity across the industry - from hardware equipment suppliers, through fixed network carriers and organisations supporting these (such as installers), specialist service providers (including Internet service providers (ISPs)), and mobile telephony. We excluded satellite broadcasting from the definition of telecommunications, although the increasing convergence of technologies and markets is likely to bring this within the overall definition before long. Indeed, BT now refers to itself as a “global communications group”, and no longer as a “telecommunications operator” (BT Annual Report, 1999).

The industry’s vertically integrated supply/service chain is fundamental when considering products and markets in the sector, and the skill needs and issues that flow from it. Developments in one part have major impacts on firms in other parts, and significant knock-on effects on how firms configure themselves and the skill-sets they need. We relate the analysis closely to this throughout the report.

Appendix A describes the industry’s structure, and how the cases were selected to represent it. Appendix B provides some basic information about the companies, while Appendix C highlights some of the problems and issues facing them. For simplicity, we group the cases as follows:

A. Hardware equipment suppliers (including installation and maintenance)

Telco 1 - network transmission systems, through SDH and photonics
Telco 2 - broadband data/voice networks
Telco 3 - wireless telephony systems
Telco 4 - supply, installation and maintenance of fixed network systems

B. Network Carriers

Telco 5 - backbone and local loop fixed network operator (also ISP, mobile phone operator, and business solutions provider)
Telco 6 - local loop radio access network operator/Internet service provider

C. Mobile Phone Operators

Telco 7 - mobile phone operator

D. Specialist Services

Telco 8 - fibre-optic system management for other carriers
Telco 9 - testing telecommunications software and hardware
Telco 10 - call centre management information systems

One of the aims of the research programme was to develop **case comparisons**. There are three ways of looking at this - in terms of segment, size, and stage of growth.

In the event, the first of these - **comparing firms within product-market segments** - proved difficult to achieve. Apart from the time pressure to gain access and conduct fieldwork, in telecommunications there is a problem, that in many parts of the sector there are few firms nationally that can be directly 'matched', and those that do compete in the same 'product-market' do so with fundamentally different technologies and services. The following comments illustrate the problem of 'matched comparisons', and give a sense of the overall industry structure.

Although the three large multinationals that supply telecommunications equipment compete to some extent in the same technologies, their facilities are spread around the world. In other respects, they compete by offering quite different technological solutions. The result is the UK cases cover areas of technology that are not directly comparable, and require different technical skill-sets. As complex, multi-product businesses, any direct comparisons of performance would also be impossible, without extensive, privileged access. What is interesting, then, is that such dissimilar businesses should highlight a number of common skills issues (to do with 'total solutions', project management, and 'hybrid skills').

The equipment installation company, Telco 4, on the other hand, is one of a large number of small UK firms doing such work, and one of the biggest. Other small firms declined to participate because of the demands the project would make. However, research by a doctoral student of the first author of this report (Spedale, 2000) has produced case studies of four small installers (as well as two component manufacturers), which we draw on for purposes of comparison.

The problem of matched comparisons is greatest in the case of the network operators, where there is only one fixed national ('backbone') network operator in the UK. Cable & Wireless and the major cable companies, who might have offered a contrast, were engaged in complicated mergers during summer 1999, and declined to participate. Cable & Wireless was also undertaking a radical shift in

its strategy, to become a specialist provider of telecommunications services to businesses. In the 'local loop', Telco 6 competes with cable companies, but serves small businesses, not residential customers, and uses a different technology (radio access). Since the failure of Ionica, it is virtually unique, but illustrates a type of provision (high speed, broadband Internet and Intranet access) that will become increasingly significant as the Oftel regulator forces the 'unbundling' of the local loop from Telco 5.

Mobile telephony is represented by one firm (Telco 7). Although there are four mobile phone operators in the UK, two were involved in major acquisitions and declined to participate, and the other preferred us to look at its core business, rather than its mobile operation. Nevertheless, we comment from time to time on the perceived strengths and weaknesses of the four incumbents.

The remaining area (specialist services) comprises firms that reflect the diversity in the sector, including small firms that support the operations of larger companies.

While some comparisons are possible, therefore, on the basis of product-market segment, the requirement to achieve coverage of a sector that is complex, the absence of UK comparators for 'matching', and the difficulties of making judgements about the efficacy of skill strategies, mean that the study is strongest in providing "a detailed assessment of skill needs and the extent and impact of skill deficiencies" across the sector as a whole.

On the other hand, the sample lends itself readily to comparisons by **size** and the related **stage of growth**, being split equally between large firms and small-medium enterprises (SMEs):

- Four are large multinationals with worldwide interests (Telcos 1, 2, 3, 5), and origins going back to the beginnings of telecommunications.
- One is a large new UK firm, now expanding internationally (Telco 7).
- One is a medium-sized old-established firm (550 employees) (Telco 4).
- Three are small (below 100 employees), although one is growing very rapidly (Telcos 6, 8, 10), while one is twenty years old, and the others less than two years old.
- The final firm has 500 employees overall, but only around 70 in its telecoms business which developed in the mid-1990s (and is therefore classed as a small firm) (Telco 9).

The majority of firms in the sector, in fact, fall into the SME category, and their needs have been the focus of particular attention from the sector NTO (TVSC, 1999). Skill and performance issues that are peculiar to large and small firms will therefore be introduced, where appropriate, into the analysis.

While it is difficult to develop valid performance comparisons at firm level, certain firms have a reputation for excellence. All ten companies have shared in the rapid growth of the sector in terms of **business performance** - although with some mixed fortunes - and many are among the leaders in the sector, nationally and in some cases globally.

Telco 3, for example, lost its world No. 1 position in the late 1980s, in part because of exposure to the financial crisis in South-East Asia, but has now recovered profitability after implementing a major programme of change. Its manufacturing in the UK, meanwhile, has remained fast-growing, and it is the UK's 7th biggest exporter. In two other large companies (Telcos 1 and 2), major acquisitions and disposals make year-on-year comparisons difficult, but have strengthened both companies, with Telco 2 a world leader and Telco 1 beginning to recover its former prestige.

On the other hand, Telco 4 has suffered from static sales and uncertainties about its strategy (although it now has ambitious growth targets); while Telco 10 has also been growing below the market rate, having failed to appreciate changes taking place in its market. Both these firms, nevertheless, are among the most successful in their market segments. Telco 9 is a somewhat old-fashioned, technical company, but is highly profitable, with skills that are recognized as leading-edge. All three of these smaller firms (Telcos 4, 9, 10) have made recent management changes to strengthen the business.

Two others (Telcos 6 and 8) have only been operational for one year, and though their initial service launch has gone well (with Telco 8 in particular seeing spectacular employment growth), it is too early to say whether they are successful, long-term businesses. Indeed, the mobile phone company, Telco 7, has only become profitable in 1999 in its 5th year of operation - a typical trajectory for a start-up in this industry, where the need to achieve high volume business also means a high initial investment.

Telco 5, meanwhile, is among the UK's biggest and most profitable companies, but attracts constant, often negative, scrutiny. Compared, though, with its continental European counterparts, it has succeeded relatively well in reinventing itself as a modern telecoms company.

Finally, given that these are generally successful companies, it does raise the question whether the sample is biased towards high-performers. However, as a number have had problems, it would be more appropriate to see them as firms who want to learn and improve, and are active in taking steps to remedy their problems. Indeed, firms that are tackling change are arguably likely to tell us more about 'sustainable' strategies in a changing industry, than those who have been historically 'high' performers.

3. PRODUCTS, PROCESSES AND MARKETS

3.1 Trends in Product/Service Demand

The UK industry has shared in the expansion of world demand. Over the last 15 years, expenditure on telecoms has grown by more than 90%, compared with a 40% increase in total consumer expenditure. In 1997/98, the turnover for UK telecommunication services was approximately £24bn. The three major growth areas are data, mobile telephony, and the Internet:

(1) **Data communications are growing** at the rate of 30% p.a. BT's published accounts show that data communications have now overtaken voice communications over its network. Moreover, costs for transmitting data are coming down much faster than prices, and profit margins (for the moment at least) are vastly greater than for voice traffic - making this market more attractive to operators.

(2) During 1999, **the number of mobile phone subscribers in the UK increased** by 1.87m (in January-March) and 1.91m (in April-June), and accelerated further during July-September to reach a total of 19,544,000 subscribers by October 1st 1999. By July 2000, this figure had reached 30.5 million. All four UK operators have shared in this explosive growth. Our case company, Telco 7, increased its subscriber base by 800% over the five years preceding this study, and is currently the fastest-growing operator in the UK market. Mobile phone use was expected to reach 35% of the UK population by the end of 1999 - instead, by July 2000, it was over 50%.

(3) **Internet traffic is doubling** every 9-12 months. Its growth was a major reason for BT's profits growth in 1998-99, with the Internet accounting for 18% of local call minutes (BT Annual Report, 1999).

3.2 The Main Drivers for Change - Technologies and Markets

A clear understanding of the technology and market drivers in the industry is essential for appreciating the skill issues that firms face. There are three principal drivers:

(1) At one end, **technology is pushing forward** and creating new possibilities, through greater bandwidth, 'packet-switching', and Internet protocols (IP). These increase the capacity of fixed and mobile networks, and hence the services that can be carried - especially the ability to carry both voice and data. Rapid advances in digital and radio technologies have brought a convergence of technologies (telecommunications with computing) and the services that can be delivered (data and voice, with video and entertainment)

(2) At the other end, **new markets are opening up**, which both drive and are driven by changing habits of communication among individual and business users.

(3) Holding the ring in all this and significantly affecting the pace of change is government **(de)regulation**. The granting of operating licenses in the UK and the obligations put upon the operators (especially BT as the legacy incumbent) influence the development of markets as well as the rate of adoption of new technology. Deregulation and the opening up of markets also have a significant international aspect.

Appendix D provides a summary of technological and market developments, and their consequences. These are extensive and indicate the complex competitive environment firms face. In brief, they include:

- **Advances in digital technology (ATM and SDH).** Traditional network carriers, like BT, have invested heavily in these. As a result, the traditional telephone system is now more like a giant mainframe computer, relying on 'smart' algorithms to route calls.
- **Internet protocol (IP) networks.** IP networks provide a significant cost advantage over traditional switched services.
- **Asymmetric Digital Subscriber Line (ADSL) technology.** This increases the capacity of traditional copper wire in the systems of firms like BT and allows it to carry data and other added-value services, such as multimedia, at comparable speeds to optical fibre.
- **The Internet explosion.** This is changing the traditional market of telcos (telecommunication companies), with data transmission becoming more important than voice.
- **E-commerce.** The Internet opens up a range of other possible services, such as e-commerce.
- **Mobile phones.** Voice traffic has migrated significantly to mobile phones, which has seen explosive growth in its customer base and usage.
- **A customer focus.** Greater choice in facilities has led to high turnover of customers ('churn'). Mobile phone companies especially are affected by this 'churn', as customers change providers to get the latest mobile handsets. This has led to a shift of emphasis among all network operators, from providing value through technology to developing a customer focus, with better customer retention and new services.
- **Customer care is both mundane and expensive.** Customer care and customer satisfaction often come down to simple things (getting faults dealt with quickly, clear pricing, no mistakes in billing). Call centres have become vital to the customer interface, and employ large numbers of people. They are therefore a large expense.

3.3 Strategic Choice and the Sources of Competitive Advantage

These drivers for change impact on the strategies of the case companies and the competitive factors they stress:

- **Open Solutions.** The convergence of technologies and competing systems, and the need to fit new technologies to 'legacy' systems in which heavy investments have been made, means that equipment manufacturers and installers emphasise 'open solutions' (Telco 4), 'open frameworks' (Telco 3), and 'unified networks' (Telco 2) - that is, systems to which other bits can be added without a fundamental redesign.
- **Falling technology costs mean price is not enough to compete on.** There is a close parallel with the computing industry, which for decades has followed 'Moore's law', costs halving and capacity doubling every 18 months. Thus, costs continue to fall rapidly as bandwidth capacity rises in major step functions. Price is, therefore, not something that firms can base their strategy on - they need to pursue innovation, quality, and above all, be first.
- **Reduced employment in running networks.** New technologies (such as SDH) have a direct impact on the cost dynamics of networks, allowing 'carriers' to reduce employment in operating the network.

- **Constant innovation.** Firms need to be constantly innovative in developing new products, higher value services, and new revenue streams, as products and services become commodities. Thus, within a year of starting up, Telco 8 already sees itself moving from being "a commodity reseller of high capacity bandwidth, to offering management services for the network".
- **Speed is critical.** Firms need to move fast - whether creating a network and customer base for mobile phones (Telco 7); building a high speed Internet and intranet system for SMEs and home workers (Telco 6); or building a high capacity network for other telcos (Telco 8). Product development times have dramatically shortened:

  > "Within the Internet Protocol industry, we are trying to get product quicker to market - as everybody is. A development programme for an older product would have been three years. It is now down to about nine months." (Telco 2)

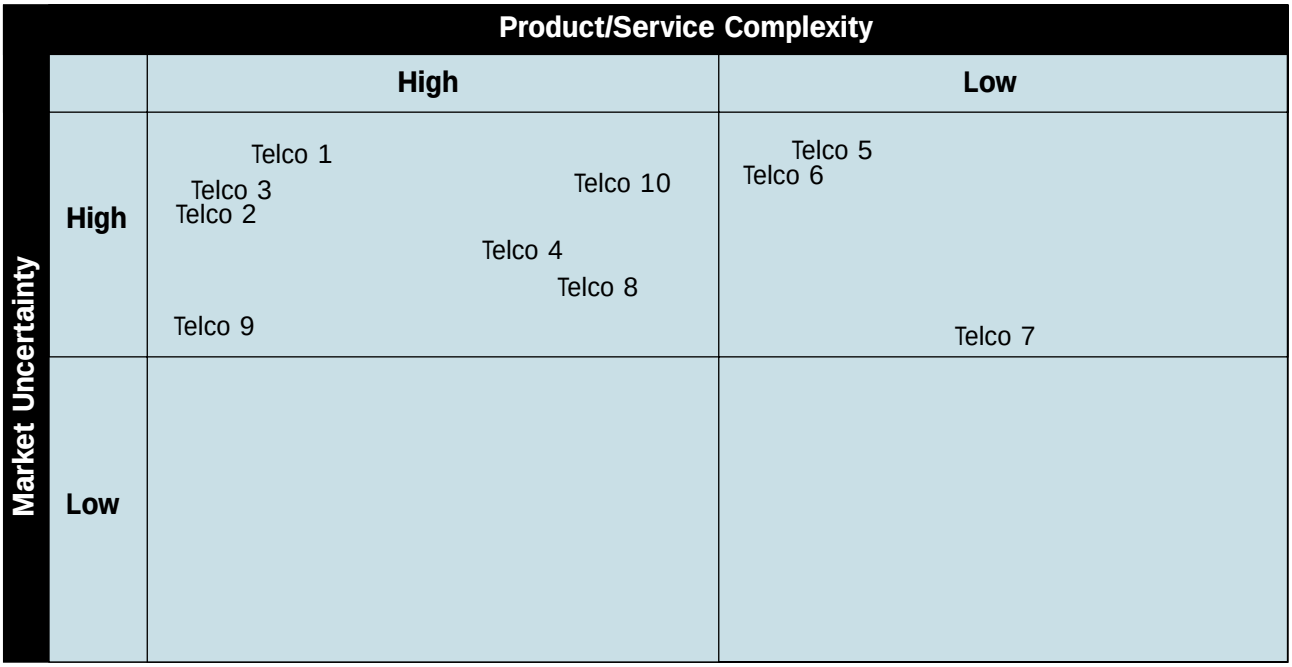
- **Turnkey solutions.** The entry of new operators looking to reach the market in a different way, or to deliver new kinds of product quickly, means that equipment suppliers have had to broaden their role to provide 'complete (turnkey) solutions' that are ready to operate (Telcos 1 and 2), 'total solutions' (Telco 3), 'integrated solutions', and 'business solutions'. The new operators have a lower level of technical expertise than the traditional network operators, and therefore rely on equipment suppliers to undertake a wider range of tasks in design and installation.
- **Marketing becomes more important.** While technology continues to be of fundamental importance, firms further along the chain say that marketing has overtaken technology in importance (Telco 5). Even in certain technical areas, "there is a clear move away from the purely technological tradition of caring about the elegance of development, to getting something done quickly that is about right" (Telco 6).
- **Building customer volume.** Building volume in the customer base quickly is vital, because of the strong inverse cost-volume relationship - that is, investment costs are initially high, but once beyond a certain volume, profits pour in. Thus, Telco 6 is aiming to roll out its local service nationally within one year; while Telco 7 has built a subscriber base of 3 million in five years.
- **Customer service.** There needs to be a strong emphasis on customer service to retain this customer base, and reduce 'churn'.

All of this creates pressure to embrace a broad set of technologies, to be of sufficient scale with a wide customer base, and to be in new and emerging markets. The significance of new technologies, which increase the complexity of products and services, and rapidly changing markets, suggests a simple model that differentiates firms on two dimensions - product/service complexity and market uncertainty. Figure 1 plots the case firms on these two dimensions. This serves to highlight how the sector may differ from others, and provides a basis to distinguish the particular skill needs and emphasis of the case firms.

It is clear that all firms, in whatever segment or part of the value-chain, face moderate-to-high market uncertainty. However, whereas the hardware suppliers and installers (Telcos 1, 2, 3, 4) and those providing specialist services (Telcos 8, 9, 10) deal in customised solutions and problem-solving, the network operators (Telcos 5, 6, 7) not surprisingly are geared to provide a service in which reliability and simplicity are basic requirements. Hence, product/service complexity is lower. However, one of the features of the changing telecommunications environment is increasing numbers of niche operators (such as Telco 6), offering services to specialist user-groups. They, therefore, also tend towards the customised, high complexity end of the spectrum.

In response, the big operators, like Telco 5, have increased their range of services substantially in recent years. This increases their overall level of complexity. In the process, Telco 5 can be seen trying to adjust its position from being less 'stuck in the middle', between the 'brand value companies' (Amazon, MCI, COLT, and Energis) and the commodity providers (particularly the European public network operators, Deutsche Telekom, France Telcom, Telefonica, and Telecom Italia, all still largely publicly-owned).

Figure 1: Product Complexity, Market Uncertainty and the Case Study Firms



In addition to product/service complexity and market uncertainty, what Figure 1 does not show is the high level of technology and technical skills that are common to all the firms. High quality technical standards are a basic requirement for being in the industry. Market uncertainty and customisation, however, mean that technical skills need to be broader and more flexible, with more awareness of market need.

3.4 Products, Strategies and Skills

Industry trends, competitive factors, and the positioning of the ten case firms anticipate the key themes for skills in the sector and the way firms deploy them, which are detailed in Section 5. That is to say:

- Firms need hybrid skills that combine different areas of technical expertise.
- Firms need hybrid skills that combine technical expertise, an understanding of the telecommunications market, the business acumen to know what products have market potential, and customer-relations (i.e. communication) skills.
- Changing sets of activities and the changing roles of firms vis-à-vis one another mean that new skill-sets are necessary. The components of these skill-sets may have existed separately within the industry in the past, but reconfiguring them means that they cannot be easily bought off the shelf from the education system.
- There is increasing demand for some of the more specialised technical skills.
- Computing-related skills are paramount and will become even more important within telecommunications.
- The speed of change means individuals need to be flexible and open to continuous learning.
- Organisation structures and cultures need to be flexible and responsive to facilitate learning.
- The rate of growth of the industry means that more skills of all kinds will be needed, and quickly.

These requirements are consistent across the sector, although emphasis does vary between firms in the different segments (see Section 5). In addition, the evolution of the sector, through the emergence of new small firms (SMEs) and the growth of broad-based multinationals (MNCs), creates special competitive dynamics and generates size-specific skill requirements:

(1) **Small-Medium Enterprises (SMEs):** The disruption to existing value chains from new technologies creates opportunities for new firms. At the customer-facing, end-user end of the chain, there is a massive boom in small firms offering Internet services. Equally, at other points in the chain, there is a flourishing of SMEs, exploiting openings for services and products in new niches. Telcos 6, 8 and 9 are all of this kind. Successful firms are likely to grow rapidly, putting pressure on their internal systems and their ability to recruit and train. Management skills become critical. Failure to grow is likely to see such firms absorbed by firms in the same line of business, as the industry consolidates, or by large firms for whom acquisition is a quick way of getting into new niches.

(2) **Multinational Corporations (MNCs):** Hardly a day goes by without an announcement of a new merger, acquisition or strategic alliance. These are being driven by three motives - (i) to achieve scale (by buying into established national networks); (ii) to be in a variety of technologies (and hedge their bets on which technologies will eventually win out); and (iii) to secure themselves in emerging markets (data, mobile and internet). There is, in addition, a considerable amount of cross-ownership involving cable, mobile phones, and fixed lines, which established operators entered into in the past, as they sought to secure themselves a position in the new technologies. The effect of increasing scale and internal complexity is for such firms to need a wide range of skills in large numbers. It also puts a premium on skills that involve working across boundaries, whether inside the MNC (project management) or with outside partners (alliance management).

3.5 A Winning Formula? - The Strategies of Case Firms

The behaviour of the world's multinationals shows why it is impossible to make definitive judgements about the strategies of particular firms in terms of 'sustainability', other than in general terms. The telecommunications industry is undergoing unprecedented upheaval (Leer, 1999), and the 'winning formula' is still continuing to evolve. Throughout Europe and North America firms are jockeying for market position, hedging their bets on which technologies will win, and striving for global reach. At the same time, it is not certain quite how new markets will develop.

It is reasonably clear that technologies will converge, and in the equipment market two groups of companies are working on the convergence of voice and data - Nortel, Lucent, and Ericsson, for example, from a background in voice technologies, and Cisco from its expertise in data switching systems. It is assumed that markets will also converge, and overlap; and that markets, especially those related to the Internet, will be enormous. But when, and to what degree, this will happen is uncertain. The timing of these developments is crucial to the acquisition and development of skills.

While it is clear also that the winners among the network operators will be those who establish 'seamless worldwide connectivity' for data and voice around the world, how far this means inter-connectivity between fixed and mobile networks, and with the WorldWideWeb, is a matter of intense debate (Waters, 2000). The 'business model' that will deliver sustainable success is thus uncertain.

Against this background of uncertainty, most of our case companies nevertheless appear to be developing strategies that reflect the overall context of change:

- The **equipment suppliers** (Telcos 1, 2, 3) all emphasise 'open solutions', which allow for flexibility to integrate different technologies; and 'total solutions through partnerships' (Telco 3) for complex, customised designs. Telco 2, in particular, "covers the waterfront" - that is, it covers the whole range of key technologies and skills - so giving it great flexibility of response.
- The **installer** (Telco 4) also recognizes the need for 'open solutions', and maintains a broad range of skills in voice/telephone systems, networking, and cabling, in order to be a "leader in converged voice and data solutions". It also has strategic partnerships with the major vendors, which broadens its portfolio.
- The **national network operator** (Telco 5) has built up a wide range of services (including fixed voice telephony, mobile, Internet and data communications, and business systems and solutions), and a global network through alliances and minority stakes in other national operators, which puts it in a position to achieve 'seamless worldwide connectivity' across national boundaries for all types of transmission.
- The **local loop operator** (Telco 6) is extending its network for small businesses and home workers nationally, in order to build volume and market share. This ensures connectivity for the customer, and reduces costs through scale. As a subsidiary of an international firm with networks in a number of countries, there is also scope for future international links.
- The **mobile phone operator** (Telco 7) is now extending its coverage internationally through 'roaming agreements' (that is, arrangements with other country operators to link into their networks) to increase 'connectivity'. It also continues to innovate in products to retain customers and generate income.

- The **fibre-optics system manager** (Telco 8) is developing value-added services to client requirements, as the provision of bandwidth (that is, telecommunications links able to carry vast amounts of data) becomes a commodity.
- The **equipment testing specialist** (Telco 9) trades on its superior expertise in an area of the market that is critical for all who install and run networks. However, as it effectively gives away this expertise, by upskilling its customers, it is beginning (slowly) to rethink its strategy.
- The **call centre information systems provider** (Telco 10) is developing marketing skills and closer links with its end-users, to secure its position as a world leader in computer telephony integration.

While the elements of a sustainable strategy are relatively consistent within (and in some cases across) segments, the world of the installation/maintenance firm is somewhat different. With the variety of technological solutions and different kinds of customers and applications, there is considerable scope for installers to pursue niche, specialist strategies. The need to maintain and service 'legacy' systems adds to the range of opportunities. As Spedale (2000) writes of her four case installer companies:

> "Because of the different nature of competition in their industry segment, installers can rely on a wider variety of strategies than manufacturers. They can more easily concentrate on protected niches of the market and pursue successful differentiation strategies. The four case studies offer contrasting examples. Company C concentrates on quality and on its ability to advise small and medium sized customers; Company D focuses on being the ideal sub-contractor and relies heavily on close partnership with a few big suppliers; Company E is similar to Company C, but it also exploits a remote geographical location to develop a strong local market; Company F bases its strategy on advanced technological knowledge for specialist applications and on unique connections in the USA." (Spedale, 2000, p. 181)

Niche strategies are attractive for small firms, because they reduce the resources needed and allow firms to focus their marketing and supply arrangements. Thus, the four companies in Spedale's study are all small firms, employing, respectively, 50, 79, 22, and 30 people. Telco 4, in contrast, employs 550 people, enabling it to offer a comprehensive service. Company D comes closest, in its supplier strategy, but Telco 4 has moved well beyond it, to pursue partner relationships also with customers. For small firms like those in Spedale's study, the relationship with suppliers is the critical factor, especially where large equipment suppliers are now reaching forward into their markets to deal directly with end-users. These four firms differ considerably in the relationships they seek and can sustain, and therefore in the skills they need. Section 7 develops this further.

3.6 The Survival of UK Telecommunications plc: A Footnote

The survival of firms, however, depends not simply on what they do and on their skills. The future of UK telecommunications, as an indigenous industry, is likely to be determined by the success of incumbent firms in forming powerful alliances, or themselves pursuing an aggressive acquisition strategy. The two major threats are - (i) the ability of cash-rich American firms to buy into UK telecoms; and (ii) the previous neglect by UK firms of European alliances, as a way of building a position within the world's largest market and countering the impending American and Japanese challenge. As American firms buy heavily into Europe and European firms consolidate, the operators (or 'carriers') are becoming global businesses, just as the equipment manufacturers already are. Germany is the key in this, as the telecommunications industry there has been moving quickly to restructure, and has acquired a strong position in the European market.

The two largest UK firms - Vodafone and BT - have followed fundamentally different strategies for growth. Vodafone has pursued a full-frontal acquisition strategy, while BT has built its position through substantial minority stakes in overseas companies and equal-partner alliances (as with At&T). BT's approach avoids the clash of competing financial and corporate cultures, which characterized Vodafone's bid for the German firm, Mannesmann, and Cable &Wireless's bid for Japan's IDC. Alliances are also crucial in the development of the operating standard for 3rd generation 'smart' mobile phones, for internet and e-mail applications, where the UK's Psion is teamed up with Nokia, Ericsson, Motorola, NTT and Sun Microsystems.

Scale is important for worldwide coverage, and building alliances is therefore an important top-level management skill. Failing that, many network operators face the prospect of making acquisitions or being acquired. From one point of view, being taken over could be considered a testament to success, and a way of extending 'connectivity', by becoming part of someone else's network (as in Telco 7's case, and probably at some stage for Telco 8). On the other hand, foreign acquisition means investment decisions being taken elsewhere, with ultimate effects on the skills that remain in the UK.

4. HUMAN RESOURCE POLICY AND PRACTICES

4.1 Organisation of the HRM Function

The rapid development of the industry in technology and markets affects the human resource management (HRM) of large and small firms in contrasting ways:

(1) There are many **new entrants** providing specialist new services. These are inevitably small at first, but fast growing, and display many of the traits of small fast-growth firms everywhere (see, for example, Hendry et al, 1995). These include:

- Informality in their HRM.
- Line managers acting as effective recruiters through their personal networks.
- Jobs defined by the way individuals develop them.
- Increasing pressure to go beyond informal ways of doing things, and a recognition of the need to put in place procedures, define job-specific skills, and develop specialist HR expertise as employment growth explodes.

(2) **Larger firms** are typically more 'bureaucratic', systematic and orderly in all their HR processes. However, larger firms in telecoms are having to change their strategies, develop new hybrid skills, and become more flexible, as traditional ways of defining skills and formality in HRM have become less appropriate. Firms that have hitherto had a high reputation for training are rethinking how people learn, and the best way to get the skills they need. In other words, large firms are having to rediscover some of the characteristics of small firms in order to be agile and responsive.

4.2 Planning Horizons and Processes

Because of the speed of change, the need to respond to rapidly evolving markets, and the impact of new technologies, firms throughout the industry all believe that:

- **It is impossible to plan with any confidence beyond 2-3 years, and skill requirements need, therefore, to be managed in broad terms, not in detail.**

This reflects the often-repeated comment of the CEO of AT&T, that anyone who thinks they can plan for five years in the telecoms industry doesn't know what is going on. However, there are different levels of planning, as there are in other industries - one year resourcing budgets, 2-3 year framework plans, and 5 year scenarios. What makes skills planning difficult is the uncertainty of timing, especially the rate at which new services will be taken up. The most serious uncertainty is not so much due to technology changes, but more to the uncertainty about markets (Telco 7).

Telco 3

"The strategy has not changed. The movement towards the data and multimedia world has always been in the Division's sights, part of the industry vision. We knew in the early 1990s there would be these developments, because people from the company spend a lot of time on the standards bodies in Europe. So we know when the standard specifications are due out, and we help shape them (as do our competitors). Hence, there are no real surprises. We know our direction for the next ten years. What is not known within that time frame is what actual network we might wish to deliver. Architecturally, there is a need to be fluid, and this links into the skill-sets. It is an incredibly dynamic marketplace, and we need an incredibly dynamic workforce.

"High-speed data and multimedia will drive the skills we need in engineering, particularly in software. We can, to some degree, identify those skill-sets. But the big problem is that the education system would like us to identify those skill-sets five years out. But the market is so dynamic, that five years out very few companies know what the market will require, other than 'mainstream requirements'. We are not in that utility-type world - we are in a world that is lifestyle-changing and lifestyle-driven."

For short-term resource planning, firms make detailed plans for skills according to their size and the kind of work they do:

- Large, mature organisations (like Telcos 2 and 5) use numbers-based, budgeting systems, whereby the numbers of employees required with different skills are 'drawn down', or derived, from the business plan (in the same way that other resources are).
- Smaller, project-based organisations, like Telco 8, on the other hand, plan to very short horizons - "on a project-by-project basis for each new network development". Such planning is nevertheless detailed, and relies on managers' close knowledge of the industry and skills, and on their contacts for recruitment.
- Firms engaged in installation and maintenance meanwhile derive their skill needs from the equipment manufacturers:

  > "Taking on products from well-known manufacturers is simple, because the skills are well defined, and to provide those products you take their accredited courses." (Telco 4)

4.3 Skills as a Constraint on Product-Market Strategy

While firms cannot plan in any detail beyond 2-3 years, they also agree that:

- **Customer demand drives skill needs. But if skills are in short supply this cannot be allowed to deflect a firm from its strategy and response to customer need.**

Since skill requirements are being driven by rapidly changing markets and technology, responding to the market can be construed as an alert way for a firm to redefine its own skill needs. The problem traditionally has been the failure of firms to think through the skills implications of their commercial strategy at any stage. This is not the case here - firms take skill issues seriously:

> "We cannot let lack of skills hold the business back. We will find ways to grow the skills we need. It is a victim mentality to blame lack of skills for poor business performance." (Telco 7)

The extent to which lack of skills acts as a real constraint on the individual firm (as opposed to the sector) is ultimately determined by financial considerations. For example, if a firm is in a part of the market that is not price-sensitive, it may be willing to pay top rates to secure skills, either in the form of permanent recruitment or in using self-employed 'consultants'. Thus, Telco 9 makes heavy use of contractors, "because the product is not very price-sensitive". Or, as Telco 10 put it, "skills are always available at a cost." The problem is when many firms adopt this approach at the same time, and poach from one another, causing spiralling wage costs. Mobile telephony has been especially prone to this, as the fastest-growing segment of telecommunications.

4.4 Job Design and Defining Skills

Smaller firms inevitably have less formal ways of defining jobs and skills - as Telco 6 put it, "the person who identifies the requirement for a new job determines its content". With all the larger firms, however, there is more formality. Telco 2 typifies the structured approach of the larger, technology-oriented firm, with functions incorporated into job families, and skills defined at different levels, according to whether working knowledge or expert knowledge is needed in the job. Competency models are also used to define the non-technical 'soft' aspects of skill.

However, the most significant development is the way **the largest, most technically advanced firms are attempting to loosen their definitions and prescriptions of skill.** Uncertainty about markets and the rapid changes in jobs, as new technologies take effect, means they are trying to manage skill requirements in broad terms, not in detail:

> "We don't have formal job descriptions in engineering. We've moved from a very formal job description, to a very informal, flexible set of generic skills and competences." (Telco 1)

Telco 5, one of the key firms in the UK telecoms industry, is also one of the leaders in its HRM and training. It has been conducting a major exercise to identify the skills it needs over the next few years, which illustrates how the skills issue is high up the agenda for many firms, and how the larger firms are rethinking their requirements.

Telco 5

"We have never had such a high level of interest from our most senior people. The Executive Committee is saying we must get to grips with the skills shortage. They are talking about the 'skills gap', 'resourcing for growth' and 'critical skills'. Our challenge is to identify the changes in revenue patterns, and the skill patterns that come from that. We want to be sure we can make the linkages between projected revenue streams, the products and services that flow from these, and the skill requirements to support them. There is a growing recognition that unless we do plan and take effective action, we are not going to be able to support those revenue streams.

"In the past, we just went for big numbers. We are increasingly trying to break that down against a common skills classification, and ask, 'what are our tactical options in sourcing those numbers of people?' The 'skills framework' is our first attempt at getting a company-wide, consistent definition, and a mechanism within which we can start to forecast and plan.

"We have had some experience of designing skills frameworks in the past, and the tendency has been for them to become very complex, very difficult to administer and keep up to date. This time we have tried to take a fairly pragmatic approach. We want a tool that is simple enough to give us a general view of the world, and not worry too much about the detail.

"We don't know what the marketplace is going to be like in two or three years' time, so we can only guess that we might need, say, a thousand IP specialists, rather than two thousand. But given that our estimate could easily be a hundred percent out, we don't need to worry too much about accuracy. We are much more interested in the general feel of where the industry is going, to give us an opportunity to start plugging some of the skills gaps."

4.5 'Skills Watch' - Identifying Future Skill Needs

This section has argued that detailed planning is difficult and skill requirements need to be defined in broad terms. But this is not to say the character of these skills is not reasonably clear. Knowledge of the industry and the implications for skills is well-disseminated in telecommunications, while ongoing research on technology and customers generates useful knowledge about future skills and the labour market. For example, in Telco 4:

> "While the HR department is responsible for recruitment, marketing seeks to find out why people choose this firm, or go to competitors, as this is considered to be important marketing information. Hence, there is a close liaison between people in the marketing and HR functions."

Informal contacts are also extensive. New entrants, such as Telcos 6 and 8, were formed by staff from larger, established firms, and they maintain a wide range of personal contacts - as Telco 8 observes, "most staff have a deep knowledge of the industry and wide circles of contacts within it."

Large firms also have extensive personal networks, and engage in formal studies of skill needs (both on their own account and by contributing to national and international reviews, as in the case of Telco 5). In the more technological areas, this industry knowledge runs deep. As Telco 3 observed above, "people from the company spend a lot of time on the standards bodies in Europe, and so we know when the standard specifications are due out, and we help shape them."

Telco 1

"We have been in the industry a long time, we have a long pedigree, so we understand very well the types of skills developed and that we will need to develop. In the long run, technology in our industry is evolutionary, and so the basic skills can be built on. Very rarely do you get something that hits the telecoms industry, when everybody stands back and says, 'where did that come from?' For some companies, such as Cisco, it may be a revolution in the way they market it, but fundamentally the technology has been around for a long time.

"There are not many secrets, because the telecoms industry works together quite a lot, because of regulation, legal and commercial issues, etc. There are lots of technology agreements between telecoms companies. It's a very competitive industry, but companies do tend to work together because you can't have lots of different standards. Also, the telecoms industry is very incestuous as people move around."

In Section 1, we identified a series of process criteria for distinguishing higher-performing firms:

(1) How they identify their skill requirements.

(2) How imaginative and comprehensive are their skill acquisition methods.

(3) Their ability to function as learning organisations.

With regard to the first of these, it is reasonable to say that all the case firms are alert to changing skill requirements, and have ways of identifying skill needs that are appropriate to their size, age and circumstances.

5. KNOWLEDGE AND SKILLS

5.1 Critical Functions and Skills

In this section, we consider skills in relation to the product-market strategies of firms, and then aspects of work organisation that affect the efficiency and effectiveness with which people are deployed. A broad distinction is made between critical skills, high-level traditional skills, and volume skills. The research was asked to focus particularly on critical skills.

i. **Critical skills** are high-level specialist skills that have a significant impact on the business. They are likely to be 'emergent' skills that are important for the future. A firm may need a relatively small number of such people, who, by implication, are in short supply.

ii. **Traditional high-level skills** are important for the functioning of a business, but are reasonably well understood. There are established systems, in the company or higher education, to supply them. Nevertheless, they, too, may be in short supply because they are needed in large numbers and are highly technical.

iii. **Volume skills** will vary in importance. Some will be of quite considerable importance, but because they are relatively easy to attract or train, they are not regarded as a problem.

While Telco 5 has made efforts to identify a list of critical skills, according to this definition, most firms do not distinguish between (i) and (ii). The following is an attempt to list those skills, or types of skill, most often mentioned. It is helpful to classify these in terms of (a) specialist technical skills, (b) cross-disciplinary, hybrid technical skills, (c) software skills, as a pervasive, underlying component of both these, (d) hybrid skills, combining technical and business elements, and (e) business and management skills.

(a) **Specialist technical skills:**
Specialist technical skills fall broadly into two groups, reflecting the principal technologies underlying fixed and mobile communications, along with the software skills for managing voice and date transmission through these networks. These are based in opto-electronics (also known as photonics), and wireless (or radio telephony), and are fundamentally different. Each of these comprises a range of technical specialisms. In addition, there are traditional technologies based on copper cable, where new digital technologies (ADSL) have been applied to increase capacity.

- A photonics system, for example, is made up of a light-emitting device (laser), a fibre connection, amplifiers to extend the range of the signal, and a light-receiving device. Audio, data or video signals have first to be converted for transmission into analogue or digital form, and then decoded at the other end. Digital switching (ASTM and SDH) has been a major area of development. Optical coupling and switching (routing) devices add to the complexity of the overall system. Photonics engineering is the core skill in Telco 1's optical networks division, and the area of expertise "that is going to make or break the company within the next 5 years". Telco 2 similarly employs large numbers in its three UK locations. Telco 8 works within this technology in building network links.

- Radio telephony also includes a number of specialisms, in satellite radio and mobile. Whilst radio (wireless) technology is relatively old, it has seen a dramatic revival in importance as a result of the mobile phone. It is the core technology and skill-set within Telco 3, and in Telcos 6 and 7, which operate wireless-based systems.

While equipment manufacturers need leading-edge skills in these two technologies, network operators need less in-depth knowledge. Their expertise is more in the design and management of systems based on them, and in software and data management skills applied to these technologies. Since Telco 5 works with fibre optics, mobile, and copper, it needs a wide variety of technical skill-sets, and has developed a detailed classification of critical skills in these areas. Telco 4 also works with all three technologies. Among the equipment manufacturers, Telco 2 claims to be the only one with in-depth expertise in both photonics and wireless telephony.

(b) **Hybrid technical skills:**

Increasingly, firms require individuals and teams with a mix of skills. We refer to these as 'hybrid technical skills'. Two factors drive this. One is the convergence of technologies and competing systems, which necessitates "open solutions". Telco 2 has three-quarters of its 20,000 R&D people worldwide (including 2000 in the UK) working on its philosophy of a 'unified network', and an enormous need, consequently, for "people who understand the systems perspective" and can bridge the divide between optics and radio telephony. The other driver is the need to deliver "complete solutions" for less technologically sophisticated customers. As a result, the firms who design and build this technology (Telcos 1, 2 and 3) need people who can combine technical skills from different disciplines (including IT).

Telco 2

"You've gone from a situation where you had BT as a dominant, technical organisation that gave very precise, elaborate requests for tenders. Now, we get customers coming to us with capital, and a licence to run a network, and they ask us to help them build it, and sometimes to run it. This creates a whole new demand on us, not only to be a vendor of equipment, but also to act as a professional services company to run networks for these new entrants."

Telco 3

"IP over wireless inevitably means we are moving towards a 'systems solution' business, as distinct from just a black box and some software. We now deliver services and solutions end-to-end. All of our competitors are faced with the same challenges, both in the UK and around the world. The emphasis is much more towards software, software services, and billing systems linked into those services, so that we can offer a cellular operator the whole suite of services, and all he is required to do is to market the service to you and I as end-user."

(c) **Software skills:**

Software skills can be defined at a number of levels in the telecoms industry. The list below traces these skills from equipment suppliers and installers, through specialist service firms, to the network operators. A more detailed specification of such skills, and proficiency criteria for assessing them, can be found in a report, recently edited by a member of the project team (Courtney, 2000).

- Software skills underlie the design and build of networks, both fixed line and mobile telephony, and are fundamental to applications engineering. All three equipment manufacturers stress the vital importance of software skills. Such software-based, networking skills include managing network interfaces, network security, reliability, and the overall management of capacity.
- The amount of embedded software affects firms down the line, who install and maintain equipment:

  > "Open systems and standards means you are exposed a lot more to a computing environment, in linking applications. You need to know how all the various bits of software talk to each other. Our engineers have always had to be reasonably multi-skilled. The difference now is that, rather than just being multi-skilled within the PBX field, they are having to become multi-skilled in telephone systems and local area networking equipment as well" (Telco 4)

- Complex, embedded software systems create a market for specialist consultancies, like Telco 9, for high-level systems integration and software testing services.
- With the fixed network like a "supercomputer", network operators have an "enormous dependence on software skills". These range in sophistication, from high-level 'data management' and 'network management' skills (Telcos 5 and 6), to the 'planning engineers' who route traffic at exchanges and within the local loop when, for example, equipment is under repair (Telco 5).
- Similarly, with mobile phone networks, system analysts who develop, and technicians who manage and maintain the network, are critical groups. Telco 7 has 600 and 700 employees respectively in these two categories, although modularisation has reduced some of the skill requirement.
- Internet protocol (IP) design is allied to the general field of data management (since it allows for new ways to manage data transmission). It is fast becoming a highly sought after specialism for firms that manage both fixed and mobile networks (Telcos 5 and 6).
- The 3rd generation of mobile phones will see the integration of multi-media, Internet, and mobile technology. This is largely a software expertise, with some systems integration knowledge, combined with knowledge of mobile phone technology. It is thus a new 'hybrid' expertise, likely to be much in demand.
- All kinds of networks have a use for management information systems (MIS) and related technology. These may be built into transmission networks (Telco 8); or part of the information systems that support call centre operations (Telco 10).
- There are also less technical software-writing skills, in developing applications.
- Finally, IT is widespread at a user-level:

  > "Everyone needs to be IT literate nowadays; there is no position in this firm where IT skills are not utilised." (Telco 4)

(d) **Hybrid technical/business skills:**

The strategy of manufacturers, installers, and operators of networks to provide 'complete network solutions' and 'integrated solutions' means a mix of technical skills, customer/market knowledge, and business management skills. This is emphasised repeatedly in relation to many technical areas across the industry:

> "The key area is people who have got broad enough experience for complete network solutions. They need a broad view of not just the business, but also the technology and the solution." (Telco 1)

This means adding new skills (viz. the marketeer's way of thinking about the benefits customers buy), 'down-skilling' other areas (viz. the engineer's tendency to over-engineer), and topping these off with business management skills. It is a consistent refrain that traditional engineers have to become more flexible in their thinking and attitudes:

> "There is a clear move away from the purely technological tradition of caring about the elegance of development, to getting something done quickly that is about right." (Telco 6)

Telco 2

"Today, the requirement is not for people to be very expert in one particular skill. Being an expert in learning is more important. Engineers, who are specialist in one particular area, want to develop the product in the best way they possibly can. That was a number one objective, and it meant that the time-to-market for most of those products was taking so long that we were missing market opportunity. That is a problem with specialist expertise - if you get too deeply into it, you lose sight of some of the wider issues. Because they were engineers, they lacked business commonsense."

- The provision of a 'total solution' affects the customer-facing, project management role which companies call variously 'engineers' (Telco 4), 'product managers' (Telco 3), and 'design managers' (Telco 8):

  > "They will usually be engineering-qualified, but moulded into business managers, and able to take ownership, not only for the development of the system solution, but also to manage it as a business from customer specification to delivery, and make a profit margin out of it." (Telco 3)

- Further down the chain, network operators like Telcos 5 and 7 have a similar need to develop integrated technical solutions for corporate customers, which require a technology background and marketing expertise.

- Other roles have a different external interface, involving suppliers, but a similar combination of technical and business skills at a lower technical level. Telco 2, in particular, has a strategy of global outsourcing ("don't develop it, if it can be bought"), which enhances the role of supply chain management. Similar skills, in logistics and supply, are needed for managing multi-site operations - including sourcing overseas ventures (Telco 3).

(e) **Business and management skills:**
Business skills, and especially marketing skills, have become increasingly important throughout the value chain, with greater product/service variety and the potential for new mass markets in telecommunication services:

- At the equipment end, and in building networks, the marketeer has had to develop a broader knowledge of markets and their needs, because of new users. This means more technological awareness, with the boundary between sales and engineering becoming blurred:

  > "Selling the business benefits, rather than 'box shifting' is the key change. The salesman's role is now that of a consultant, aiming to understand what his customer needs, rather than 'feature selling' and 'feature dumping'. He needs to know what the drivers are within the end-user's business." (Telco 4)

- A number of the 'critical skills' identified by Telco 5 involve knowledge of specific markets, combined with technical expertise. Some of this expertise derives from the base technologies of telecommunications, but other comes from disciplines that reflect the shift away from voice-based telephony to 'communications' - including multi-media contents development (for e-commerce).

- In the mass, customer-service end of telecoms, marketing and sales are important for growing market share rapidly in new businesses (Telcos 6 and 7), and for holding onto it in others (Telco 5). Again, a different style of marketing is wanted:

  > "Soft skills are now key. The company does not want traditional marketeers who impose their own world-view. We want marketeers that will attempt to understand the new world and match the technology to it." (Telco 7)

- Customer service and customer care acquire critical importance for these businesses in retaining customers, and as an arm of the sales function. Call centres are an important part of the business of Telcos 5 and 7. Half of the latter's 5,000 staff work in its call centres, and this number is expected to double in the next year. Senior management and around half of the call centre staff are regarded as critical, because of the overhead cost, and the need for coaching and supervision. Although there is a view that other means of communicating with customers may become significant in 5-10 years time (for example, through the Web), the imminent rapid growth in staffing, the upgrading of skills currently taking place, and the fact that Telco 7's centre is regarded as the most complicated and demanding of all call centres highlight the nature of key skills and skill supply issues affecting call centres. These are addressed in the following sections, in the importance of 'attitudes' (5.4), the style of organisation (5.2), recruitment and retention (6.2), and the approach to training and learning through performance feedback and coaching (7.3).

- Finally, the importance of joint ventures and alliances in the communications industry makes this a 'critical skill' for Telco 5. These involve not just telecoms partners, but large corporations in customer industries. This is a high-level general management skill, but the number of senior people needed is quite significant.

The requirement for these five types of skill is consistent across most parts of the sector and most of the case firms. The need for software skills [c], of various kinds, is pervasive, and all firms make use of specialist technical skills [a] according to their core technology. Convergence of technologies and

'interconnectivity' also creates a need for hybrid technical skills [b] that can make these links and bridge technologies. This applies especially to the equipment suppliers and installers, and to the national network operator (Telco 5), but less so to those (like Telco 7) who work in one technology. Many installers also have a far narrower focus than Telco 4.

With all firms facing a relatively high degree of market uncertainty, as indicated in Figure 1, there is a widespread need for business and management skills, especially marketing. The precise form varies, according to the stage a firm is at in building market share, and whether it deals with the general public or companies. Firms whose offering involves a high degree of product/service complexity, on the other hand, as shown in Figure 1, have a particular need for hybrid technical/business skills [d] - to work with customers to develop customised solutions, and manage projects from design to delivery.

5.2 Work Organisation

Skills need not only to be adapted to the requirements of product-market strategy, but also managed and organised well to make effective use of them. The emphasis on hybrid and broader skills in the above discussion suggests that the successful firms will be those that organize people effectively in teams, encourage teamwork through their culture, and develop team skills. Company structure and management philosophy are crucial in how skills get organised at the work level.

Telco 2 is probably the best-adapted in this respect, with a flexible organisation structure consisting of 'lines of business', a strongly matrixed organisation, a team culture, an emphasis on generic rather than occupationally-specific skills, contract outsourcing, a learning culture, and a wide range of products and skills. It also monitors its learning processes against other companies. Those that are less well-adapted, in contrast, tend to be single-product firms or those that have held on too long to older products, and who have traditional functional structures and strong specialisation (Telcos 9, 10).

- The large companies are shaking up their **corporate structures** to create greater flexibility, improve speed of response in uncertain markets, and develop integrated solutions for complex design problems. Telco 2 embarked on a three-year programme in 1999 to reorganise along 'lines of business', flatten management layers, and introduce project team structures under "empowered" senior engineers who have considerable autonomy. Similarly, Telco 5 changed its corporate structure in 1998-99 from functional divisions, to a market-based structure that achieves better integration among different market segments. The large companies all recognize the need, but Telcos 2 and 3 are probably more successful in creating a flexible 'learning culture' (see Section 7). Despite making considerable progress to become more entrepreneurial, Telco 5 is often still seen as a prisoner of its "civil service-style bureaucracy" which its history and size imposes on it (Doward, 2000).
- The **supervisor/first line manager role** has changed in many of the large firms, with an emphasis on teamwork, particularly in technical/professional areas to do with project management:

  > "Skills have changed from being a hands-on manager to more of a facilitator - much less hierarchical, much more team-based, much more about individuals taking responsibility for things that previously would have been done by a team leader. My engineers need a lot less managing than five years ago." (Telco 1)

- This, in turn, affects the way **workforce skills** generally are deployed, with widespread expectations that people need to have broader skills, and, in particular, flexible attitudes and a willingness to learn. The largest firms seem to have taken this strongly on board, while the new small start-ups (Telcos 6 and 8) are built round multi-skill and team-working principles. However, the older small firms (Telcos 4 and 9) have yet to move from a basic functional structure; while Telco 10's problems can be attributed to rigidities in its functional organization - poor handling of customers by engineers, loss of marketing focus, and being technologically- rather than commercially-driven. 'Small' does not therefore necessarily mean 'beautiful', and older, outdated models of management are liable to be more rife among small firms.
- As a relatively new company, Telco 7 provides an interesting example of how organization and the **management model** can change skill requirements:

  > "The company has emphasised creativity and speed of development, over business process and organisational efficiency. This tends to emphasise autonomy, and places greater demands on leadership at all levels. Hence, we require good leaders throughout. If we had recruited more operationally-experienced people, and installed more structure - as, for example, [X] have done, we would not need 'leaders'."

  However, growth has now created a need for more systems, and the recent restructuring involves an increase in staff scrutiny and stronger control, although it is also designed to support team-working and continuous learning (see 7.3 below).

5.3 Production Processes

The notion of 'production processes', as such, has limited relevance for telecoms companies - certainly for their 'critical skills'. Systems design, installation of complex systems, developing and marketing services for a network, testing equipment are not production processes in the way that factory-based operations are. They cannot be readily observed, and the efficiency and effectiveness with which they are managed cannot be judged from cursory inspection. The main test is 'time to market' and similar time-based measures. Almost all firms stressed this (see 3.3); most acknowledge their failings in this respect; and the developments in work organisation are directly aimed at speeding up the response rate.

However, in other areas, the telecoms companies do have 'production processes', since the equipment manufacturers build systems. They aim to improve their efficiency principally by outsourcing component manufacture (Telcos 2 and 3), as technologies mature and rising industry standards allow them to do so without loss out of quality. This increases the importance of the purchasing function (as described under 'hybrid technical/business skills'), and raises the skill level required in 'assembly', to the extent that it becomes a graduate engineering task.

Running a telecommunications network is also, generically, a 'production process', as a routine service in which efficiency is a key measure (although, so also, is reliability). The network service operator, Telco 5, has been intent on taking out costs for many years, through technological means such as modularisation, and has drastically reduced its operations workforce. Telco 7's call centres are also operations that lend themselves readily to efficiency and effectiveness measures (for example, 90% calls answered in ten seconds, all calls solved with one call, and falling numbers of calls about problems). Recognizing that their call centres have been under-performing, Telco 7 introduced a new management structure in 1999, and mentoring and monitoring processes to improve skills.

However, just as it is impossible, through a cursory inspection, to evaluate 'critical skills' in innovation activities such as design and project management, it is equally difficult to judge the quality of skills in these manufacturing and service operations without systematic, detailed observation using agreed job specifications and validated performance criteria. As for the 'traditional high-level' skills involved in network system management - managing capacity, routing and software design - these are almost entirely invisible as skills, except to those who understand them intimately, under controlled conditions, and with the aid of detailed performance measures.

5.4 The Person Specification - What Kinds of People?

Firms' requirements for skills result in a 'person specification', which underlies recruitment and training. There are two aspects to this the project is interested in:

(1) Changes in the definition of skills in terms of occupation-specific skills and knowledge, generic skills (i.e. communication, problem-solving, computer literacy, etc), and attitudinal factors.

(2) Changes in qualifications required, particularly with reference to graduates

Changes in the definition of skill were outlined at 3.4 and 5.1.

(a) **Occupation-specific knowledge and skill:**

- Increased demand for certain types of highly specialized technical knowledge and skill, many of which are relatively new.
- Increased demand for software knowledge and skills.
- Considerable demand for hybrid skills, combining different areas of technical expertise.
- A considerable demand for hybrid skills which combine technical expertise with an understanding of the telecommunications market.

(b) **Generic skills:**

- Business awareness (recognizing the market potential for a product) and customer-relations skills (empathy, relationship-building, and communication) - thus, the 'hybrid technical/ business skills', referred to at 5.1(d), comprise both knowledge and generic skill elements.
- Team-working.
- Communication skills ("the ability to negotiate, give and receive feedback, team cooperation") as an element in teamwork, which some stress is a particular feature of their company culture (e.g. Telco 3).
- An almost universal need for general IT-user skills.

(c) **Attitudes:**

- The speed of change means individuals need to be flexible and open to continuous learning.
- Other general attitudinal traits include self-reliance, a willingness to take risks, entrepreneurialism, and attitudes conducive to team-working.

The frequent criticism of engineers, and the need to "think out of the box", indicates that attitudinal factors are an important element in 'hybrid skills'. 'Soft skills', like communication and team-working, have become increasingly important in technical environments, where specialists need to work across boundaries, and in businesses that have a strong customer interface.

Attitudes are also emphasized in start-up and fast-growing firms (Telcos, 6, 7, and 8), where 'fit', flexibility, risk-taking, willingness to learn, and coping with stress are important attributes because of the changes, not just in telecommunications technology, but in the business itself.

Telco 7

"Training in knowledge is easy, in skills is harder, but the hardest is attitude. In future, call centre staff will need to learn much more - for example, how to use multiple communications channels. However, these skills can be taught. It is the generic skills that are important and difficult to find - including commonsense, the ability to handle pressure and change, and flexibility. You need to have commonsense, to be able to keep your nerve, a low boiling-point, to be relaxed about problems that cannot be fixed, judgement, be able to manage, and adjust to change. All of these fall under the heading of generic skills and attitudes… More people fail in this environment than succeed."

Qualifications have become more important with the increased sophistication of occupation-specific skills. On the other hand, the increased importance of generic skills and attitudes means qualifications can be regarded as 'necessary', but no longer 'sufficient'.

Most firms have a need for highly qualified people, driven by the changes in industry configuration. In terms of qualifications, skill levels have been undoubtedly rising. Telco 2 has "a huge number of people with Masters and PhD qualifications" (including 350 within R&D). By outsourcing lower value manufacturing, it has "moved away from apprenticeships and craft working, to highly skilled graduate-level work", and has converted its apprenticeship scheme at its main English site into undergraduate placements. Its craft training centre now concentrates on IT and general training in 'soft skill' areas (viz. work attitudes, teamwork, and business awareness). Telco 5 likewise has a major R&D centre, with around 3,000 technical staff, and graduates with mainly upper second degrees. The speed of change means higher levels of basic education:

> "In the past it was possible to bring on board people without degrees. But nowadays, people don't have as much time to go through the learning curve. They need to be established by the time they come to us - in terms of lots of useful experience, or a first degree. (Telco 3)

Some managers, though, continue to make a distinction between graduate and technician jobs, preferring those with practical, experience-based skills from the FE sector with HNC/HND qualifications. They see the expansion of the universities as "cannibalizing" the FE sector and lowering standards, because the entry pool is a fixed quantum. The result is that firms who need high-level scientists and engineers take a two-tier view of universities. (This is hardly new, since there has always been a pecking order among the engineering schools, as in other professional disciplines.) Some of the criticism of the qualification system, however, is directed at the engineering institutions' credentialing process, and the process of 'academic drift':

> "We are forcing too many people into overly-academic degree courses of a very general nature. We will not recruit someone with an ordinary degree in 'combined engineering'. There are roles that it's assumed you need a graduate for, whereas 10-15 years ago you'd be using a non-graduate." (Telco 1)

Some newer skills, however, cannot be readily matched to existing qualifications and education patterns, even though they may require high-level technical skills as a building block. This has implications for how people learn and construct new skills, and for models of education and training.

Telco 5

"We are highly dependent upon good quality professional expertise, particularly in our research capability, and that will continue to be an important route for us - people who have been well-educated in the technological disciplines. But there is now this other stream of people coming through, who are saying, 'But I don't have to do that. I have been playing with computers and surfing the Internet since I was 11 years old.' By the time they get to 18, they have got more experience than many people would have had in 10 or 20 years working in the industry. So we are entering into some new paradigms in how people acquire skills and knowledge, how that's deployed, and how people learn. Young people tend to learn through trial-and-error experimentation, and not worry if something goes wrong. That builds up a pattern they would like to take into their careers, where they are free to 'play' and experiment and try new things.

"This presents a real challenge for the academic world and the professional institutes, in keeping up-to-date with a rapidly changing market-place. As people enter the world of Internet and multi-media, we are finding the last thing they want to be associated with is a traditional professional institute, or formal academic qualifications. They are looking at role models of people who have left college at 16 or 18, gone into a start-up venture, and are millionaires by the time they are in their mid-20s. We are starting to see these as the people who make a difference."

Company attitudes to qualifications are complex, and often conservative. However, the emphasis on non-credentialed aspects of skill, clearly shows firms are thinking beyond formal qualifications. The closer to the market, where changes are most rapid, the more this is so.

6. RECRUITMENT DIFFICULTIES

6.1 The Importance of Recruitment and Recruitment Difficulties

While the project is concerned to increase our understanding of 'skill deficiencies', it is necessary, first, to separate out skill supply problems that have their origin elsewhere than in individual companies. An absolute and severe shortage of basic skills available to an industry means the solution lies more firmly in the public domain - with a need for concerted action by companies, the education sector, and government - than if the problem lies with, for example, the training and recruitment policies of companies alone. Telecommunications, as one the fastest growing sectors throughout the world, European and UK economies, has real difficulties that cannot be ignored.

Table 1 gives some information about key skills being recruited, and the extent of recruitment difficulties and labour turnover. It is clear that firms have substantial requirements, and these are not being met. The problem is easily summed up:

> "Market demand is far outstripping the supply of skills required." (Telco 8)
>
> "Labour turnover is endemic to the sector." (Telco 6)

Many skills are held to be in short supply. These are primarily technical and software skills - telecommunications engineers, photonics engineers, sales engineers, IT (system developers/analysts), software engineering, radio engineers, IP - in fact, "most of the key functions are hard to fill". The revival of wireless technology, for example, has led to a temporary acute shortage, while the demand for knowledge of Internet Protocol (IP) has suddenly boomed. These shortages are compounded by the rate of new product development:

> "We are a year ahead of our competitors in photonics, so trying to recruit people with the right skills is difficult. So we train them in-house, but need people that are hands-on from day one. If a lot need training and supervision, we can't get the project out the door quick enough. So we are in a Catch-22 situation." (Telco 1)

The effect of recruitment difficulties (we are assured) has not been to deflect firms from their strategy, but it has slowed their development and response to opportunities, and has increased costs. For a small firm like Telco 6, whose business is based on radio telephony and IP, both of which are in acute short supply, the effect could be extremely detrimental, where time-to-market is crucial in establishing a new service. Other consequences experienced by firms are loss of orders, missed deadlines, misuse of management time in replacing staff, higher costs in employing subcontract staff, and longer working hours.

6.2 Reasons for Recruitment (and Retention) Difficulties

We list the various causes of recruitment difficulties and how companies perceive them. It shows the complexity of the problem, which aspects may be self-correcting (due to the dynamics of the labour market), which are healthy processes that benefit the industry, which pathological, and which are caused or aggravated by companies themselves.

Table 1: Case Companies Recruitment of Some Key Skills

Case Company	Key Skills	Target Number Recruiting this year	Numbers Recruited Last year	Reason for recruiting
Telco1	Hardware/ software designers	70-100 p.a. (optical networks division only)	30 (below target)	Business growth
Telco2	Software design/ development (50%; hardware design and related engineering (40%)	300 graduates (increasing from 150-200-300 over last three years) *+ 700/1,000 experienced staff (Europe)*	Fewer than 300 graduates; 700 experienced staff (1998) (Europe)	Business growth *Labour turnover at 7-10%*
Telco3	Software engineering, digital hardware engineering, systems testing, IP systems design, RF engineers	150 engineering; 150 support services (one site) (Total UK - 1,500 engineers) *Graduate recruitment doubled in 4 years (25-50)*		Business growth. Recognition of importance of graduate recruitment *Labour turnover is "substantially higher than we would like"*
Telco4	Installation, service support, marketing	50 (including replacements for redundancies)	(30-40 redundancies)	Business change. Turnover at 5% is "too low"
Telco5	Marketing and sales; all technical areas; network 'engineers'	3,000 p.a. (including 2,000 'engineers', after heavy 'release' programme) *300 graduates*	Graduates and 'engineers' easily recruited *IP and multi-media very difficult*	Business growth and change. Turnover 5%, but 25% in some areas (marketing/sales)
Telco6	Sales; customer services	1 at present	12	Replace contracted staff with own
Telco7	Call centre staff; system developers; network designers	1,000 (est.)	1,400	Business expansion. 12-20% turnover
Telco8	Sales engineers; design engineers; network managers	400 more by end-2000	Grown from 7-80 employees	Business start-up; major expansion
Telco9	Software testing; systems engineers		15 in telecoms	Expansion and labour turnover
Telco10	Sales; IT	10	15 (NVQ assessors)	Labour turnover

- **Supply from the Education System.** The problem of supply from the universities is two-fold - (i) lack of students going onto appropriate courses; and (ii) courses which are not sufficiently up-to-date for companies, who are themselves at the leading-edge of developments.

  > "The growth of IP has outstripped the capabilities of university education. There is no university curriculum for IP in the UK, and a delay in universities taking up this new technology. By the time they have caught up with Internet skills, it is quite possible something else will have come along." (Telco 2)

  The "very small numbers of women entering engineering" (Telco 1) is also a factor. Although mentioned by few firms as a specific issue, the recent TVSC (1999) report highlighted the heavy male-orientation of the industry. The inability of the education/training system to attract women into ICT programmes is seen as a significant factor in Europe's growing skills gap, and a recent study by seven of Europe's leading firms (including BT) commented that, "The situation represents a major threat to the development of the ICT industry in Europe" (www.icel@pohost.eunet.be).

- **Supply in the 'Open' Market.** A number of processes contribute to the overall dynamics of supply and demand. Some involve short-term transfers between different activities, and are self-correcting in the medium term. Others involve small firms benefiting from an outflow of trained staff from larger firms. While this is in a sense 'poaching', it is usually accepted as a fact of life in many industries, and may well benefit the industry as a whole. The problem arises when the supply dries up, and the smaller firms are slow to recognize it, slow to respond, and do not have the resources to do so. The biggest problem in telecoms, however, is the entry of many new firms, in a short space of time, because of market growth opportunities. While this raises the overall skill level in the long-term, the short-term effect is poaching, job-hopping, and spiralling wage costs. The problems identified by firms are listed below in terms of their relative negative impact:

  - Mobile phone companies constantly poach from one another. Many senior managers and call centre managers will probably have worked for one of their competitors, and while this increases the level of experience, it is also destabilising for companies. All but one of Telco 7's senior call centre managers, for example, had been recruited within the last two years, and several reported being regularly approached by headhunters.
  - Telecoms is particularly affected by demand from global competitors entering the UK market (Telco 2). Certain of these, such as Cisco and Microsoft, are seen as having aggressive recruitment strategies - "because Cisco regards it as a critical part of its business strategy to get the right people" (Telco 2). New entrants of this calibre, however, raise the industry skill level, and set new benchmarks for recruitment and quality of training.
  - New firms in specialist niches who need a quick source of proven experience (Telcos 6 and 8) have relied on poaching technical skills from established network carriers, and sales skills from others.
  - Smaller firms (such as Telco 4) relied in the past on the apprenticeship schemes of BT and the Armed Forces for recruiting to senior positions, and benefited from their 'release' programmes. These have begun to dry up, resulting in "a net loss of skills to the industry" (Telco 8).
  - Loss of skilled people is not always seen in a negative light, however. Telco 2 loses a lot of engineers to customers:

Telco 2

"A lot of our customers poach from us. This is not a problem, and we almost encourage it, because an ex-employee with the right knowledge of a system, working for the customer, is an advantage to us. A common pattern is for a customer to buy a network management control centre, contract us to run it for the first 12 months, and then take over this function and some of our staff. We refer to this as 'build, operate and transfer'. This is a recognised situation, and it is often written into the sales proposal that there will be no veto on customers doing this. In some sales proposals, potential customers ask to see the people who will deliver the solution, and this may involve showing them our recruiting plans. This places the recruiting department in a more strategic position with the business units, because they now often need our input on getting the resources to deliver a network solution."

- Some large firms, that have traditionally offered long-term careers for life, also now see a degree of labour turnover as a way of "re-energising the organisation and the culture" (Telco 5).
- Y2K has created some temporary strain (e.g. Telco 7), although not as much as was expected (British Computer Society, 1999). As people are released from this, there may be some short-term benefit.
- Some traditional areas of the sector - usually those that need lower skills - have a relative glut of people:

  > "In the carrier area, people come flooding in. When we need to recruit engineers to install the smart boxes we do for people like Colt, they literally fall in the door. This area needs a relatively low skill set." (Telco 4)

- The life-cycle for certain market segments also benefits firms, through the 'recycling' of skills. For example, cable TV companies had a high need for network designers when they were building their networks, but have now released them back onto the market. However, raised pay expectations, during the heyday of building cable networks, have carried over into other parts of the telecoms industry.

Quite a number of these effects are actually positive, and suggest the value at a policy level of being able to map the interaction of different industries, and segments within them. Poaching itself, although it has negative effects for the 'poachee', and raises the general level of wage costs in the industry, is inevitable when a new firm starts up. When endemic, it reflects, above all, on the basic level of supply into the industry from the education system, or in transfers from other sectors.

- **Local Labour Markets.** Most firms have some difficulty with local labour markets - either they are in an unfashionable, or out-of-the-way, place to be able to recruit people (Telco 1, 5, 9), or they are in highly competitive local labour markets, especially London and the South-East (Telco 4). Some, like Telco 6, have no choice because they serve the business market in that area. However, once those in unfavoured locations get people, they tend to stay, because people are unwilling to relocate again. Call centres generate large increases in employment opportunities, and even though a company may take care in siting its own centres, it becomes vulnerable to poaching when other firms move in. A few firms enjoy favourable locations. Telco 2 has a major UK site with few competitors for local skills, and two universities nearby producing large numbers of graduates with the skills it needs. Telco 4, in the North of England, benefits from the availability of skills from IT companies and local call centres.
- **Pay.** Local and national shortages result in pay levels being bid up, affecting both the ability to recruit and retain. Reward systems are regarded as key in retaining sales staff (Telcos 4 and 5); while software and IT staff move also for better career opportunities. The salary structures of the large firms tend to be relatively inflexible, and they frequently complain of losing employees to small start-ups (although older small firms (Telco 10), are equally vulnerable to market rates). Salaries at 50% more and the lure of "massive stock options" are frequently cited. Telcos 7 and 8 have share option schemes, and Telco 8 has found this effective in attracting people, even though its basic rates are "on the low side". Many firms mention Cisco as offering attractive share options. It is not clear, however, whether the general perception is created by many, or just a few, such cases. Smaller firms (Telco 4) believe the training they give employees makes them more vulnerable to the market (even though they accept it as necessary), with rising pay rates in a rapidly moving industry giving employees increased leverage.
- **Image of the Firm.** Companies are acutely aware of the effect of image. Telco 2 used to have a problem, but is recognised as having made great efforts to become better known. Telco 5 is widely recognised as being among the top ten companies for graduate recruitment, retention and development. Telco 8 regards its image, as a company with a sense of purpose and good top managers who are well known in the industry, as a positive factor in its success and in attracting good people.

  > "Our image was of a dinosaur company, a traditional, low-payer. The large number of redundancies in 1992 did not help. Trying to get rid of that history is difficult. We have been the company that's provided the network for telecoms in this country for years, but nobody has ever heard of us. But success breeds success, and we're suddenly being mentioned in the press." (Telco 1)

- **Uncertainty about a Firm's Future.** The reality for many smaller firms (despite the advantages large firms attribute to them) is often uncertainty about their immediate future as new firms (Telco 6), or because of business problems (Telco 4 and 10). This affects recruitment and retention. However, rapid success (Telco 7) quickly breeds a positive culture, and creates opportunities for promotion.
- **Image of the Industry.** The negative image of engineering as a career still affects telecommunications, even though it is now a different world from the old public telephone (PTT) systems.

- **Different Industries Fishing in the Same Pond.** With the emergence of new skill-sets, labour markets have become more varied and complex. In multimedia, telcos compete with web publishing, and indeed with anyone who uses the Internet commercially. As software is built into mobile phones, firms in this segment are discovering they are in competition with many other industries (Telco 3).
- **Many Labour Markets are also International.** In the Internet data world, for example, Telco 5 competes with the US market, where base salaries are 60% higher (at $250-300,000, plus stock options).
- **Failure to Anticipate Skill Needs.** Managers at the operational level often have a different view to those at corporate level. They want recruits who can make an immediate contribution, and see the future more in terms of existing skills to meet short-term needs. This is a problem when they also have some control over graduate recruitment, which is the feedstock for the future (Telco 2). While this may reflect on line managers not having an adequate perception of company strategy, the reverse can also apply, in that managers at board level may ignore pleas for recruitment to maintain the basics of the business (Telco 5).

6.3 How Firms Have Responded

The above are problems cited by the case firms. They reveal a high degree of awareness of factors affecting the labour market, and some self-criticism of their own role. Most actively monitor the supply of skills in the market through their relationships with agencies and universities. Specialist agencies give a good view of the short-term situation; while the annual intake onto university courses can signal problems 3-4 years on. Larger firms, like Telco 3, use these sources most actively. Pay surveys are common, but apparently more developed for IT than for telecommunications.

The true test, however, is the way they respond to recruitment difficulties. All firms agree that it is not an option just to live with these problems. The list that follows indicates the effort being devoted to a variety of solutions. This is notable for the wide range of responses by large firms, and the relatively limited strategies for recruitment among smaller firms.

- **Increase Graduate Recruitment.** The large Telcos 1, 2 and 3 have all substantially increased their graduate recruitment. Telco 2 has increased its resources to recruit graduates and its visibility in the graduate market, and Telco 3 is adopting many of the same initiatives. According to Telco 3, “the generic route of electronic, electrical engineering and computer science will satisfy many vacancies”, and provide the basis for training into specialisms. However, some are also changing their philosophy of recruitment:

  > “The market has, to some extent, become devalued, because of the big inflow of graduates, and the huge variation in qualifications and competence. We are re-targeting specific universities and specific types of graduates, and are likely to bring in slightly lower numbers, but of higher quality, whom we can bring into fast-track careers and be sure they the capability to attack these new technologies. We will also put increased reliance on recruiting people who have 2-4 years work experience.” (Telco 5)

- **Build Better Links with the Education System.** Two of the most admired companies, Telcos 2 and 5, have a highly proactive approach to graduate recruitment, and are also active in building relationships with schools. Both sponsor scholarships, fund university chairs, and invest in university facilities. In addition to the direct benefits for their own recruitment, such initiatives attempt to counter the negative image of the engineering industry and promote telecommunications. This is a recognition that industry drives the demand for college courses, and therefore has a responsibility (and self-interest) to influence this demand at source:

  > "There is a lack of formal ties between academia and industry. They [academia] do not know where we are going, they do not know the growth we are going through, so there is no way that they can bring in the people we need."

  An emphasis on partnership is at the heart of proposals to close Europe's ICT skills gap (see *icel@pohost.eunet.be*). In creating closer relationships with the education system, telecoms companies recognize also that they are in a recruitment market where other firms may be sending out different messages about the benefits of FE/HE, and they have to counter this by selling the benefits of the telecoms industry and studying for appropriate qualifications.

- **Employ Contract Labour.** A general consequence of the tight labour market is the heavy, long-term dependence on contract staff (self-employed, or employed through agencies) at premium rates. This is now accepted as a normal feature of the industry, although some like Telco 1 are wary of the extra costs in supervision.
- **Recruit Abroad.** The large multi-nationals, like Telcos 2 and 3, manage their recruitment and development (including graduates) on a pan-European scale. This allows them to centralize their processes, apply more resources, and recruit elsewhere in the world for the UK. Some countries are recognized as being particularly strong in certain skills (for example, Italy for radio expertise). As Telco 2 observes, "Skill sets are coalescing in different geographic spaces." Many specialist labour markets in telecoms are international. This has some advantages where skills are not yet readily available through the education system and can only be acquired through job experience. As North America is ahead in 3rd-generation mobile telephones and related services, Telco 5 has been recruiting fairly heavily there, especially in marketing.
- **Recruit from Other Industries.** This helps to build expertise in sectors that are being targeted for products or services through the Internet.
- **Pay More.** Large firms actively monitor pay rates. Telco 1 has improved its rates to attract graduates, and Telco 3 gives a £2,000 'welcome bonus'. One aspect of graduate recruitment that is generally unstated, but to which Telco 2 alluded, is that new graduates are cheaper to employ. There are other reasons for recruiting graduates, and the cost of further training has to be weighed against this, but initially it keeps the salary bill lower. While the industry has a young profile at present (TVSC, 1999), in the longer-term it implies that firms' costs will rise. Large firms are becoming more willing to make offers outside their normal salary rates to attract staff for key functions - especially for sales jobs, where pay is a key motivator and sales staff are particularly mobile.
- **Manage the Whole Employment Package.** However, large firms generally do not like to break with their existing pay structures, because of the knock-on effects, and try to emphasise the whole employment package and being seen as a good employer (Telco 1, 2, 5).

- **Change Image.** However, as Telco 4 has found, offering a range of employment benefits is also not enough. Some of the newer skills, in multi-media and the Internet, are dominated by young people, with less traditional views of career. They are attracted by the excitement of working in fast-moving small firms, and the traditional career development 'deal' is no longer such a selling point. Large firms are therefore trying to "reinvent" their culture, and create the same ethos:

  > "We are very aware that it's a combination of the financial and the cultural. We have to reposition ourselves as a world leader in emerging technologies, and not just as a plain old telephone company. It's not just about the package you give on recruitment - it is transforming the image of the company so that it is perceived as being the place to work." (Telco 5)

- **Improve the Recruitment Process.** Many firms - especially the larger ones, who have been used to running large, rather slow recruitment processes - emphasize the need to speed up recruitment. Offers now need to be made within days, or a single day, to secure people. Smaller firms, like Telco 10, that have had difficulty attracting people, have attempted to build closer relationships with recruitment agencies, who play an important role in specialist segments of the industry.

- **Recruit and Train.** Modern apprenticeships are popular with many firms. Telco 4 has 23 employees (out of 550) on the telecoms scheme devised by the TSVC; Telco 5 has 360 in Networks; and Telco 2 has 80 (as well as sponsoring increasing numbers of 2nd year HND students (42 last year)).

- **Lower Entry Standards and Train Up In-Company.** This is an option used in limited circumstances. Telco 3 lowered its entry requirements for graduate engineers this year because it was getting too few applications. Generally, however, it insists it would not recruit less qualified people or compromise quality in recruitment. At Telco 2, where graduates considered themselves over-qualified for jobs in field engineering, they decided to recruit HNDs and train through modern apprenticeships instead, and "these have been a tremendous success". Within a strategy of generally looking for higher-level qualifications and continual upgrading of technical skills through training, Telco 10 has adopted a similar approach towards its software engineering function, as it feels more qualified recruits would get bored and leave.

- **Revise the Job Specification.** Small firms (e.g. Telco 10) sometimes have to reduce their list of requirements in order to attract sufficient applicants, but large firms do so as well:

  > "When we started to become more marketing-led, we thought we would take good engineers and bolt some marketing onto them. But it doesn't work very well. You end up with second-rate marketers, and lose good engineers. I would prefer to take people with the right marketing background and use them properly in association with engineers." (Telco 1)

- **Revise the Job Specification and Train.** Telco 10 has dealt with the problem of filling IT vacancies, by a combination of up-skilling and re-allocating work.

- **Buy a Company for its Skills.** Buying another company to acquire its skills is a serious alternative to recruitment or training, where speed is vital (Telco 1, 5).

- **Relocate to Other Countries.** As a global firm, Telco 3 is considering transferring some of its R&D to other countries, because of the difficulty of recruiting in the UK. It has already located some R&D in China as a way of securing business there. However, it has just substantially invested in new, enlarged facilities in the UK, so relocation is only marginal to its overall strategy. Similarly, multinational companies can ease the pressure in national labour markets by locating specialist development facilities (such as for software) around a number of countries.

This is a long list, and suggests a degree of pro-activity across the sector - more especially among the large firms. Smaller firms have focused more on improving their recruitment processes, adapting their entry standards and job specifications, and training recruits into specialised work processes. While this reflects the greater resource strengths of the large firms, it suggests smaller firms can play an important role in developing and utilizing intermediate level skills. Size is therefore an important differentiator as regards recruitment strategies, while the stage of development also plays an important role, as fast-growth new firms take staff from incumbent firms.

According to a senior figure involved in training for the telecoms industry, the majority of companies see high quality recruitment as an imperative at all levels. This is clearly borne out by the examples above, and it is clear that both large and small firms are pursuing such a policy. As the basis for enhancing skills (as we discuss in Section 7) and pursuing high added value product strategies, this is a positive sign.

However, the threat of relocating is a concern. The European ICT study referred to was spurred by concerns that the shortfall of such skills in Europe might lead firms to locate relevant activities elsewhere. Telco 2, indeed, came close to relocating manufacture of a technology invented on one of its UK sites to Israel. Where multinationals are organised around worldwide centres of expertise, they make assessments about the availability of skills locally. Thus, in an international market, MNCs decide where to locate on the basis of skills, not whether to compete.

7. SKILL GAPS

7.1 The Nature and Extent of Skill Gaps

In this section, we consider whether firms are hampered by skill gaps that arise from the people currently employed by the case firms being deficient in skill. This has been defined in terms of reported, unreported, and latent skill gaps - that is:

- What skill deficiencies do firms report?
- Are there deficiencies that are apparent to the observer, but not to managers, or to some managers but not others?
- Are there deficiencies that result in less efficient operations and inferior product strategies, than higher skills would allow?

Skill gaps can be conceptualised in three ways, corresponding to the life-cycle of firms and sectors:

i. Changes in technology and markets can create a general need for new skills which are not immediately available, either in the firm or market.

ii. Older firms can have a problem of obsolete specialist skills - the so-called 'skills inheritance' problem (Pettigrew, Hendry and Sparrow, 1989).

iii. Younger firms often have to develop more formal management processes and new management skills, as they move from an entrepreneurial to mature stage.

Our sample comprises older large firms, older small firms, and young new firms, and the industry has a high proportion of relatively new firms. While (i) reflects a general problem, other skill gaps can be related to the development trajectories of firms. Thus, Telco 5 has had a large 'skills obsolescence' problem in its network, as new transmission systems and improvements in efficiency have displaced large numbers of 'engineers'. Telcos 4, 9 and 10 are older SMEs which are having to upgrade their core skills in various technical areas, including marketing, business development, project management, and technical sales. Both these are examples of (ii). Telcos 6, 7 and 8, in contrast, are young firms that need to develop management skills, now or in the foreseeable future (an example of (iii)).

There is therefore a big difference between fast-growth new firms, like Telco 8, facing the pressures of rapid expansion in employee numbers, who know they have to put in place business systems, recruit professional managers, and define job roles and skills more precisely - and the small firm that simply lacks a long-term perspective and the management skills to take the business further. A large number of older SMEs in the sector, set up to exploit niche markets, are of this kind (personal communication, Ian Lorimer, TVSC). While Telcos 4, 9, and 10 fall into this group, they have recognized the problem, and have taken steps to renew themselves. It is important, then, to distinguish between the fast-growth and traditional firm, where the successful new firm is not facing a skill gap as such, but the effects of rapid recruitment. Nor are the management issues fast-growth small firms face the same as the larger firms, who need to turn specialised technical staff into broader business managers. What the smaller firm needs, in Telco 8's case, are managers who can bring discipline, through functional and job-specific skills.

The big issue for the sector, however, is the general problem implied by (i) - the requirement for new skills and new combinations of skill, which neither firms nor the education system can readily supply.

In 5.1, we distinguished five types of skill - (a) new technical specialisms; (b) hybrid technical skills; (c) software skills; (d) hybrid technical/business skills; (e) business and management skills. We can conceptualise the skills supply issue in relation to these, by saying that the problem of (a) (technical specialisms) is essentially one of basic supply from the education system, because these entail a period of basic study in scientific and technological disciplines. From the company point of view, this is a 'recruitment difficulty' - a straightforward resource problem of not enough bodies coming onto the market. The problem of (c) (software skills) is essentially the same - lack of sufficient people with the right educational background - although there is also a 'trainable' aspect in the need for continual upgrading of software knowledge, and therefore a responsibility on individuals and companies to take advantage of training through the highly developed system of external training providers. In both cases, closer partnership between industry and academia should lead to quicker identification of emerging skill needs and encourage student uptake of courses.

The real **'skill gaps'** lie with (b), (d), and (e) - **hybrid technical skills, hybrid technical/business skills, and business/management skills.** All imply broadening experience by in-company training and career development moves, and as such are a company responsibility. Recruitment philosophy can make some impact on these, insofar as firms actively recruit across industry boundaries or from different sub-sectors within telecoms, since these result in individuals having more varied experience. There are also implications for the education system to develop broader people, and this in turn implies closer relations between firms and the education system. The importance of generic and attitudinal elements for these skill areas also highlights the role of recruitment and selection processes (getting the right people), and company culture and structure (developing the people right). These distinctions fit the way companies think about the problem:

> "There is a resource shortage, which I classify differently from a skills shortage. The resource shortage is in some of the basic technical areas, like systems development. These people are a rare commodity, and we have not got enough of them. Probably, there are a finite number of them in the industry, who just move around. The challenge for us is, how do we widen the pool of people? The skills gap is more in the area of soft skills, such as whether the managers we have are capable of managing the changes we face." (Telco 2)

The description of skill needs in relation to these hybrid technical and business skills, in Section 5.1, is an explicit acknowledgement of significant skill gaps. The following quotations indicate the nature of the problem, and build on the comments in 5.1:

Telco 3

"People are very knowledgeable in their specialist area, but lack other skills. Last year we did a competency profile on 800 managers, looking at business acumen, people management, problem-solving skills, etc. But this environment is very much engineering and white males. So, communication skills and people management are not their strongest area. If they get promoted on their specialist skills, they fail in motivating and communicating with others, or helping to coach and develop. This is a very important training area. But they don't understand why these skills are needed."

Telco 2

"Engineers like to build things into black boxes and make them work. We almost have to de-skill that, and introduce business thinking. None of that stuff works unless it makes business sense. So we take people through the technical path first. They start in R&D, and have fun doing technical things for three or four years, understanding products, and what is possible and not possible. Then the good ones go into planning, and then, ideally, into sales and marketing, and eventually into management."

Telco 1

"The management problems - leadership and breadth of vision - are issues now because of the kind of organisation we are. Ten years ago, we were a much more hierarchical organisation, so people had authority from their position. Now we work in a much flatter organisation, on more of a project basis in teams, and what we need from key people is leadership skills."

Nevertheless, most firms put more emphasis on their recruitment difficulties. The limited supply of people in critical skill areas precedes all other considerations for most telecoms firms - "We just do not have enough bodies" (Telco 2). Consequently, they make little or no distinction between the effects of skill gaps and recruitment difficulties. The effects are slower development, increased costs, loss of orders, and missed deadlines - not only in terms of past performance, but also in terms of future growth plans and market positioning (Telcos 4 and 10).

Is there, then, a lingering suspicion that firms are under-estimating skill deficiencies? In answer to this we note that all the large firms use a range of tools to identify individual and company skill gaps. Telco 1, for example, uses appraisal; development centres for its 'young people with potential'; an 'organisational capability review' (whereby each business unit or function does an audit of current and expected skill gaps); and an 'organisational effectiveness survey'. Some smaller firms do similar things. For example, Telco 4 has recently audited its skills in relation to its growth plans, in order to identify skill gaps, and appraises staff regularly against skill and knowledge criteria. On the other hand, Telco 6 has no formal processes in place, and, as a very young company, its approach to skill needs is entirely reactive. However, as we noted in Section 4, being reactive to the market is actually a very sensible way for a new firm to establish its skill requirements. SMEs do not need all the paraphernalia of formal planning.

On the broader question of whether the case firms have accurately reported their skill needs and gaps, however, we would suggest emphatically that they have. All the researchers conducting case studies found interviewees very open and willing to discuss skill issues, problems, and their failings. The interview schedule comprised various probes, but usually there was very little need to press interviewees to disclose things. Information was cross-checked with a range of informants, and though this occasionally threw up differences of perception, there was mostly a high level of agreement in companies about the issues.

7.2 Reasons for Skill Gaps

What, then, are the reasons for the perceived skill gaps in hybrid technical and business skills? Skill gaps can arise because of poor quality (or the wrong) recruits, which in turn may reflect on the basic quality available, or on company standards and selection processes. Alternatively, they can be the result of inadequate, or inappropriate, training and development by the company.

- **Higher Education.** There is an implied (and actual) criticism of graduate quality and university curricula:

  > "A lot of the problems come about, not so much in the up-skilling once you've got people in, but in getting people with the right skills base, so that you can then train them." (Telco 1)

Caution is needed, however, in interpreting what firms are saying here. First, it is only one or two individuals among the equipment manufacturers who criticise graduate quality. As we noted at 5.4, company attitudes to qualifications are complex and often conservative, especially in the engineering professions. The trend is clearly towards recruiting graduates, and to a higher standard. The real problem is matching university curricula to technology development in firms.

- **Training.** There are two problems with training. The first is being able to keep up with the volume of (re)training needed. Firms recognize the role of training, and their responsibility for it, in supplementing graduate education. Graduates are not expected to have all the skills, but to complete their practical education in the company. But the speed at which the industry is moving is greater than the capacity of companies to develop hybrid technical skills through in-company training:

  > "It is expecting too much for a graduate to come ready-skilled for work in the industry. So, we'll always see a need for up-skilling. But it is the time you need to train people. The industry is moving so fast that you need people skilled yesterday. The rate of change is outstripping the rate at which we're training, and the gap is increasing between the two." (Telco 1)

  This puts pressure on the HE/FE system to develop people with flexibility and learning skills, and on companies to develop quicker ways of delivering training:

  > "We used to have the luxury of 5-10 year lead times for developing skills. Now we are down to as little as six months in certain software features. We need to develop educational scenarios that anticipate." (Telco 3)

The second problem is timing the development of new skills, or knowing whether those skills will be needed at all. While this might be seen as the classic failure to invest in good time, it involves, on the one hand, the problem of new learning fading if it is not put to use quickly, and, on the other, the commitment of substantial resources which may be wasted:

Telco 3

"Why haven't we begun retraining earlier? It's not so much a question of cost, but what do you retrain for? The dynamics of the market are such that, although we can plan for our packet-radio system, and our multimedia, the timing of when we want the packets is a very complicated exercise. As an industry, we are entering a market that is not defined. It's not like designing a new car where you know its requirements. Our industry is changing day-by-day, month-by-month, and you are getting tremendous convergence.

"The service provision of tomorrow will not be mainstream British Telecom or the mobile operators. They will be Reuters, American Express, Pearsons and Longmans. Those with information will be the most powerful. We are entering a world, where the power base is moving towards information, and as that moves, it moves onto a platform of technology that we provide. Our job is to marry the platform and new services in a world that is overlapping between Internet, wireless-Internet, and satellite. Those worlds are all vying for the same market-place, and as such the services will become legion.

"No longer will you have just one choice of service, through the copper-wire telephone line, or through the computer terminal. You will have a choice, through two or three routes, to the same service provision. It's the dynamics of that which adds to the complication and complexity as to why training becomes so difficult to time. Because if we train them, and that piece of the market doesn't take off, we have wasted a fortune. We need to be sure that where we spend on development will lead to a tangible result. As we move into the world described, there are fewer guarantees than ever before that we can make money - whereas today it is easy, because everyone wants mobility and voice. It's a guaranteed market.

"But, in the high-speed multimedia, information world of tomorrow, there is no guarantee that we, in the wireless world, will get sufficient of it, because the satellite world, broadcasting world, and Internet are accelerating at the same pace. They will want to steal mobile customers from us, and will do so by providing service provision in outlets, such as a shop, where you will have access to your e-mails. That world will attack some of the mobile world we thought we had, and that is where the dynamics of change are quite terrifying."

- **Development.** Given the importance of experience for many of the new hybrid skills, criticism by companies of their own career-pathing and development systems is surprisingly muted. Some of the larger firms acknowledge the need to be more proactive (Telco 1), but the requirements for broader skills are largely defined in terms of individuals' limitations, not as a failure of policy and company organization. The way corporate structure and culture frame the opportunities for, and the style of, employee development is crucial in broadening skills. However, moves towards flatter, less functional, more project-oriented organizations, described in 5.2, are a tacit recognition of this. Small firms, who cannot easily offer progression, are well aware, however, of the shortcomings of their career management - for example, Telco 9, for whom "the notion of career progression has only emerged in the last 12 months".

7.3 Company Responses to Skill Gaps

The test of whether companies are serious about skill gaps, however, is what they are doing about them. An absence of activity might suggest there are 'unreported' skill gaps, which they are prepared to live with or do not recognize. We will describe initiatives the case firms are taking and contemplating as a whole, and then compare their performance. **A high skill culture results from a combination of factors:**

- quality recruitment,
- initial training,
- continuing training,
- retraining,
- systematic training,
- a learning culture,
- an organisation that facilitates this, and
- human resource management systems that support all these processes.

- **High quality recruitment** is regarded as essential to be able deal with skill gaps, and almost all firms have raised their entry standards.

  > "We would rather struggle by with fewer people, than recruit the wrong people. We don't expect to be able to take on experts, but we expect to take on people at a level where we can then train them." (Telco 1)

  As a result, firms expect to develop more extensive liaison with the education system. This needs to be a two-way collaboration. In addition to the kind of liaison described under recruitment, this includes joint development of tailor-made courses (Telco 1, 2, 5), and sponsorship of research. Sponsorship not only delivers useful research, but gives a company favoured access to good quality students.

Telco 2

"We should be upskilling the marketplace through sponsorship in technical colleges, and certificating skills. If I were running a university, I would be looking for lead companies, like ourselves, to provide equipment. So, students could learn on our equipment and come out of university ready to take on real responsibility. I am also a strong supporter of placements, which give an assessment opportunity to the student and the company. It is also a great way of influencing the curriculum. Students going back into university after industry placement should be in a position to say what features of the curriculum need to be emphasised. In fact, they should be asked by the university to do this."

Telco 3 takes a similar view, but has been inhibited by lack of structural cohesion (through being run from the USA) from engaging effectively with the university sector:

> "We must review the inputs, and go back to the root causes in the educational system, and decide how we can we change it. If we can make those changes, our educational system will benefit almost as much as we will, if not more. I believe ultimately that we will have to let industry and commerce shape our educational system." (Telco 3)

However, others see risks in developing over-close relationships:

> "Universities should provide graduates with the right basis in their discipline. We can't expect much more, unless we say, 'Be a centre of expertise for us, and we'll give you as much knowledge as we've got'. This is quite a dangerous thing to do, because you don't know who else is watching." (Telco 1)

The balance of influence between companies and the education system is a sensitive issue. As North American firms, Telcos 2 and 3 are used to having such influence, and Telco 3 actually runs its own company university. Company influence on undergraduate and FE courses they draw directly on benefits everyone concerned; similarly tailor-made Masters courses for company employees. Company requirements for skills are not so unique that either is likely to put significant limitation on the transferability of skills.

Quality recruitment may need to be complemented by an outflow of obsolete skills and less qualified people. Some firms see increased labour turnover as desirable:

> "Turnover is currently too low, as the aim is to remove people performing in the bottom 5%, to raise the quality of new and existing staff." (Telco 4)

- **Initial training.** The large firms engage in extensive training of graduates to develop the special skill-sets they need, and accept that they are going to have to give new graduates a lot of training. All have broad-based graduate development programmes lasting 2-3 years, and monitor their progress through such means as 'personal development plans' (Telco 2). Specific programmes that address the need for 'hybrid skills' include Telco 1's 'Network Skills Development Programme'.

- **Continuing training.** Large firms engage in extensive training of professional employees. Continuing in-house training is regarded as essential, especially where many are global companies operating at the leading edge. Telcos 1, 3, and 5 all spend around £1,000 per person per year on formal training - equivalent to around 5 days - in addition to on-the-job training. Telco 2 spends around £60m, equivalent to 6-10 days per person, and has more than 200 technical trainers in Europe. Small start-up firms, like Telco 6, not surprisingly provide very little training (1-2 days of mostly induction training), because they are absorbed in bringing to market the projects on which their immediate survival depends. However, specialist firms, like Telcos 9 and 10, encourage their software staff to continuously update their technical knowledge, through internal training or externally funded courses. Telco 10, for example, spends £3,500 p.a. per person using the Microsoft Development Network, and sponsors staff on a range of other manufacturers' courses.

  In addition, some of the large firms have introduced 'crash' courses to train employees in new skills (especially IP). While Telco 2 aims to add this to the existing skill-sets of the software engineer, Telco 5 has an ambitious training programme to develop IP at an 'expert' level for hundreds of such employees, and at an 'awareness' level for thousands more.

- **Retraining.** The above example represents 'upskilling', rather than 're-skilling', since it builds on skills and educational achievement that are already compatible. There is less evidence of re-skilling, in different skill-sets, to obviate redundancy. Nevertheless, Telco 5 may give greater emphasis in future to re-skilling employees, because of the increasing numbers of middle-ranking employees with obsolete skills, and the increasing seriousness of the shortfall in emerging skills. In the past, it has relied far more on voluntary redundancy to rebalance its skills.

- **Systematic training.** According to the TVSC, most UK companies in telecommunications work to TVSC occupational standards, and all the large case firms, and a number of the smaller ones, are members. In addition, a number of large firms sponsor custom-designed degree and HND courses, which go beyond the basic standards. Telcos 2 and 5 are the most active, with Telco 5 having a modular in-house Masters degree, taught on site by a university provider, and 300 staff registered on the course.

  Training certification relating to products is also increasingly common. Equipment manufacturers and software firms require those who install and commission their systems/products to have completed accredited training. Telco 2 is making a major investment in accreditation for external contractors and its own staff; while Telco 4 (as an installer) is a big user of accredited training programmes. (These include Lucent, Microsoft, and Cisco, the latter operating a highly systematised system of training through a network of certified training firms.)

  With many fast-growing new firms relying on poaching experienced people, the point at which firms develop systematic training becomes a key issue. Previous studies have shown that rapid growth in employment tends to stimulate an overhaul of training systems in SMEs at around the 5-7 year stage of development (Hendry, Jones, Arthur and Pettigrew, 1991). This has particular relevance for the mobile phone companies, which have been prone to job-hopping and are around this age. Two of the mobile companies not in this study have initiatives to train their call centre staff more thoroughly, and Telco 7 has also recently introduced a major training programme. It sees the mobile phone industry as having distinct skills and reached a point where in-house training has become essential. The roles and skill requirements of call centre staff have been systematically analysed, a 3-year NVQ-based apprenticeship developed, and substantial investments made in training.

- **A learning culture, and an organisation structure that facilitates learning.** Becoming a 'learning organisation' is a matter of mind-set and structures (Jones and Hendry, 1994). The mind-set says people are an investment that needs to be topped up:

> "A graduate recruit comes with a certain amount of intellectual capital. From the moment they come to us, that capital begins to depreciate, unless it is topped up by experience, training, salary. As long as that intellectual capital is increasing, their anxiety can be kept at bay, and they will not be so tempted to look in the job market. Once staff begin to feel that intellectual capital is declining or depreciating, it sets in train a frantic search to trade it before it is too late." (Telco 1)

The mind-set also involves a recognition that people can grow their jobs, and grow with their jobs. This is important in high-skill areas where technologies are continuing to develop:

> "When you get down to specific skill-sets in optical products, you can't recruit or train from an established model. These are new products, so you're very dependent on managing the learning process and people evolving their jobs positively. The key to the company culture is the emphasis on the individual and their ability to collaborate." (Telco 2)

Heavy graduate recruitment, new firms attracting young people into the industry, and 'release' schemes for older staff in traditional telephony, mean that the telecoms industry has a very young age profile (TVSC, 1999). Telco 3, for example, has an average age of 27 in engineering. This not only suggests scope for continuing renewal of skills, but a need to provide such opportunities to keep staff.

In addition, organisations need to build in structures and opportunities for continuous learning. Some large organisations, with well-developed training systems at craft level, are now emphasising open access and "self-teach" facilities, and developing new ways to deliver training (such as interactive distance learning). This does not imply training becoming haphazard, or left to chance, since it has long been recognized that distance and open learning need close support. Instead, it is a way of getting people to take initiative to develop their skills, in short bursts, and to "move on from the formal training culture of NVQs" (Telco 2).

Flatter, more open structures are seen by the large equipment suppliers, and others with a big R&D organisation such as Telco 5, as necessary to encourage learning. Thus, the conventional view is that flatter structures support broadening of individual skills and knowledge, through teamwork and wider responsibility. This may apply in project management settings, but does not necessarily support management development or where the organisation performs routine tasks. Supervision, performance review, and mentoring become more important. A flatter structure is actually at odds with mentoring as a process to develop the individual. Flat structures mean wide spans of control, and therefore make it harder for managers to give close attention to their subordinates' development.

Telco 7 has clearly grasped this point in introducing structural change to support its overhaul of training and development. The old organisation, below senior management level, was a conventional bureaucratic structure, designed to deliver a relatively routine service through operatives (CSRs), trained to deliver a standard service over a telephone help-line. A revised structure, implemented early in 1999, removed one level of supervision, but added more middle-level team supervisors and changed their role, to provide closer support to the front-line CSRs. In addition, a new role of coach was created, to give full-time support to the mentoring process at CSR level. The new structure is designed to support continuous learning through feedback-loops on performance. The success of the new system can be seen in the reduction of labour turnover, reduced customer churn, and improved call quality.

- **Supportive human resource management systems.** Finally, recruitment, training and learning need to be supported by other HR systems and processes:
  - The HR function needs to be organised so that it has a clear view of the overall skill resource, and can ascertain skill needs. Telcos 1 and 2 are developing more cohesive structures that will assist this. Although Telco 3 is an open organisation, with a strong belief in the individual and organisational renewal, its UK structure has made it difficult for the HR function to give a concerted lead. A 'coherent' structure also entails closer liaison between product divisions, where specialist resources tend to get dispersed.
  - HR software packages have begun to provide much improved information systems for monitoring and reacting to skill gaps. This is particularly important for the large organisation where information can be very dispersed. Both Telcos 1 and 5 have adopted the American HR planning package, 'PeopleSoft', which includes a facility for recording skills and competences. Telco 1 has an existing system for defining sets of generic competences in hardware and software engineering and in project management, against which it can measure individual competences. A complete audit has been carried out of the knowledge, experience, education and training of the engineering field force, and both this and engineering competences are being migrated onto the PeopleSoft database. This is then used as a core process to manage recruitment, career development, training, and resource allocation.
  - In time, this may enable a clearer specification of skill needs arising from technology, and identify the accompanying training needs:

    "I use the analogy of a 'bill of skills', like 'bills of materials' to manage products and plan supply chains. I believe when we introduce a technology into a product, we should define a skill profile on a 'bill of materials' principle, so that we know how much of each particular sort of skill (software engineering, optical electronics engineers, test engineers) we will need." (Telco 2)
  - Career development needs to ensure cross-functional moves that develop broader leadership and commercial expertise for professional staff. For example, Telco 4 has introduced "nurseries, where engineers are taken out of engineering, and seconded into business development". This may mean sideways transfers - which requires a more active approach to career management - rather than leaving training and career development to be driven by individuals seeking promotion (Telco 1).

- Career structures and pay, in particular, need to reflect the importance placed on management and hybrid skills. Thus, Telco 1 is changing the emphasis of its reward systems and career paths for engineers to make management roles more attractive.

In summarizing the responses to skill gaps, it is clear that again **firm size is a key differentiator.** Larger firms engage in a much wider range of initiatives, although, as their more developed HRM systems suggest, this is partly because they need to manage a more complex skill base. Smaller firms concentrate on systematic and continuing training with a technical focus. This does not necessarily help them, however, with skill gaps to do with hybrid technical/business skills and business/management skills.

7.4 An Assessment of Skill Gaps

In Section 3.5, we argued that the business strategies of the case companies generally indicated a very clear perception of what was necessary to compete successfully in the rapidly changing world of telecommunications. In Sections 5.1 and 5.3, we described companies' perceptions of the skills needed to deliver these strategies, and the changes this meant in occupational and generic skills, and in employee attitudes. In Section 7.1, we noted that this description of skill needs could be seen as an explicit acknowledgement of significant skill gaps. The extent of company responses to develop skills, which we have just detailed, would also indicate they are serious in addressing these. We would, therefore, be very reluctant to suggest they have 'unreported skill gaps', of which they are unaware or have adapted to (with negative effects on their strategies and operational performance). There are ways, however, of testing this conclusion:

1. **How do we know they do what they say, in dealing with skill gaps?** There are a lot of "should's" and "must's" in these statements. We have direct evidence, however, that some, at least, of these activities exist and are being implemented. We have seen the documentation for training programmes and talked with line managers about their involvement in these. We can corroborate some of the facts about their approaches to training and development from prior knowledge of some of the firms. We also asked a senior figure involved in the training system for the telecoms industry to comment on the list of initiatives relating to learning and training. In addition to citing a number of our case firms as good examples of particular practices, his comments indicated that many of these practices were common across the industry. For example:

   "The majority of telecommunications companies see high quality recruitment as an imperative at all level."

   "Extensive training of graduates is undertaken across the board, and there are good examples of good practice."

   "This is essentially the case also in the training of professional employees."

   "Certificated training is increasing, with significant take-up of masters courses."

   "Certainly the large companies see themselves as promoting life-long learning. 'Investors in People' is increasingly being seen as a benchmark."

Ian Lorimer of the TVSC likewise commented that:

> "Some of the firms in this sector work like R&D organisations, seeking to continuously upskill their people, so they can be prepared for working with new technologies as they are developed."

These are pretty strong testimonials, and independent corroboration, of firms addressing skill needs. However, both observers have reservations about smaller firms.

2. **Do people actually have the skills they are supposed to have, or need, in order to perform effectively and to deliver the intended strategies?** That is, 'are there skill deficiencies that result in less efficient operations, than higher skills would allow?'

   In Section 5, we observed that key skills in telecommunications - in areas such as design and project management, network management, and even manufacturing and service operations - are relatively 'invisible'. They are difficult to observe in a cursory inspection, and certainly not in a way that allows the observer to evaluate whether a person is proficient or not. Other studies that have attempted this, such as those by the NIESR, have done so by focusing on measurable and narrowly defined activities (such as bank lending transactions) within specific skill-sets, supported by operational performance data. Call centre skills could be assessed in this way; so could product assembly activities among the telecoms equipment suppliers; so could equipment installation times by installers. Each of those is a project in its own right, however, requiring matched samples, controlled conditions, and specification of the relevant skills in advance.

   The important activities in telecommunications - software, design, project management, and marketing - remain extremely difficult to observe and access. To illustrate what would be required, IS skills were recently comprehensively studied in a project for the IT National Training Organisation (Courtney, 2000), involving 15 months to produce a framework of IT/IS skills, 9 months to validate and test it, and estimated costs of over £600,000.

3. **Is there evidence that some case firms perform significantly less well than others, as a result of skill deficiencies?** Lower performance might indicate 'unreported' skill gaps, or even shortcomings in the present strategy - in which case there could be 'latent' skill gaps that would emerge if they tried to upgrade or refocus their strategy.

   - **Are there high-performing firms that do better on account of their skills strategies?** As we noted in Section 2, many of the cases are leading firms internationally or in the UK market. It is very difficult, however, to say there is a correlation between their business performance and their skill strategies, or that some firms currently have 'sustainable strategies' and others do not, for the reasons set out in Sections 1 and 3.5. Telco 2 is certainly one of the most admired firms; it is a world leader in its business area; and it features constantly in our descriptions of innovative and proactive strategies for recruitment and skill development. It aspires to be 'learning organisation'. On the other hand, people acknowledge significant problems, in developing hybrid technical/business skills and recruiting other skills:

Telco 2

"The skill-set has certainly changed over the years. We are probably accumulating new skills quicker than we have done historically. Whether we are accumulating the right skills, and whether we are applying them in the right way, is questionable. We are probably accumulating technical skills faster than we have done previously. But whether we should be accumulating technical skills, or the capability to take the technical proposition to the marketplace is the issue."

Equally we could point to a firm like Telco 5 that understands very clearly the way the telecommunications industry is going, takes skills issues and its responsibilities for developing skills very seriously, and is among the most admired for its recruitment and training. Its success, however, is highly dependent on regulatory decisions that affect its market position, the speed with which it responds to new market opportunities (which is governed by many factors as well as skills), and the way it presents its strategy to retain investor confidence (to avoid the threat of a takeover).

- **Are there differences between market segments?** Differences between case firms are a result of the segments they operate in, which, in turn, are a combination of size, age, and life-cycle effects. Firms in different segments face different challenges:
  - Equipment manufacture is dominated by large multinationals (with a large hinterland of smaller component manufacturers). Most of these are long-established. The challenge for them has been to move with the changing technologies, by organic growth or acquisition. They depend on technical excellence and increasingly flexibility.
  - In most countries, national fixed networks are dominated by one or two carriers that have been around since the public telephone system came into being. The challenge for them has been to broaden their service range, and transform their culture and skill base.
  - The mobile networks are dominated by medium-to-large firms, which are getting increasingly large as the industry consolidates. Their problems are those of young firms - and moving into profit after building their customer base.

  The issues for each are highly distinctive, with specific skill-sets affected by the degree of market uncertainty and product/service complexity. The major performance change has been the advance of mobile telephony at the expense of fixed networks. But this is about seizing a new market with a new set of skills, not about the inherent quality of skills on either side. Where new entrants, in the form of mobile phone companies, have had a significant impact is in stimulating a stronger customer orientation among incumbent firms, through new ways of organizing and by the example of their own marketing approach.

4. **Are there 'latent skill gaps' that arise from the fact that some firms may be following strategies that are not sustainable in the longer-term?** In describing the aims of this study, we considered the hypothesis that 'better performing firms will have identified sustainable product strategies, and developed effective skill strategies for resourcing these'. In Sections 1 and 3.5, we argued, however, that it is very difficult to make such judgements about the telecommunications sector, primarily because of uncertainties about the future shape of its markets. The future is assumed to lie with mobile telephony, data traffic and the internet, and the sums paid for 3rd generation mobile operating licences reflect this belief. However, the rapid re-assessment of e-business prospects should be a warning not to make over-confident assumptions about how consumers will use technology.

Although we cannot easily make judgements about the 'quality' of firms' strategies, latent skill gaps certainly exist because of the continuing reconfiguration of the value chain. Case firms like Telco 10 show the effects of this, where they failed to read the way their market was changing. In these circumstances, it pays to keep open a range of options (Telco 2), or to have the organisational flexibility to adjust quickly. While some large firms may be slower to react (Telco 5), they at least have the advantage of resources to pursue a number of options simultaneously.

Size is therefore a major issue, which differentiates the product-market and skill strategies of firms. The problem of a 'sustainable' strategy for the small firm is a result of the very thing that ensured initial success - concentration on establishing a niche (Barber, Metcalf and Porteous, 1989; Hendry, Arthur and Jones, 1995). There is an immediate skill gap in not having a broad enough management base to maintain market awareness, and a latent gap in the possibility that its skills could become ill-adapted to a changing market. Technical skills recruitment and training may be excellent (as at Telco 9). But the perception of the market and the ability to influence it is limited by size and, often, by preoccupation with its own technology.

The installation and maintenance segment illustrates the problem, where many small firms are concentrated. Their relationship with suppliers (the equipment manufacturers) is crucial in coping with the shifts in markets and technology, and hence not being caught out with latent skill gaps. Spedale's (2000) study illustrates this, and the risks of an overly-technical focus.

Company D, in her study, aimed to be a 'willing partner', as a sub-contractor for a few general equipment suppliers. Significantly, it was the largest of the four cases - large firms not wanting to deal with very small firms. Company C, in contrast, had avoided being locked in to large manufacturers by confining itself to specialist providers in fibre optics, and serving a well-defined group of customers. Company E maintained its independence through its monopolist position in its local market. Company F was the most vulnerable. Its strategy was based on advanced technological knowledge for specialist applications, which it gained through the American connections of its owner. By this means, the owner/MD hoped to avoid becoming subservient to the big manufacturers, whom he saw as wanting to standardise around their own products. Paradoxically, however, this 'high skill' technical strategy - where (as the MD put it) they were all "in love with the technology" - put it commercially at risk, because it limited their flexibility.

What constitutes a high-skill strategy, from a commercial point of view, is therefore not altogether clear-cut.

7.5 Recruitment and Skill Gaps: Are Present Actions Likely to Create Future Problems?

A final question for the research is whether recruitment difficulties and skill gaps are related. The theory of a 'low skills equilibrium' sees the problem originating in the quality of recruitment, which provides a poor basis for continuing upgrading of skills. Are responses to recruitment difficulties in telecommunications likely to lead to skill gaps, or make them worse?

The attitude of the case companies is very positive on recruitment. High quality recruitment is seen as an imperative for enhancing skills as the industry moves on. Apart from continuing advances in technology, the main dynamic in the industry is the reconfiguration of skills along the value chain. This opens up skill gaps within firms - staff are expected to do new or additional things, and broaden their skill-sets. In recent years, the value chain has been extending forward into new services, and pulling firms, back along the chain, into new shapes. There is a recognition of this, especially among large firms, who have a good view of overall developments, which is why they see high quality recruitment as essential. The difficulty of recruiting sufficient numbers is much the bigger problem.

A second issue is outsourcing. A certain amount of this is traditional in the telecommunications industry, in the outsourcing of lower added-value installation work, and both old and new network operators do this. However, we are seeing more of this now in areas of relatively high technology. Telco 2, for example, is engaged on a strategy of outsourcing much of its manufacturing, including photonics, to "world-class contract manufacturers". Telco 3 is now also following a cost-reduction programme, and expects outsourcing of its "non-strategic" manufacturing (and parts of its engineering) to increase substantially over the next ten years. The reason firms are able to do this is the growing maturity of the components industry, greater reliability, and a wider choice of suppliers. However, this does imply skills in building sub-systems at the supplier level. All of this is a well-trodden path in other industries, such as motor manufacture and defence procurement, and network operators like Telco 5 went through this process of withdrawing from technologies they no longer needed to control some years ago.

The impact of such outsourcing may not be adverse, but will certainly upset the distribution of skills. The danger is when outsourcing is undertaken as a way of avoiding a skills problem - as a substitute for recruitment, or worse, as a substitute for developing a firm's own skills. Outsourcing is usually seen as specialisation - a more efficient way of allocating resources across the industry. What guards against using outsourcing to shift the skills problem elsewhere is that it is highly unlikely major international firms would do this without carefully scrutinizing prospective suppliers.

> "One of the reasons we are forced down that route is that we can't get the skills in engineering. So you sub-contract work to a company that has them. I'm focusing our manufacturing on our core technology, but I'm allowing joint ventures to focus on the non-core. So we are outsourcing the parts that are not 'crown-jewels'. That is a very useful way of overcoming lack of skills. Software companies are now growing at an increasing rate because of outsourcing, and that will be a big factor in the skill dynamics." (Telco 3)

The interaction between recruitment strategy and skills is, therefore, in general very positive. Almost all firms have raised their entry requirements, and consequently have a better base to build new skills on. What they do emphasize, though, is the need for a partnership between firms, education, and government as the basis for an effective skills strategy, and this is the concluding message of this research. Where policy can have a concerted impact is in promoting telecommunications as a career, stimulating the uptake of existing university courses in telecommunications, and ensuring the university and FE system is responsive to the changing requirements of the industry, in terms both of numbers and new disciplines:

Telco 5

"Some of how we tackle new skill needs will be organic. A lot will come from the recruitment process, and some from retraining. But I don't think huge amounts will come from retraining. I would expect recruitment to contribute a lot. I share what's probably a big concern, whether or not the university education process is going to drive that development fast enough and deep enough. It's a combination of curriculum emphasis and the speed of transformation. The problem is the running is being made by the corporations. That's where the knowledge is, and there's not the incentive for people with up-to-date knowledge to be working in an academic environment. It's one of those areas where government and enterprise really do have to come together and solve the problem. It's a worldwide problem, not just a UK problem."

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APPENDIX A:
STRUCTURE OF THE INDUSTRY AND THE CHOICE OF CASE FIRMS

In telecoms, privatisation and liberalisation are farther advanced in the UK than elsewhere in Europe. The traditional means of offering telecommunication services - by a vertically-integrated incumbent, who built and maintained a fixed local access and backbone network - has been transformed in this deregulated environment. Whereas ten years ago there were only two firms - BT and Mercury - operating public telephone systems (PTTs), today there are more than 100 licensed telephone operators, and the UK is the only country to experience local loop competition.

While BT retains a dominant position in the local loop and backbone network, with 70% of national calls and 81% of local calls over its network (BT Annual Report, 1999), and an estimated 70% of international calls (according to Oftel), its fixed network faces competition from:

(1) Cable TV companies who have laid fibre-optic local networks that can be used for residential telephone calls with a modem.

(2) Specialist telecoms operators who have laid fibre-optics networks in high-user business areas, such as the City of London (now with three new operators).

(3) Specialist operators using fixed radio access technology (FRA) offering a broadband data service (ie. fast, high capacity transmission) to businesses (for example, in Berkshire, with its concentration of high-tech SMEs).

(4) Mobile telephone operators (using radio technology via cellular transmitters), who compete in both the local and national loop.

(5) National and regional competitors who are able to link into and buy space on BT's fixed network (under the terms of BT's operating licence) to sell services, plus resellers of BT's own capacity.

Competition is thus both a matter of geography and technology, with BT's legacy copper system competing with fibre-optics and mobile radio (wireless) telephony, and all of these affected by developments in fixed switching systems, and the ability to send data in 'packets' using digital technology and IP (Internet protocol).

In addition to the network operators, the industry also includes:

- Equipment suppliers (for fixed transmission and mobile phones).
- Firms providing specialist support to the carriers' fixed networks, through installation, testing, and maintenance.
- Other forms of specialist support and consultancy to large users of telephone systems (such as call centre operators).
- Providers of end-user customer services, especially Internet services (although these will also be provided by firms further back in the industry chain).

Our cases cover the complexity of the industry in terms of these different, but linked, segments, and competing technologies.

APPENDIX B: SUMMARY DATA ON ESTABLISHMENTS AND PRODUCTS

Co.	Region	No. employed in estab't	Annual sales or budget, £	Rate of growth/ decline	Single site, UK multi- or MNC	Main product/service	Quality position	Scale of production/ degree of product customisation	Main customer/ end-user
T01	Site: Midlands Division: UK, Group: world	Approx 3,000 (of 25,000 worldwide in division) out of group's 75,000 worldwide	Not given for estab'mnt only as part of division of the MNE i.e. £1,858m business in 1998/99 of MNE's £7,625m turnover	Growth	UK-owned multisite	Telecoms equipment and services, but others in rest of business not covered in this case.	World leader in its technology	Custom-designed systems	Telcos, (network operators)
T02	UK	6,800	$17.6bn world UK ~ 10%	20% world growth	MNC	Telecommunications hardware, software and services	High	Customised solutions using standard components	Public and private network operators. Multinational companies
T03	Thames Valley site studies	9,000 (UK)	$30bn world; UK export sales £2.8bn	Previous one year fall in sales now turned round	MNC, with multi-sites in UK Foreign owned (USA)	Company wide: integrated global solutions & embedded electronic solutions, involving wireless technology Site: GSM infrastructure production, design & development	Applies Six Sigma quality process. Global leader	High degree of customisation	Mobile phone operators
T04	North East	550		Static	UK Multi-site	Supply, installation and maintenance of telephone CTI to call centres	Industry leader	Attempting to move from tendering to providing consulting services so increasing product customisation in a partnership role & helping to advise customers	Corporates, government & institutions

Continued

Appendix B continued

TO5	UK	119,000	£18,223m	7% profit growth	UK multi-site	National and local loop network operator	UK Industry leader	Commodity – i.e. Licence requires it to provide telephone services to all.	Individual and business consumers
TO6	Thames Valley	25	Start-up		Single site	Internet service provider	High	Moderate - specialist service	SMEs and homeworkers
T07	South and NE (call centres)	5,000	$1,213m 1998	170% subscriber increase	Multi-site in UK	Design, construction and operation of a national UK digital personal communications network (mobile telephone service)	Best innovator; poor on retail; good on rest	3rd out of 4, but close to 2nd/prolific innovator of new products	SMEs and individual consumers
T08	London (SE)	75	n/a	High	Single site	Provision of wholesale high capacity bandwidth, and co location facilities	Moderate	Small but growing very fast/ aim for customised service	Other Telcos
T09	Surrey	500	n/a	Stable overall, but increasing at over 100% per annum in the telecoms area	Single main site with three satellite units	Multimedia software and systems development and testing for the major telcos	Very high	High	Major telcos
T10	Central England	96	Est. £12.5m	Growing but below market rate	UK	MIS providing real time data to improve management decision making and agent monitoring tools for call centres	Operating in a declining market	Some customisation depending on software flexibility	Call centres

APPENDIX C:
THE CASE COMPANIES

Telco 1 is a UK multinational specialising in the production of advanced telecommunications systems and equipment. It is a world market leader in transmission equipment linking exchanges across and between networks, using SDH technology. Its other area of expertise is in photonics, which it sees becoming increasingly important to its strategy. It has recently made a series of acquisitions and disposals to strengthen its international position in these technologies and markets. Its aim is to move out of traditional telecoms equipment supply (where the emphasis was on switching systems for voice) to offer complete turnkey solutions, with an emphasis on data transmission:

> *We have tended to cling onto our traditional markets slightly too much. We've tended to be a survivor rather than anything else. Part of the expansion strategy is to be more a world force in those areas that we clearly are not leading in.*

In the past, it had a captive market in BT, who bought from UK companies. It could sell product without being especially innovative or cheap, while BT had the technical expertise to specify its requirements. Now:

> *Increasingly, the operators are no longer telecoms companies like BT, who knew where to go. They are increasingly cable operators, one man and his dog, who just want to make money. They want to buy a complete system, and have it maintained and installed, even managed by us. The new market operators don't always know what they want. So it's a case of offering them a consultancy package. They are not recruiting to operate totally on their own. They are expecting suppliers to do it, and trying to keep their own headcount down. Therefore, by default we're expected to do more.*

Telco 2 is a North American MNC, with a long history in analogue switching systems for voice. Now it produces digital networks of all kinds, and has recently made a major acquisition to strengthen its position in packet-switching for data. Its customers include local and long-distance telecoms operators, cellular mobile phone operators and business users, cable television companies, and local access providers. It covers the full range of technologies (with the UK business specializing in opto-electronic (photonics) devices). From this base, it aims to provide complete network solutions, combining hardware and software. Its strategy is to do this through a network of 'system houses' in different countries. At the same time, the maturity of the hardware component industry is allowing it increasingly to outsource its manufacturing (whereas before it was vertically integrated, with a considerable manufacturing resource). This also reduces its cost base in its competition with other global companies.

The features of its business it emphasizes are - the ability to build systems with vastly increased capacity, at much reduced cost; the need to build these "for applications created by companies who will have no knowledge of networking issues"; the need for open architecture in such systems so that they can be built on existing networks, be compatible with competitors' equipment, and allow for future upgrading; to build for reliability, but "in double-quick time":

> *Our customers are new entrants to the business. They are not the PTTs. They have invested money in acquiring and operating a network, but they will not have the technical skills to be able to do this. So they look to us initially for support and as a source of skilled labour. In the old days, someone like British Telecom would have designed their own network, but a lot of the new competitors do not have this capability. All they are interested in is winning as many customers as possible onto their network and being able to offer a reliable quality service. We aim to supply complete networks to the customer, complete turnkey solutions. We manage the supply of components and sub-systems, and effectively pull products from all over the world. We have the ability to manage the global supply chain. We continue to lead on very proprietary high technology, but we will integrate other peoples' products in any solution that we supply to the customer.*

Telco 3 is a North American global leader in integrated communications solutions and embedded electronic solutions, involving wireless technology. It aims to move up the value chain to provide "total network solutions", while its customers emphasise that they don't want to be trapped in the proprietary products of single manufacturers. This means open, extensible frameworks on which others can build. It seeks to rely on superior integration components and reduced cycle times for product development (ie quicker innovation) and for manufacture (ie reduced cost):

> *People are always looking to deliver something tomorrow that is substantially more cost-effective, easy to install, and easy to implement. The industry is typically experiencing an average selling price reduction of 20% per annum. Few industries face that sort of pace. Every two to three years we are effectively delivering a new system backbone - whereas in the early 1990s this would have been every five years. And that, if anything, will accelerate.*

It is gearing up for the move from voice only to data and multi-media capabilities on its mobile phones. It sees this as fulfilling a different purpose to fixed networks, which can already deliver enormous bandwidth.

Telco 4 is one of the UK's leading independent suppliers and maintainers of business communication systems, involving telephone systems, computer telephony integration, call centres, networking equipment and cabling. It has 6,000 customers across the UK, and strategic partnerships with major equipment vendors. It has recently installed one of the first Voice-over-Internet-Protocol networks in the UK. It aims to position itself as a leader in converged voice and data solutions, and has identified the call centre market as an opportunity for this, as they begin to use different media and become 'interaction centres' rather than just 'call centres'. It recognizes the need for "open solutions", where it is not tied to any particular manufacturer or product, and for "total solutions", working in partnership with customers to develop their systems. The challenge it faces is to develop a more consultative style with customers, instead of, as a traditional contractor, just responding to invitations to tender. This requires "business skills, technical skills, and diagnostic skills".

Telco 5 has moved from being a UK telecommunications operator, dealing mainly in fixed-voice telephone calls, to a global communications company with operations that span the world, and services that, in addition to fixed-voice telephony, include the Internet, mobile and data communications, business systems and solutions. It defines this shift as being from a "line company" to an "on-line company", no longer focused on managing a fixed (line) network. Future revenue growth will come from the increase in the overall level of data, through the Internet, mobile phones, and the introduction of the third generation of mobile technology. Mobile and the 'datawave' explosion imply a significant change in how customers use technology, and require "a radical, almost paradigm shift" in the company, which takes on board the challenge of IP for data and voice transmission. Rather than just providing a technical infrastructure, the company will move towards providing content (through multi-media) and developing new services. As mobile and fixed lines, and data and voice, each converge, it will have to provide "integrated solutions".

Telco 6 is the UK subsidiary of an MNC which operates cellular telephone services worldwide. It has a public telecommunications licence to provide broadband wireless data communications services, with high-speed Internet and intranet access. In doing so, it competes directly in the ISDN (high-speed fixed lines for data, voice and video) and leased line market, within the local loop. It serves principally SMEs and small office/home office workers in the Thames Valley region. National roll-out is planned for 1999, with the aim of reaching 60% of the UK population by 2003. It competes on product design and price, and was the first firm to launch a service permanently connected to the Internet. It is also innovative in using fixed radio access technology to link users with their exchanges, rather than fixed cabling. It is flexible and customer-facing, and achieves rapid installation of its service to customers' premises by outsourcing installation to teams that also install satellite services. BT's launch of its ADSL service recently and OFTEL's intention to force competition in the local loop means the company will have a limited time (perhaps 3-4 years) to build market share before competition becomes intense.

Telco 7 is a UK firm operating a national mobile telephone network. It is rapidly extending coverage of this internationally via 'roaming agreements' (ie. alliances with other network operators), and expanding the range of products/services offered over the network. It has built up its customer base to 3 million in 5 years, and faces continued rapid growth. It invested deliberately in a superior network which ensures reliable performance and fast delivery of new services (through an open IT platform), and will be able to adapt readily to 3rd generation mobile phone technology without fundamental changes to this. (However, it does not expect the network to remain a differentiating factor beyond the next 3 years.) It stresses product simplicity, clarity, and transparency in pricing, and innovation (in products and services) over low-cost. It sees the collaboration it has developed between marketing and technology skills as a particular strength, and has shifted from "being device-centred to person-centred in thinking about new products". The key drivers for the future will be technology developments in computing and telecommunications, and social and business trends, which affect both customer needs and staff attitudes to working conditions. Its call centre operation is a vital link with customers, but does not yet perform as well as the company would like. However, it also anticipates call centres losing their importance within 5-10 years, as other channels and media take over.

Telco 8 was formed 18 months ago and its first commercial network went live in summer 1999. Its business is the wholesale provision and management of high capacity bandwidth between specific points. Thus, its first network links seven European cities, and its second, under construction, will connect a further sixteen. Its customers are the rest of the telecommunications industry, particularly other telcos. It considers itself a "carrier's carrier", seeking out the requirements of major operators like BT and C&W, and Internet companies like AOL, and creating network links that deliver high speed at low cost. Thus, it searches out fibre-optic cable that has been laid, but is still unused (unconnected, or 'dark fibre'); and connects this up through strategically-located 'POPs' (point of presence kits), using the latest technology. Its strength is to bring new capacity to market faster than competitors, particularly in Europe. At present, it has only one equivalent supplier, while there are another eight companies building such networks in Europe. It claims its own is the most technologically advanced network in Europe. However, it already foresees its future strategy focusing on value-added services, and it is moving from being a commodity reseller of high capacity bandwidth, to offering management services for the network through customised 'management care packages' tailored to fit each clients requirements.

Telco 9 is an old organization, formerly publicly-owned, and now limited by guarantee, which has developed new areas of expertise in recent years. It tests and develops electrical equipment, IT, and telecoms hardware and software. The latter business stems from work for BT in 1994, and from this it has built a business with some 70 staff (out of around 500 overall) as a high-tech telecoms consultancy. It sees its strengths as flexibility and responsiveness:

> *Telcos are driven by tight time-to-market schedules and they know we can match them. They are not driven by price and we do have a reputation for not being the cheapest.*

It still lacks a properly commercial approach, however, and seems content for its clients to internalize its skills when it works with them, and move on to more advanced skills itself.

Telco 10 was formed in 1981, and claims to be a world leader in computer telephony (CT) integration, and the design and implementation of call centre information systems. A rough estimate would be that it has about 7.5% of the call centre CT market in the UK, which was worth approx. £150m in 1999. Its management information systems provide real-time data to improve management decision-making and agent monitoring. Key products include 'workforce management software' (to identify the number of staff needed for the volume of calls, etc.), and 'talk/listen analyser' (a productivity tool for training and motivating call operators). These systems use colour-screen graphics and provide extensive historical reporting.

In the past, it grew strongly as a result of the telecommunications manufacturers incorporating its software within their own hardware. However, as the industry moved on, it found it was growing more slowly than the telecommunications market as a whole, and realized it needed to go directly to the end-user call centre operators and expand its product base. One new line of business recently developed is the provision of training (since many call centres lack adequate training), and it has established its own training section, with NVQ assessors.

The call centre business is a rapidly expanding market, especially in small-to-medium sized centres of 40-50 agents. The nature of the call centre is also changing in terms of size and technology, with dispersed call centres being developed, with people working at home. These will require different forms of infrastructure, and new tools. To respond to these developments, it has to be better at identifying market opportunities for new products, rather than being simply IT ideas-driven.

APPENDIX D:
TECHNOLOGICAL AND MARKET DEVELOPMENTS

- **Advances in digital technology (ATM and SDH).** Traditional network carriers, like BT, have invested heavily in these. ATM (asynchronous transfer mode) 'chops' information (voice, data, and video) into 'packets' of binary data ('bits'). It is likely to be the basis of the 'information superhighway'. SDH (synchronous digital hierarchy) is found in the most modern systems, and allows high-speed transmission of multimedia. As a result, the traditional telephone system is now more like a giant mainframe computer, relying on 'smart' algorithms to route calls. The investment in ATM, however, is vulnerable to the development of IP.
- **The introduction and gradual proliferation of IP (Internet protocol) networks.** IP networks operate by sending packets of voice, data and video images over the Internet, and can provide a significant cost advantage over traditional switched services. The new so-called 'datawave operators', who are investing heavily in IP and DWDM (Dense Wavelength Division Multiplexing), hope to be able to undercut the incumbent telecommunication companies. While some observers foresee a bleak future for the traditional telecoms firms (Economist Intelligence Unit/Deloitte & Touche, 1999; Editorial, FibreSystems, 1999; Cane, 1999; Cole, 1999), others are more sanguine that ATM, SDH and IP will co-exist within the big networks (Standards, FibreSystems, 1999).
- **The introduction of Asymmetric Digital Subscriber Line (ADSL) technology.** By compressing data, this allows traditional copper wire within the legacy systems of incumbents like BT to carry data at comparable speeds to optical fibre. While this negates the latter's advantages for broad bandwidth (high capacity) transmission of voice and data, it will also allow the fixed copper local loop to carry value-added services such as multimedia to the home.
- **The Internet explosion.** This is changing the traditional market of telcos, with data transmission becoming more important than voice. The volume of data traffic is growing at 30% per annum, while voice over fixed networks is static.
- **E-commerce.** The Internet also opens up a range of other possible services, such as e-commerce. While this usage will inflate the revenues of the network operators, it also encourages the latter to consider offering such services themselves or (more likely) entering into alliances with those who do.
- **Mobile phones.** Voice traffic has migrated significantly to mobile phones, which has seen explosive growth in the customer base and usage. Developments in software and hardware mean that the 3rd generation of mobile phones will have similar facilities to fixed lines (i.e. be able to carry data as well as voice, and access the Internet), so that the mobile phone itself becomes a computer. Wireless Application Protocol (WAP) on new mobiles handsets currently provides a limited facility of this kind, but the next generation of mobiles using Universal Mobile Telecommunications System (UMTS) technology will give vastly greater capacity. It is unclear, however, how far customers will want to use mobiles for these services, or whether mobile internet use will be simply an addendum to fixed line access (Waters, 2000). The issuing of licences in the UK during Spring 2000 will see the appearance of 3rd generation mobiles around 2003.

- **A customer focus.** Greater choice in facilities (more operators and alternative technologies) has led to high turnover of customers ('churn'). The mobile phone companies especially are affected by this 'churn', as customers change providers to get the latest mobile handsets. This has led to a shift of emphasis among all kinds of network operator, from providing value through technology to developing a customer focus. The massive increase in high-speed network capacity, which increases the services that can be carried, and therefore the potential for additional revenue streams, puts a premium on the ability to get and retain customers. This is the target of the new entrants - to win over customers; and a challenge to existing operators - to retain customers and sell additional services.
- **Customer care is both mindane and expensive.** Customer care and customer satisfaction often come down to simple things (getting faults dealt with quickly, clear pricing, no mistakes in billing). Call centres have become vital to the customer interface, and employ large numbers of people, although some predict they will be replaced by Internet systems within 5-10 years, and certainly are likely to change. Customer care and billing systems are estimated to absorb around 50% of the IT spend of the entire European communications industry (Walcot, 1999), although pre-payment systems could substantially reduce this.

APPENDIX E:
BUILDING BETTER UNIVERSITY LINKS

Telco 2

"We have always aimed at particular universities, but now spend more money focusing on our chosen universities, rather than national advertising. We have changed our name from 'university recruitment' to 'university relations', to underline that we are trying to improve our relationships with the education sector. We now have the 'campus ambassador' programme, to build relationships at all levels between us and the university. Recent graduates from the selected universities are assigned to help us on matters of local knowledge, student attitudes, etc. We have 10-12 universities on our main list, and an additional 10-12 as back up. In choosing universities for the main list, we have a number of requirements - that it has a high entrance requirement; that it runs an industrial placement programme; has a computer science department of recognised quality; and is possibly a university we have had a relationship with in the past.

"We are now going to the Scottish universities, because a lot of people from here go to Scotland for their university education. We look to employ local people, and will check with the schools where the best pupils go for their further education.

"We also have a department called 'education liaison', which is about building relationships with lower-tier educational institutions, such as secondary colleges and schools. It is about raising awareness, not only for us, but also for the industry generally among schoolchildren.

"There is a lack of formal ties between academia and industry. The more I go round colleges, the more I realise they do not know what industry is, and what it can offer their students. I am trying to put together a plan to bring academia back into industry. They do not know where we are going, they do not know the growth we are going through, so there is no way that they can bring in the people we need."

APPENDIX F:
CONTINUOUS LEARNING THROUGH FEEDBACK AND MENTORING

Telco 7

The lack of senior call centre management and high quality call service representatives, with the right experience and skills, has been identified as a major problem. A system of mentoring has been established for the senior management group. The head of consumer services, for example, will spend time each week with the customer services manager (one of eight reports), discussing all aspects of her job and how this fits into the company's way of operating. They discuss the "rules of the business", and review specific actions or decisions taken if either have concerns about these. The customer services manager keeps a logbook of these reviews, for future reference. This is a time-consuming, personal tutoring system, designed to develop staff in their current jobs, and to identify and develop potential for senior levels as expansion continues.

The old organisation, below senior management level, was a conventional bureaucratic structure, designed to deliver a relatively routine service through many operatives ('customer services representatives', or CSRs), trained to deliver a standard service over a telephone help-line. A revised structure, implemented early in 1999, removed one level of supervision, but added more middle-level team supervisors and changed their role, to provide closer support to the front-line CSRs. In addition, a new role of coach was created, to give full-time support to the mentoring process at CSR level.

The new structure is designed to support continuous learning through feedback-loops on performance. The supervisory role has changed from a mainly disciplinary, administrative, monitoring and fire-fighting role, to giving staff feedback, discussing training needs, and managing team performance. Monitoring is now for the purpose of identifying personal problems and weaknesses, and agreeing training or help. Much more time is spent at all levels in self-assessment and performance management.

The key feedback mechanism involves the CSRs, team leader and coach. The coach's job is to focus on team development. As a full-time educator, he or she will work closely with the team leader, while the team leader concentrates on work levels and quality. The team leader will be monitoring around 30 calls a day, and discuss the issues raised by these with each CSR each day. The team leader and coach agree an action plan, for training or other activities, with each CSR, based on call-monitoring, self-assessment, and the coach's reports and suggestions. Meanwhile, the customer service manager spends time each day with the help-desk manager, reviewing team performance.

The success of the new system can be seen in the reduction of labour turnover, reduced customer churn, and improved call quality (shown by the company's internal monitoring system).

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