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*Telecommunications infrastructures and policies as factors in regional competitive advantage and disadvantage*

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Abstract

There has been a revolution in telecommunications technologies in recent years. New technologies with myriad applications have helped transform markets, industrial structures and the organisation of firms throughout the economy. These changes have had important spatial effects. Some argue that “distance no longer matters” and that new communications technologies could have a significant impact in reducing the traditional economic disadvantages of peripheral regions. However, there is a contrary argument that there remain strong centralising tendencies. These theoretical arguments are revisited in the context of a case study of the Scottish Highlands and Islands. This is a particularly interesting region because, although it is a peripheral, rural area, it has a highly developed telecommunications infrastructure. This case study deploys the results of a recent survey of the use by firms in the Highlands and Islands of communications technologies. The paper finds little significant evidence that telecommunications initiatives in the Scottish Highlands and Islands have significantly altered the competitive position of the region.

## 1. *Introduction*

There has been a revolution in telecommunications technologies in recent years. Less than twenty years ago, telecommunications in the UK largely consisted of a publicly owned telephone system. Since then, many new information technologies have emerged with applications across the whole economy, such as remote data processing, on line data services, the electronic transfer of funds, and remote working (Graham, 1991). Computing and telecommunications are now closely integrated and they, in turn, are becoming integrated with the media industries.

The new communications technologies have emerged in response to, and have in turn reinforced, the increasing importance of information resources which have become a key input into all economic activities. These developments have contributed to the breakdown of “Fordism”. Computer aided design and manufacture, and advanced information systems have facilitated the shift from large scale standardised production, exploiting economies of scale, to specialised batch production, exploiting economies of scope. A parallel development has been the increasing contracting out of information functions by large, previously integrated corporations. These various changes have occurred within an increasingly liberalised framework, particularly in the UK. Since the privatisation of British Telecom in 1984, the UK has developed one of the most market oriented telecommunications policies in the world (Berben and Clements, 1995).

This telecommunications revolution has had profound spatial effects, from the global to the local, but there is a great deal of controversy about the extent to which, and the ways in which, new communications technologies are transforming spatial patterns of development (Gillespie, 1987; Giaoutzi and Nijkamp, 1988; Gillespie and Williams, 1988; Graham, 1991; Goddard, 1992). There may have been a “shrinking of spatial distance” (Capello and Nijkamp, 1996) but, as Castells (1989) notes, there has been no “annihilation” of space. Rather, telecommunications technologies have wrought changes in the spatial pattern of economic activity.

New technologies may permit a reduction in the distance related constraints which have limited the potential for economic development in rural and remote regions. However, given that this new industrial economy is increasingly dependent on the transmission of information, it is vital for the long term survival of rural and remote regions that they are equally able to access the appropriate information and skills to enable them to compete successfully. If new technologies are developed and exploited primarily by established firms in core areas, increasing polarisation between core and peripheral areas is likely.

The structure of this paper is as follows. The next section discusses whether such technologies lead to the centralisation or decentralisation of economic activity, with particular reference to the impact on rural areas. Developments in the Scottish Highlands and Islands are discussed in section 3. The results of a survey of the use by firms in the Highlands and Islands of new communications telecommunications are presented in section 4. Finally, some policy implications are considered.

## *2. The balance of centralising and decentralising forces in rural areas*

The increased development of new telecommunications media has allowed cost functions to become less sensitive to distance and this has meant that tariffs have become more time related. Moreover, new communications technologies enable firms to exert influence and control over more diffused production and decision making systems. However, these changes will not necessarily lead to the increased dispersion of economic activities. The processes of change are complex and there remain important, and possibly increasing, incentives for firms to seek a location in core regions and urban areas.

In the short run, firms are likely to consolidate their activities, relocating industrial activities within the existing geography of the firm, using space and facilities more efficiently. This process of rationalisation may involve the centralisation of strategic functions and the decentralisation of production functions to the peripheral regions. It is only in the long run that spatial relocation may occur. In this period, strategic

functions tend to remain at a central location, whereas intermediate functions such as marketing and finance, which undergo huge changes as a result of introduction of new technologies, may well be relocated to new sites. Production functions remain in peripheral locations where traditional locational economies can be exploited. However, the reorganisation involved may also allow production functions to gain some degree of autonomy over their own activities at this point, as they benefit from access to centrally held information.

Telecommunications may therefore facilitate the growth in multilocal firms, allowing different functions to be performed in whichever region possesses comparative advantage in the relevant inputs. The end result of such developments will probably be increasing centralisation of economic power in a smaller number of urban centres, as they exploit their technological advantage to enhance their national and global position. Certainly, current trends indicate that firms are centralising administrative and bureaucratic processes away from the peripheries to gain from economies of scale and that, while there is some decentralisation of intermediate decision making, all strategic and control functions “remain strictly centralised and managed by headquarters” (Capello, 1994, p.196). However, once again, the new technologies may simply be playing an enabling role. The key factor behind all these changes lies in the organisational structure of firms and their locational strategies. In theory, new technologies can be used either to centralise or to decentralise decision making.

Most discussion of the effects of new communications technologies has been at the broad regional level or the urban level. However, new communications technologies could have a potentially significant impact upon peripheral, rural areas (Hansen et al, 1990; Hudson and Parker, 1990; Grimes, 1992; Cronin et al, 1995)

At present, there is a dearth of studies of the rural telecommunications infrastructure and of how firms in rural areas actually use the new technologies. An exception is the study of north Lancashire and south Warwickshire by Berkeley, Clark and Ilberry (1996). The two areas surveyed differ in that north Lancashire is “‘remote rural’ typified by its remoteness from major urban areas” whereas south Warwickshire,

“being close to ‘main urban areas’, is ‘accessible rural’” (Berkeley, Clark and Ilberry, 1996, p.77). However, firms in both areas had access to a similar telecommunications infrastructure, and in terms of business structure, the two regions are similar.

The results of the survey indicated that, in general, small firms were less likely to use the whole range of specified new technologies, from fax machines and ansaphones through to mobile phones and computers, with the take up of these technologies significantly lower in north Lancashire than in south Warwickshire. Even among larger firms, computers are underutilised, being mainly used for standard administrative tasks such as word processing and accounts, with the majority of firms using computers for more advanced processes being in the Warwickshire area. The reasons for low take up of computer equipment may include the high costs involved in investing in equipment which can become obsolete very quickly, and from which the expected benefits are relatively low. Computing equipment suppliers were heavily criticised for providing inappropriate systems and failing to supply adequate after sales support. Firms in both areas also expressed concerns regarding the level of skill and expertise required to use computers, as little formal training was available. Small firms in particular seemed to be lacking in knowledge of and confidence in the potential for using telematics. Only a minority of firms used, or were even aware of, data and conferencing teleservices, with less than 10 per cent of those surveyed using electronic data exchange, electronic funds transfer, or even electronic mail. Again, levels of awareness and use were found to be higher in Warwickshire than in Lancashire. The main users of these services were larger businesses with multi site operations, who benefit from a wider range of equipment, more on-the-job training, and have extensive networks of both customers and suppliers.

There are a number of possible reasons for these discrepancies in take up rates between the two regions. Inadequate infrastructure is commonly seen as a primary cause of low adoption rates. However, although in general rural telecommunications infrastructure is of a lower standard than that enjoyed in metropolitan areas, the two areas in this survey were equally well served. The size of firm is also related to take up rates, with larger firms tending to make more use of telematics but again the two areas were well matched in terms of firm size. Similarly, the costs involved in

adoption of telematics are comparable in the two regions, although the survey did indicate a higher degree of scepticism and “techno-fear” among firms in north Lancashire firms.

Finally, it may be significant that the Lancashire firms operate within a more closed economy than those in Warwickshire. They have a stronger local orientation and are less likely to be operating in national markets. As a result, these “remote rural” firms have less contact with those larger firms which make greater use of the new communications technologies and encourage their suppliers and customers to do likewise. If this is an important factor, then it may be that the interconnectivity of a region and its proximity to primary economic centres will have a major impact on its adoption of new technologies.

In another relevant study, Gillespie, Coombes and Raybould (1994) sought to identify those regions of Scotland which demonstrated the highest potential to benefit from attempts to stimulate the demand and supply of telecommunications. They identified a number of factors, the presence of which would tend to make a region more amenable to the deployment of telecommunications services. The five principal factors were population density and clustering, the type of industry represented, the structure and profitability of companies, the level of income and current telecommunications expenditure, and marketing and training. They then used 47 variables, grouped under four broad categories (economic structure and entrepreneurial potential, labour supply attributes, lifestyle and wealth indicators, and accessibility and geographical attributes) to act as predictors of the likely role of telecommunications in stimulating local economic development. The results for Scotland yielded eight underlying factors, three of which - rural entrepreneurship, the presence of information professionals, and metropolitan connectivity - accounted for most of the variance.

The first factor, rural entrepreneurship, revealed very clear differences between urban and rural Scotland, in which rural areas were strongly associated with entrepreneurial potential as interpreted by the incidence of self employment and the rate of new firm

formation. The areas with the highest scores on the rural entrepreneurship factor included some of the most remote parts of the Highlands and Islands.

The second factor, the presence of information professionals, is an important indicator of the attractiveness of an area as a location for decentralised office activities and for teleworking businesses. In contrast to rural entrepreneurship, those areas which scored highest on this occasion, that is areas with a large proportion of people in white collar information occupations and with high levels of educational attainment, tended to be in the affluent suburbs of major cities and on the metropolitan fringes. Very few areas scored highly on both factors, the exceptions being North East Fife, Gordon, and Perth and Kinross.

The third highly significant factor was the degree of interconnectivity between local areas and the major metropolitan centres (Glasgow, Edinburgh, Aberdeen and Dundee), as measured by the extent of commuting links and migratory movements. Gillespie, Coombes and Raybould (1994) argue that interconnectivity can be interpreted as an indicator of the potential for decentralisation from the cities. It may also be the case, as Berkeley, Clark and Ilberry (1996) suggest, that interconnectivity is an important determinant of the rate and degree of adoption of new communications technologies. Two areas of Scotland scored highly on this interconnectivity factor, an area around Edinburgh (including Ettrick and Lauderdale) and a band in the Highlands from Skye and Lochalsh across to Inverness and Strathspey.

### *3. Telecommunications in the Scottish Highlands and Islands*

Some insight into whether centralising or decentralising forces are likely to dominate in peripheral regions can be gained by looking at the experience of the British Telecom/Highlands and Islands Initiative (Richardson and Gillespie, 1996; Highlands and Islands Enterprise, 1997).

The Initiative commenced in 1989. Given Mercury's concentration in urban areas, BT had a monopoly over supply to the Highlands and Islands and, while BT had a

universal service obligation, this did not apply to advanced technologies. Pressed by the region's development agency, the Highlands and Islands Development Board (HIDB), BT agreed to a £16 million programme of investment in new communications technologies. The HIDB contributed £5 million to the programme. The programme initially involved the upgrading of 43 exchanges to provide an ISDN (Integrated Systems Data Network) connection although further exchanges were subsequently included. Data transfer services were provided at local rather than trunk call rates. New advanced services, such as computer conferencing and electronic mail, were provided. The formal investment programme was completed in 1992. In parallel with the investment programme, BT and the HIDB sought to raise awareness in the region of the new technologies and encourage their take up.

The BT/Highlands and Islands Initiative had three specific aims (Richardson and Gillespie, 1996). It was defensive in that it sought to prevent existing companies losing business through lack of adequate data communications. It was developmental in that it sought to attract new information intensive industries to the area. Finally, it was persuasive in that it sought to increase inward investment, enabling external firms to transfer "back office" functions from areas with higher overhead costs. There was a recognition from the outset that the Initiative's impact would be gradual and that its full effect would only be felt in the long run.

The investment programme made access to ISDN services available to 70 per cent of people and 80 per cent of the businesses in the Highlands and Islands. Even now, not all exchanges have been upgraded to digital standard although BT has embarked on a fresh investment programme, part funded by the EU, which will upgrade 40 remote exchanges and eventually ensure universal ISDN access across the region (Highlands and Islands Enterprise, 1997). For the moment, however, many smaller firms in the Highlands are not linked to the ISDN while the larger firms, which perhaps would have been expected to make fuller use of it, already had their own privately leased lines prior to the launch of the Initiative and they continue to use these lines. For example, the Atomic Energy Authority nuclear establishment at Dounreay is linked to other AEA sites by leased lines.



While digitisation of exchanges has benefited all firms to some degree, Richardson and Gillespie (1996) did not identify a single example in which provision of the ISDN has been crucial to the viability of the firm. Nor is there any evidence that the new network has saved jobs in the region which would otherwise have been lost.

The Initiative does not appear to have been much more successful in developing new and expanding data intensive firms. Among these firms, the founders and managers of firms are virtually all returners or incomers to the region. While some firms saw the provision of the ISDN and other improvements in telecommunications as crucial to the success of the business, none of these firms were located in the more remote areas of the Highlands, leaving the success of the Initiative in attracting new and developing firms to these areas still in doubt.

The third aim of the Initiative was to make the region more attractive for firms seeking to establish or relocate “back offices”. Since the Initiative was put in place, a number of significant “back office” operations have been established in the region. The largest is actually a BT office, a telecentre in Thurso which now employs 400 people (Highlands and Islands Enterprise, 1997). Although managed by Manpower, it serves as an intra BT help desk. In Forres, the Hoskyns Group has a business process outsourcing operation now employing over 70 staff on tele-based work including processing council tax claims and administering parking fines for three local authorities in London. In Inverness, Cap Gemini have just set up a call centre operation in Inverness which is projected to employ 120 people (Highlands and Islands Enterprise, 1997). However, both Hoskyns and Cap Gemini are part of the Gemini-Cap-Sogeti company which does not use the ISDN. It is regarded as “uneconomical and unsuited to the volume of traffic generated” (Richardson and Gillespie, 1996, p.105). One of the few examples of a company where the telecommunications infrastructure in the Highlands and Islands has been an important consideration in the decision to locate in the region is Database Direct. Based in Dunoon, it sends out direct marketing materials. While use of the ISDN is integral to the company’s operation and has proved cost effective, other business considerations figured in the location decision, not least the availability of low cost, high quality labour.

Highlands and Islands Enterprise (HIE), the successor to the HIDB, has argued that the spread of new communications technologies has brought unequivocal benefits to the Highlands and Islands. However, even if the estimate that more than 1000 jobs have been created in the last five years is accepted, there is little evidence for the HIE claim that “as sophisticated modern telecommunications remove the traditional disadvantages of distance and remoteness, a new set of competitive advantages for the Highlands and Islands is becoming apparent” (Highlands and Islands Enterprise, 1997, p.23).

#### *4. Business use of new communications technologies in the Highlands and Islands: survey results*

A questionnaire on business use of new communications technologies was sent to firms in the Scottish Highlands and Islands in May and June 1997. Of the 962 questionnaires sent out, 167 usable responses were received, a response rate of 18 per cent. The sample was structured to reflect the spatial distribution of activity within the Highlands and Islands (given by the local authority areas), the size of firms, and the industrial structure of the region, as proxied by the distribution of employment and as derived from the Census of Employment. The firms were drawn primarily from business directories for Highland, the Orkney islands and the Shetland islands while firms in Argyll and Bute were selected principally from a list provided by the local authority and firms in the Western Isles were selected from the Yellow Pages. The Yellow Pages was also used to fill any shortfalls in particular sectors for the other areas. To facilitate a comparison between this peripheral, rural region with a medium sized city, the questionnaire was also sent to a number of firms in Aberdeen. Like the Highlands sample, the Aberdeen sample was structured to reflect the size of firms and industrial structure of the city. Of the 480 questionnaires sent out to firms in Aberdeen, 94 usable responses were received, a response rate of 20 per cent.

Of the 167 respondents in the Highlands and Islands, 102 were located in Highland Region, 25 in Argyll and Bute, 14 in Orkney, 13 in Shetland and 13 in the Western

Isles. With the exception of Orkney, which had a response rate of 25 per cent, this is a broadly representative distribution of responses across the constituent areas of the Highlands and Islands.

The industrial distribution of respondents reflected the actual industrial distribution in the regional economy fairly accurately although a number of sectors were slightly over represented: mining and quarrying; electricity, gas and water; food and beverages; chemicals and metal products; business services; and leisure and other services. No sector was seriously under represented apart from financial intermediation.

In terms of firm size, 107 or 64 per cent were small firms (1-24 employees), 33 or 20 per cent were medium sized firms (25-99 employees), 16 or 10 per cent were large firms (100-499 employees) and 11 or 7 per cent were very large firms (more than 500 employees). This distribution constitutes a serious over representation of small firms (they represent just 32 per cent of the population of firms) and an under representation of the other three categories.

This distribution is surprising since small firms are typically under represented in surveys of this kind. It may be that the owners or managers of small firms felt better able to answer the questionnaire given their better overview of the entire firm's activity. In addition, larger firms are more likely to be externally owned - evidence of this is presented shortly - and it may therefore be that the questionnaire was forwarded to head office but discarded there. Whatever the reason for the biased distribution of responses by firm size, it was essential to correct this bias by weighting the results. Otherwise, it would not be possible to distinguish "size effects" (due to the preponderance in a given area of firms of a particular size) from "area effects" (reflecting the business culture of a given area). Separate weights were calculated for each area. The weights were calculated as the ratio of the percentage of questionnaires sent out to firms of a particular size to the percentage of questionnaires received back from firms of that size. For example, 163 questionnaires were sent out to firms in Argyll and Bute. Of these, 51 or 31.29 per cent were sent out to small firms. 25 questionnaires were received back from firms in Argyll and Bute. Of these, 15 or 60 per cent were received back from small firms. The ratio of 31.29 per cent to

60 per cent, 0.5215, is the weight attached to small firms in Argyll and Bute. The weights attached to small firms in the other areas of the Highlands and Islands are also about 0.5. The weights for firms in the other size categories are more than 1.

There is one problem with this procedure. No responses were received from very large firms in either Orkney or Shetland. This makes it impossible to correct for firm size bias in these areas or rather introduces a new bias in that “the weighted estimate of the population in that sub-group will be zero and hence the estimate of the total population will be too small” (Labour Force Survey, 1996, p.1.27). To sidestep this problem, responses from the three island groups were pooled. This was possible because a response was received from a very large firm in the Western Isles. An incidental, albeit small, benefit of pooling is that the response rate for the islands as a whole was 19 per cent and thus the distribution of responses is now representative across the Highlands and Islands. All the reported results for the Highlands and Islands were weighted using the procedure described above.

In contrast to the responses from firms in the Highlands and Islands, the 94 responses from Aberdeen firms broadly reflected the firm size and industrial distribution of the city’s economy. Nevertheless, the same weighting procedures were applied to Aberdeen firms. As expected, all the resultant weights are close to 1. As with the responses from firms in the Highlands and Islands, all the reported results for firms in Aberdeen were weighted.

The results of the survey indicate knowledge of, and use of, a whole range of new communications technologies in the Highlands and Islands. The majority of respondents were aware of the whole range of technologies. Nevertheless, the survey did reveal evidence of what Richardson and Gillespie (1996) term an “awareness gap”. Between 14 and 25 per cent of respondents (across the three areas Highland, Argyll and Bute, and the Islands) are not aware of the possibilities of private or leased wires. Between 9 and 18 per cent of respondents are not aware of cable networks, between 7 and 22 per cent are not aware of electronic data interchange, and between 7 and 14 per cent are not aware of the ISDN.

While more basic technologies, such as telephone and fax, are used by virtually all the respondents, use of new technologies such as electronic mail, personal and networked computers is also relatively high, at between 45 and 94 per cent. Between 38 and 54 per cent of respondents have an ISDN connection. Cable networks, electronic data interchange, audio conferencing and video conferencing are the least used technologies and services. With a few exceptions, they are used by less than 25 per cent of respondents.

The pattern of use of communications technologies across different industrial groupings is broadly similar. There are some sectors, notably Standard Industrial Classification sectors C+E (mining, quarrying, electricity, gas and water supply) and L (public administration, defence and social security) which appear to display greater use of the more advanced technologies. However, given the employment of 21 industrial groupings and the resultant small numbers in each category, too much reliance should not be placed on these results.

As shown in Table 1, use of new communications technologies in the Highlands and Islands by firm size exhibits an almost uniform pattern of use increasing with firm size. Most of these size gradients are very steep. Thus, only 1.1 per cent of small firms (1-24 employees) use cable compared to 42.3 per cent of very large firms (more than 500 employees). Only 5.6 per cent of small firms use video conferencing but 65.8 per cent of very large firms. Only 7.0 of small firms use private or leased wires but 94.3 per cent of very large firms, and so on.

Table 1  
Percentages of firms in the Highlands and Islands using communications technologies or services, by firm size

	Small	Medium	Large	Very large
Telephone	100	100	100	100
Mobile phone	72.3	92.8	98.6	100
Fax	89.8	97.1	97.0	94.6
Electronic mail	39.7	55.2	61.0	98.9
Personal computer	82.5	91.5	95.5	100
Computer network	39.5	77.7	84.6	100

ISDN	15.2	49.2	54.5	89.0
Private/leased wire	7.0	29.3	52.0	94.3
Cable	1.1	7.7	17.6	42.3
Electronic data interchange	11.0	30.4	25.2	55.2
Electronic funds transfer	26.8	39.6	55.4	84.8
Audioconferencing	10.0	18.7	26.9	65.7
Videoconferencing	5.6	17.2	15.2	65.8

Another striking feature of the pattern of use revealed in Table 1 is that, for a majority of technologies or services, the largest increase in use is from large firms (100-499 employees) to very large ones. This is true of electronic mail, the ISDN, private or leased wires, cable, electronic data interchange, electronic funds transfer, audio conferencing, and video conferencing. There were only 11 respondents in total in the Highlands and Islands category and therefore caution has to be exercised in interpreting these results. Nevertheless, it appears that for most of the newer or more advanced technologies, it is only among the very large firms in the Highlands that use is at all common. All 11 very large organisations in the Highlands and Islands were either public sector bodies (in 6 cases) or part of a larger private sector business (in 5 cases). There were no very large indigenous private sector firms in the sample.

To explore the spatial distribution of current use of new communications technologies, Table 2 shows the percentages of firms in each area using various communications technologies and services. Each of the three areas within the Highlands and Islands (Highland, Argyll and Bute, and the Islands) are shown as well as the figures for Aberdeen.

Table 2  
Percentages of firms using communications technologies or services, by area

	Aberdeen	Highland	Argyll and Bute	Islands
Telephone	100	100	100	100
Mobile phone	92.1	87.5	88.1	87.3
Fax	96.1	92.7	95.7	91.2
Electronic mail	78.4	55.2	65.1	45.4
Personal computer	93.9	87.0	93.5	87.8
Computer network	81.0	65.6	78.2	62.3

ISDN	44.5	53.9	38.1	44.9
Private/leased wire	44.4	35.4	53.3	39.3
Cable	20.0	8.8	0	23.4
Electronic data interchange	37.4	24.2	21.2	22.3
Electronic funds transfer	56.2	45.9	59.3	32.7
Audioconferencing	31.7	22.8	34.2	27.9
Videoconferencing	26.6	18.9	8.6	39.3

It is notable that in general there is greater use of communications technologies and services by firms in Aberdeen than by firms in the Highlands and Islands. Mobile phones, fax, electronic mail, personal and networked computers, and electronic data interchange are all used by a larger proportion of firms in Aberdeen than in any of the three constituent areas of the Highlands and Islands. The ISDN is the only example in which there is greater use in two of the areas of the Highlands and Islands than in Aberdeen and this is perhaps not surprising given that the ISDN is the vaunted centrepiece of the communications infrastructure in the Highlands.

It is worth reiterating that these patterns reflect “area effects” and possibly also “industry effects” but not “size effects”. Lesser use of communications technologies and services in the Highlands and Islands cannot be explained by a greater preponderance there of small and medium sized firms which are themselves lesser users of these technologies since the weighting procedure described above removes such “size effects”. Rather, the patterns of use are the result of the different culture and habits of use of communications technologies of firms in the different areas - “area effects” - and perhaps also the industry mix of respondents in the different areas - “industry effects” - although the latter are unlikely to be important since, as noted already, there are not large and significant differences in the patterns of use across the various industrial groupings.

A further important point is that use is generally greater within in the Highlands and Islands in the mainland, less remote areas of Highland Region and Argyll and Bute than it is in the three island groups. Cable and video conferencing are the only two technologies or services in which firms in the Islands exhibit greatest use. This suggests that the distinction between “remote rural” and “accessible rural” areas

which Berkeley, Clark and Ilberry (1996) identified in their comparison of north Lancashire and south Warwickshire is applicable also to the Scottish Highlands and Islands. These results also appear to confirm the importance of what Gillespie, Coombes and Raybould (1994) term the degree of interconnectivity with major metropolitan centres.

Firms were asked which technologies and services they did not currently use but planned to use in future. Electronic mail is the technology for which planned use is greatest. It is also the clearest example of a technology in which firms in the Highlands and Islands are catching up on firms in Aberdeen. On the other hand, Aberdeen firms are themselves catching up on their counterparts in the Highlands and Islands in use of the one technology, the ISDN, in which they currently lag. Moreover, the gap between firms in Aberdeen and the Highlands and Islands is actually increasing with greater planned expansion of use by Aberdeen firms of electronic funds transfer and audio conferencing and, to a lesser extent, cable networks and electronic data interchange.

Firms were asked in which business functions they employed the different technologies. The functions which were listed were 1. all business functions, 2. research and development, 3. production, 4. ordering and stock control, 5. transport and distribution, 6. finance, accounting and administration, 7. marketing and sales, 8. customer, supplier and management information, 9. recruitment and personnel, and 10. staff training and development. Respondents were also asked to state how important each technology is to their business, on a scale of 1 (not important) to 5 (vital).

In general, firms which have adopted a particular technology tend to use it across the whole range of business functions. This was true of the data set as a whole but also of firms in each of the individual regions. To the extent that there were some business functions in which use was greater, these were 6. finance, accounting and administration, and, to a lesser extent, 7. marketing and sales, and 8. customer, supplier and management information. Otherwise, there was very little variation. The



only notable exception to this was electronic funds transfer where, not surprisingly, use is concentrated in finance, accounting and administration.

The more distinctive patterns concern the differences between individual technologies and between areas. These patterns reinforce many of the conclusions already drawn. As before, the evidence shows, fairly consistently, greater use across all business functions of the simpler and more established technologies than of the more advanced technologies or services. In addition, although less clearly and consistently than before, there is greater use of communications technologies and services by firms in Aberdeen than by firms in the Highlands and Islands and, within the Highlands and Islands, by firms in the mainland, less remote areas of Highland Region and Argyll and Bute than by firms in the three island groups. These same patterns are identifiable from the value placed by respondents on each technology.

All of the technologies listed were felt to increase efficiency and provide better communications. Cable networks, electronic funds transfer and personal computers were valued most highly for increasing efficiency and cable networks, private/leased wires (rather than the ISDN) and the telephone for improving communications. Overall, the various communications technologies and services were not felt to be as valuable as means of reducing costs or providing improved access to information. On the other hand, those individual technologies which were rated most highly in these two areas were greatly valued. Electronic funds transfer, cable networks and fax were rated most highly for reducing costs and cable networks, computer networks and electronic mail for access to increased information. Improving access to markets was the least valued advantage of new communications technologies. The telephone, fax and electronic data interchange were the most highly rated technologies in this regard.

Respondents were also asked to identify the principal disadvantages of the listed technologies. Most of these new communications technologies and services are not viewed as posing notable problems. Of the individual technologies, those which are judged to present most problems are cable networks, computer networks and personal computers. Of the individual disadvantages, only high purchase costs and technical difficulties register as at all significant. Most respondents do not view these new

technologies as involving high training costs or the alienation of users, or as inappropriate technologies.

##### *5. Conclusions and policy issues*

The survey results discussed in this paper are consistent with other studies of the impact of telecommunications upon the Highlands and Islands. Despite substantial infrastructural investment, use of the advanced services which the ISDN can support remains limited. New businesses employing digital telecommunications have been established and collectively they are beginning to account for significant levels of employment but the number of firms involved remains very small. The deployment of new communications technologies have raised business efficiency in the Highlands but the same is true elsewhere, nationally and internationally. There is little to suggest that the rate of change is any greater in the Highlands than in other areas. Overall, there is not much evidence that, to date, telecommunications initiatives in the Scottish Highlands and Islands have significantly altered the competitive position of the region.

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