# Government Studies Programme

THE IMPORTANCE OF TELECOMMUNICATIONS TO REGIONAL ECONOMIC DEVELOPMENT: PHASE I, REPORT.

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# GOVERNMENT STUDIES PROGRAMME

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## THE IMPORTANCE OF TELECOMMUNICATIONS TO REGIONAL ECONOMIC DEVELOPMENT

Phase I Report



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Forward

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# THE IMPORTANCE OF TELECOMMUNICATIONS TO REGIONAL ECONOMIC DEVELOPMENT

0.0.1 This report represents the findings of Phase I of a project investigating "the importance of telecommunications to regional economic development". More specifically the purpose of this report is to examine this topic by identifying, at a conceptual level, ways in which telecommunications have influenced, or might influence, regional economic development in Canada; to discuss potential methodologies to test these effects; and to identify case studies to serve as test vehicles. It is not the purpose of this present report to actually undertake any measurement. That task, in the context of specific case studies, is to be the work of Phase II of this project.

## 1.0.0 Definitions

1.1.1 Telecommunications may be defined as:

> "Communication modes involving the transmission of electrical impulses".[1]

Defined as such, telecommunications would include both one way flow of information modes (e.g. radio, T.V., CATV) and two way flow of information modes (e.g. telephone, telex, telegraph). This report will confine itself to the latter. This same distinction is perhaps better captured in the following definition:

> . . . define "telecommunications" industry as largely common carrier activity based on the electronic delivery of point to point messages over a distance. Broadcasting, on the other hand, is in the first instance concerned with message creation and only secondarily with message delivery; in addition, the message is received by many and so is not point to point communications.[2]

It is then telecommunications as an electronic, two-way, message delivery system on a point to point basis which will be used here as the working definition of the term telecommunications.[3] Within this broader definition of telecommunications, discussion will focus on each of four different types of use: voice, data, written record and video transmission.

1.1.2 Voice transmission has been the dominant use of the telephone network up to the present. It involves audio contact between at least two persons and offers the advantage of instantaneous voice message delivery.

1.1.3 Data transmission is, relative to voice, a new and growing telecommunications use which also primarily involves the telephone network. There is, however, with data users a higher incidence of dedicated or private line use versus public switched network use than is the case with voice. This should change over the foreseeable future, however, as more data-line sharing programmes are introduced. This should also have the effect of reducing the cost of data transmission to most small and medium range users. Data involves transmission between terminal devices or machines and may be of three types:

> simplex or one way information flow where the terminal equipment at one end is merely a drone;
>
> half-duplex which permits two way sending and receiving but in only one direction at one time;
>
> and full-duplex which permits simultaneous two way transmission.

1.1.4 The average voice grade circuit can transmit 2400 bits of information per minute but can be modified to accommodate data transmission up to 9600 bpm without substantial cost to the carrier. All types of switching centres can handle data except step-by-step type exchanges (i.e., data can be handled by cross-bar, electronic, or digital type switching centres). The presence of

step exchanges is not a major obstacle, however, in the Canadian case, since carriers can reroute a user to the nearest non-step exchange and then put the flow through the switched network. Private line service is always available to any user prepared to pay the cost and thus is an alternative even when the first option is not possible. In effect, then, data service is now available virtually anywhere in Canada where regular telephone service is available.

1.1.5 Written record transmission in the form of telegraph is the oldest form of telecommunications. Telegraph, however, no longer necessarily supplies written record copy. Today's written record transmission is primarily Telex or TWX or facsimile transmission. Teletypewriter or various types of photo-copying-telecommunications systems are types of facsimile transmission. This type of service has not been very fully developed in Canada to this point but may be expected to grow in importance in the future. In particular, many futurists see the day when we will have such things as an electronic mail system and telecommunications will become the dominant mode for transmitting written record information.

1.1.6 Video represents the newest and as yet least-developed use of telecommunications. Devices such as the videophone permit visual as well as audio contact on an instantaneous basis. Although there is much potential in video use, price has to date prevented any extensive adoption and video is, as yet, a use of telecommunications which is largely untested in the market.

1.1.7 When the term telecommunications is used in the present report, no attempt will be made to distinguish these different types of use. In Phase II of the project, in undertaking specific case studies, these distinctions will be considered.

1.2.1 Regional development requires specification of both the word regional and the word development. Given that a region must be defined in geographic space, it may nonetheless be defined in several ways, depending on the use to which the definition is to be put.[4] One could, for example, define a region by administrative boundaries, which, depending on the desired level of aggregation, would look at municipalities, counties, or provinces. One could also define regions by physical characteristics, by social or cultural characteristics, or by economic characteristics or by various combinations of all of these.

1.2.2 Given that the focus of this report is economic characteristics, the definition of a region must be useful for this purpose. It is also necessary that the definition of region be one for which data is available. In the Canadian case this constrains one to deal in some fashion with administrative units, however arbitrarily they may be defined, since this is the basis on which most published data is collected at present. It is also necessary to strike a balance between the level of aggregation employed in defining a region and the utility of the definition for policy purposes. If the regions are defined so broadly that they cease to be largely homogeneous in terms of economic characteristics, then the utility of the definition is obviously impaired. As McCrone notes:

> On the one hand, the regions must not be so aggregated as to conceal the differences which it is their purpose to illustrate, but, on the other hand, their number must be small enough to enable comparisons to be made and the priorities of policy between them properly coordinated.[5]

Isard, however, stresses that, a region is "an area that is meaningful because of one or more problems associated with it".[6] It is to preserve the meaningfulness of the definition that the definition here will in fact be somewhat ambiguous.

1.2.3 In Canada, a frequently used regional division is to identify the Atlantic Provinces, Quebec, Ontario, the Prairie Provinces, British Columbia, and the Northwest Territories and the Yukon. This grouping is used because it is a convenient way of establishing the regional setting of Canada with classifications made at a high enough level of aggregation to simplify comparisons while using administrative units for which data is readily available and grouping these administrative units in a way which results in approximately homogeneous units according to broad economic characteristics.

1.2.4 Table 1 indicates the degree of regional income differentials in Canada both by province and by provinces grouped into these six regions. The substantial disadvantage of Atlantic Canada and Quebec vis-a-vis the Prairies and especially Ontario and British Columbia is readily apparent.

1.2.5 Not only are these regional inequalities quite large, they are also extremely persistent and as Chart 1 indicates they can be traced as far back in time (with some temporary fluctuations) as reliable statistics exist. In the last two decades some amelioration of these disparities has occurred and income has grown somewhat faster in the poorer regions. As Table 2 indicates however, the differential in rates of growth is so small (only .5% to 1% greater than Ontario) that a very long time will be required to eliminate altogether regional differences. Furthermore, the fastest growing segment of total income in the poorer regions has been government transfer income, which is surely not a healthy source of growth. Wages and salaries have grown only marginally faster in the poorer than in the richer provinces.

TABLE 1

Alternative Measures of Regional Income Disparities, by Province and Territories, 1970[1]

| | Newfoundland | Prince Edward Island | Nova Scotia | New Brunswick | Quebec | Ontario | Manitoba | Saskatchewan | Alberta | British Columbia | Yukon and Northwest Territories |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | (Canada = 100) | | | | | |
| Regional indexes: | | | | | | | | | | | |
| Market income per capita[2] | 55 (56) | 60 (57) | 75 (75) | 68 (68) | 88 (89) | 120 (114) | 92 (96) | 70 (96) | 100 (104) | 109 (110) | 101 (101) |
| Personal income per capita | 63 | 67 | 77 | 72 | 89 | 118 | 93 | 72 | 99 | 109 | 95 |
| Personal disposable income per capita | 68 | 72 | 79 | 75 | 90 | 116 | 94 | 75 | 100 | 109 | 93 |
| Average family income | 70 | 73 | 82 | 78 | 96 | 111 | 90 | 76 | 99 | 104 | 99 |
| | | | (77) | | (94) | (109) | | (100) | | (105) | (n.a.) |
| Average family disposable income[3] | 74 | 79 | 84 | 81 | 98 | 109 | 91 | 79 | 99 | 104 | 97 |
| Family disposable purchasing power | | | | | | | | | | | |
| Excluding housing cost differential[4] | 70 | 76 | 82 | 78 | 98 | 110 | 94 | 80 | 101 | 101 | 69 |
| Including housing cost differential | 75 | 77 | 83 | 87 | 102 | 106 | 97 | 85 | 101 | 97 | 70 |

n.a. – not available.

1 All figures in parentheses are for 1974.

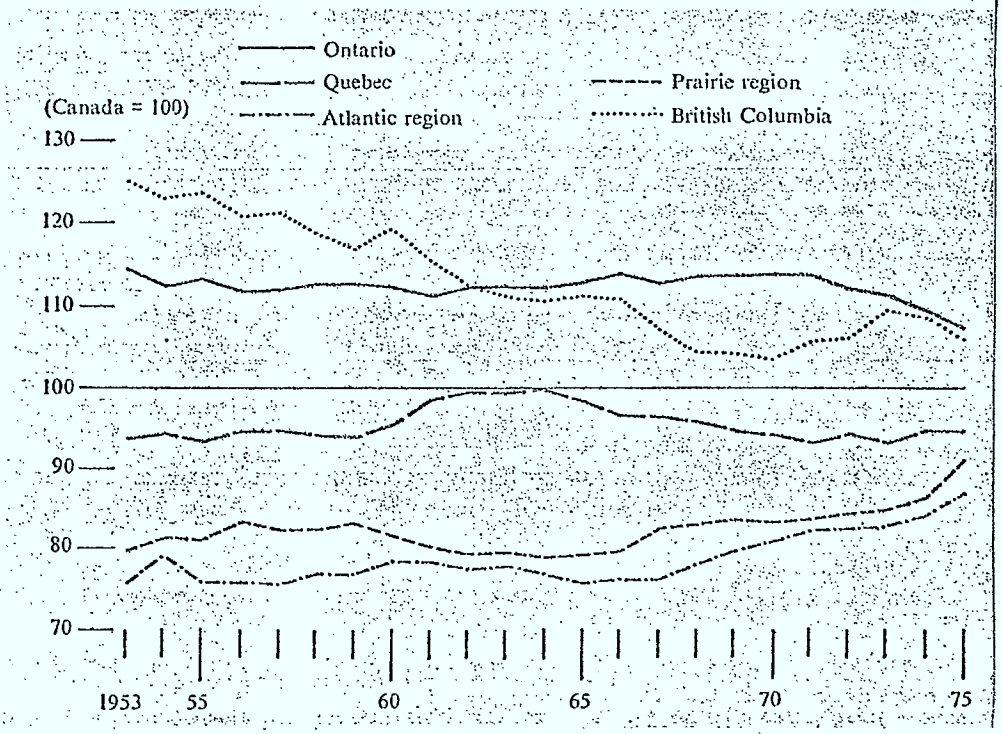
2 Personal income minus transfers to persons, divided by population as of June 1, 1970.

3 Family income adjusted by the ratio of disposable income to personal income in each region.

4 Family disposable income deflated by inter-city partial consumer price index: Winnipeg = 100, May 1971. The price index for the Yukon and Northwest Territories was assumed to exceed that of Edmonton by 48 per cent.

SOURCE: Living Together, A Study of Regional Disparities, Economic Council of Canada, 1977. Table 4-8, p.46.

Chart 1 Index of Wages and Salaries per Employed Person, Canada, by Region, 1953-75




SOURCE: As below p.35

Table 2

Growth[1] of Components of Personal Income per Capita, Canada, by Region, 1954-75

| | Average annual rate of growth ($ current) | | | | | |
|---|---|---|---|---|---|---|
| | Atlantic region | Quebec | Ontario | Prairie region | British Columbia | Canada |
| | (Per cent) | | | | | |
| Market income | 7.1 | 6.8 | 6.4 | 6.9 | 6.1 | 6.7 |
| Wages and salaries[2] | 7.6 | 7.1 | 6.8 | 7.4 | 6.5 | 7.1 |
| Farm income | 0.0 | 1.8 | 1.8 | 5.1 | -0.5 | 3.2 |
| Unincorporated nonfarm income | 3.8 | 3.6 | 3.1 | 3.5 | 2.8 | 3.4 |
| Dividends and interest | 9.2 | 8.7 | 8.3 | 10.4 | 8.5 | 8.9 |
| Government transfer income | 10.2 | 9.4 | 8.9 | 8.2 | 7.2 | 8.9 |
| Total income | 7.6 | 7.1 | 6.6 | 7.0 | 6.3 | 6.9 |

1 Estimated, using an unrestricted logarithmic regression.
2 Including "other" income, which is mainly military pay and allowances.

SOURCE: Living Together, A Study of Regional Disparities, Economic Council of Canada, 1977. Table 4-2, p.36.

1.2.6 This broad regional definition should be used more as a guideline to assist in the selection of specific cases and as a focus for discussion than as a definitive statement. If our emphasis is towards remote and/or underprivileged areas we will wish to test the findings generated here at different levels of aggregation. Thus what is found to be true of the Atlantic Provinces should be tested for Cape Breton within the Atlantic Provinces. Alternatively, it could also be tested for entire nation states in a less developed country context. Section 6 of this report discusses the potential relevance of this study, which is placed in a Canadian regional context, to the telecommunication experience and planning of underdeveloped countries.

1.2.7 Having defined region, or at least clarified the sense in which the word is used here, it is also important at the outset to clarify what is meant by "regional development". By this we mean the economic development of the less developed regions of Canada. Emphasis, as already noted, will thus be concentrated on remote or underprivileged regions and, in particular, on differences in income and employment opportunities between these regions and the rest of Canada. The regions to which the analysis will be directed will be those regions with the lowest income levels and the lowest employment opportunities. To a large extent, the case study topics suggested for detailed examination will generate measures of increased firm or industry productivity or profitability and job creation, or employment, effects. Thus, the work proposed for Phase II will not involve a measurement in terms of aggregate income levels of the role of telecommunications. To move from individual firm profitability or employment changes would require a model designed to translate such "micro" changes into "macro" measures. Such a task would be a large and expensive one and is not directly envisaged. The case study results, however, will be both suggestive of the virtue of undertaking such an exercise and the results that might be expected.

## 2.0.0 The Historical Role of Telecommunications and Regional Development

2.1.1 Certainly some people believe that telecommunications has had an influence on regional development or on differential rates of regional development. Regional economic disparities are a problem related to the spatial distribution of economic activity in a country. Telecommunications offer a potential means of overcoming the disadvantages of distance and a means for remote or underprivileged regions to gain access to other regions. To quote a portion of a 1971 study of the Telecommission in Canada:

> Telecommunications is, in a sense, a substitute for presence. Its availability in an underdeveloped area allows the user to overcome some of the disadvantages of distance . . . telecommunications can substitute for travel with an associated saving in time, cost, and personnel. As a substitute for the mails, telecommunications can act to save time and to speed up a decision making process. As a means of access to information, telecommunications can allow quick and frequent access, by managers and others in a remote area, to the pools of information and talented advisors found in large population centers . . ..[7]

Similar statements to the above are to be found in other works, as, for example:

> Telecommunications, in addition to being a lucrative venture in highly developed areas, are also a vital stimulant to marginal areas . . . Indirect benefits also arise from the incentive effect of extending adequate national telecommunications which enable the establishment of industrial complexes and associated sub-industries in remote areas.[8]

To date, however, assertions such as these are largely unsubstantiated. The Telecommission study referenced above, for example, cites as evidence of the importance of telecommunications as a "catalyst for development" the fact that

> Telephone development (expressed by telephones per 100 population) is higher in areas of high development than in areas of low development.[9]

This finding does not however imply anything, necessarily, about causality. It certainly does not permit a conclusion that increasing telephone density, in a given region, will promote economic development in that region.

2.1.2 In fact, a major difficulty in assessing the role telecommunications have played in regional economic development in Canada, is the fact that a characteristic of telecommunications is the presence of externality effects. Externalities are benefits or costs which are captured by, or imposed on, a party other than the immediate producers or consumers of a good or service. In the case of telecommunications, these externalities represent benefits which accrue to persons or economic units other than the immediate subscriber and take one of two forms. First, the potential calling capability of every user is enhanced when new users are added to the system just as the value of the system is enhanced for any new user the greater is the size of the existing system when he joins. Second, the two way nature of telecommunications (within the restricted definition being used here) means that benefits are derived not only by persons making calls but also by persons receiving calls.[10]

2.1.3 The implications of the presence of such externalities in telecommunications for the question of regional development can be illustrated as follows. Suppose we have two regions, A and B, which are geographically separated but are both parts of the same country so that there are no artifical impediments to trade between the two regions.

Each region already possesses a telecommunications system of its own but initially these systems are not linked to one another. Assume now that the two systems are linked. Then users of the systems in each region now have access to both regions in placing and receiving calls. The effect of joining the two telecommunications networks may be either to open B as a market for producers in A or to open A as a market for producers in B or both. If initially A is a relatively more developed region than B and possesses proportionately, a greater share of the country's total economic activity than B and if the telecommunications link when put in place acts to increase A's penetration of B's market by more than it does the reverse, then the improvement in telecommunications will have acted to reinforce existing spatial distribution patterns of economic activity and existing regional disparities. Exactly the same effects could result if, with a telecommunications link already existing between A and B, the system in B, the underdeveloped region, were to be upgraded in quantity or quality terms. Given the externality features of telecommunications, there is no way that the benefits of such expansion or improvement can necessarily be totally contained or even largely contained in B even though that is where all of the new investment is taking place.

2.1.4 The specific implications that these externality effects exhibited by telecommunications have had for regional development in Canada are not at all clear. If, in the above example, region A were to be identified as Ontario and region B as the Atlantic Provinces, then it becomes a definite possibility that telecommunications services may have acted to reinforce existing regional disparities in Canada to the

present rather than having acted to lessen them. The area stretching from the southwestern limits of Windsor, Ontario along the St. Lawrence to the northeastern limits of Quebec City has been termed the Canadian Industrial Heartland.[11] In this area are to be found the majority of Canada's population, the majority of the Canadian manufacturing labour force, a high proportion of Canada's skilled and professional labour force, and approximately half of the personal disposable income of the country.[12] The advantages which this area has make it highly probable that the growth in inter-provincial telecommunications services over time have allowed firms in this region to penetrate markets in other regions more than the reverse. For telecommunications itself the characteristics of this central region of Ontario and parts of Quebec have meant a lower cost of service on account of the higher population density allowing the carriers in this region to achieve lower per capita network installation costs, with lower basic charges for telecommunications service as a result. It is certainly possible that, as a 1973 study by D. Clark on the impact of telecommunications investment on spatial economic activity in Wales concluded,

> Rather than invert existing patterns, telecommunications at present are reenforcing, not revolutionizing, traditional frameworks of spatial organization.[13]

2.1.5 Added to all of the above is the fact that over a very long historical period, regional disparities in Canada have tended to stay relatively constant. (see Chart 1, above). A recent study of the Economic Council of Canada stated that between 1955 and 1970 there was a "substantial narrowing in differences of personal disposable income

between provinces on a per capita basis between 1955 and 1970."[14] As noted above, however, there was a "considerably more moderate" reduction of disparities as measured by market income (i.e. income excluding government transfer payments).[15] A 1966 study by Chernick[16] concludes that over the period from 1926 to 1964 there was little or no change in the ranking among regions in terms of per capita income levels. Thus, while it may be true that telephone development is highest in regions where income levels are highest, it is also true that as telephone development has advanced over the last several decades, this development has not been accompanied by any marked change in the relative development status of Canada's regions.

2.1.6 It must be noted that this argument on the relative share of benefits received by each region does not mean that in absolute terms every region may not have become better off as the telecommunications system has grown over time. To the extent that regional disparities versus aggregate growth of individual regions is of concern, then this question of relative rates of growth is crucial. But even if it is only absolute growth by individual region which is of interest, this externality characteristic of telecommunications requires that attention focus on plant investment and other features of telecommunications, such as prices, in all regions and not just the region being examined. Just as the benefits of new plant investment in one region cannot be solely contained in that region so too the total benefits derived from the telecommunications sector in any one region may not be solely derived from the plant investment in that region.

2.1.7 In addition, historically, the provision of telecommunication services in Canada has been largely demand determined. Thus while it might be said that telecommunications have not limited economic development, neither does the nominal evidence allow one to say that telecommunications have caused economic development.

2.1.8 Canadian telecommunications carriers have typically provided "service on demand" either by regulatory order or charter obligation. Certainly there are individual services which have been introduced by some carriers in advance of demand, but, by and large, this is not true of the provision of basic telephone service to first time users nor is it true of most of the services offered by the common carriers. Where supply factors seem to be most dominant is in adoption of new technology in switching equipment, transmission facilities, and so on. These factors have, however, served more to lower the cost of telecommunications rather than to alter the basic service being provided; the incentive to the carriers to adopt the technology has been largely one of cost.

2.1.9 If the telecommunications services in Canada have been supplied on a "service on demand" basis, then we cannot use historical evidence in Canada to test the question of whether telecommunications might be a pre-condition to growth. To the extent that telecommunications plant has been built ahead of demand, it has been only for relatively short periods of time and done, then, because it is cost-effective for the carriers doing it.[17]

2.1.10 If telecommunications investment does not, in fact, cause growth but serves merely to "accommodate" growth which is caused by other factors, then the role of telecommunications in regional development takes on different meaning. To quote the Telecommission Study 2(d):

> Except in the case of a few communities which are comparatively isolated, there is little evidence that telecommunications has been a limiting factor in regional development. On the contrary, the evidence available suggests that telecommunications services has generally kept pace with other forms of development within the region examined in this study. In part, the situation is attributed to "service on demand".[18]

None of this discussion is intended to suggest that telecommunications has not influenced the spatial organization of economic activity in Canada to the present time. Nor is it intended to suggest that this influence, if present, has necessarily worked to the disadvantage of less developed regions. Rather it suggests a) the need to study the question in far more detail than has yet been attempted by anyone and b) the highly intractable nature of the problem if looked at at too high a level of aggregation. Phase II of this study is therefore to be structured as a series of individual case studies, since at the more micro level, the problems discussed above do not emerge in explicit fashion. From these case studies it might be possible to draw generalizations which allow the above problems to be considered at a more aggregate level.

2.1.11 The above also suggests that the future impact of telecommunications on regional economic development may differ considerably from the past impact. Telecommunications technology is rapidly advancing and may in the future, influence spatial patterns in ways which were previously impossible. It is, also, not at all obvious how the development of the system to this point has affected spatial activity nor is it obvious that the way it has acted historically need continue in the future. To the extent that attitudes on the part of business users have inhibited use

or usefulness, the future may be far different than the past if attitude or awareness factors can be changed. To the extent that prices of service may have created certain historical demand patterns particularly vis-a-vis substitution of telecommunications for other information transfer modes, the future may again differ from the past, given the likelihood of relative price declines in telecommunications with further technological development.[19] To the extent that new peripheral equipment attachments are developed to interact with the switching/transmission network, new applications may be developed by, or for, specific users which were heretofore impossible.

2.1.12 There is thus a need, in examining the historical record, to temper such finding with a forward look that considers how underlying circumstances, apart from the physical network itself, might change. In addition to testing the impact of telecommunications investment historically, it will also be important to test the historical influence of price, attitudes, awareness, and limitations on use because of inadequate or insufficient terminal devices (peripheral attachments). In the following section, attention is focused on identifying, conceptually, the ways in which all of these factors might influence the impact of telecommunications in a regional context.

## 2.2.0 Assessing the Potential Role of Telecommunications on Regional Development

2.2.1 As noted above, the role which telecommunications has played in regional economic development is, in the aggregate at least, extremely difficult to assess. The externality features of telecommunications services create the problem of determining how a given benefit nationally has been distributed regionally. The fact that service has been largely

demand determined means that, on a general level, there is no ready means of testing the role of telecommunications as a causal factor, versus accommodating factor, in the growth process. The fact that (1) new technology in telecommunications plant and peripheral hardware has now made certain uses possible which previously were not; or (2) prices or attitudes might have in the past inhibited certain effects means that the actual historical record may not prove what effects telecommunications might have in the future.

2.2.2 Assessment of the future is undoubtedly a tricky business and the realism of futuristic conjectures is sometimes difficult to assess, but in a sector as technologically dynamic as telecommunications there would seem to be little alternative. Historical experience may be only a rough guide to future possibilities - for example, if this study had been performed in 1900 or so, historical experience with the telegraph would only have hinted at the developments of telecommunications that have actually occurred. History is indeed a great teacher, but it is better at some subjects than at others.

## 3.0.0 Telecommunications and Employment

3.0.1 Regional development is usually taken to mean the regional growth in employment opportunities. Telecommunications has the potential to affect both the supply of and the demand for labour. Section 3.1 considers the former; section 3.2 the latter. It is, of course, the interaction of supply and demand at the regional level which determines the regional distribution of employment.

### 3.1.0 The Impact of Telecommunications on Labour Supply

3.1.1 In some areas of Canada the chief problem of regional development is not a lack of jobs per se but the high level of turnover among those individuals who hold jobs. In isolated areas of the country, high labour turnover and the social problems that attend the consequent lack of a stable community feeling are both an important social problem and a source of great expense to government and industry. Often this turnover is ascribed to feelings of social and cultural isolation and lack of access to the amenities of urban life. The spread of telecommunications may have a major impact in reducing the relative isolation of such communities and offer the prospect of increased access to metropolitan amenities. Telecommunications, advertised as "the next best thing to being there", offers the potential for greater social contact with persons outside the region (relatives, friends) and within the region. Remote communities are often characterized by low population densities. The greater contact permitted within the region by a reliable telecommunications system may be as important as the greater contact allowed with other regions.

3.1.2 A more widespread and long-term problem in Canadian regional development has been the widely varying level of labour "quality" available across the country. Numerous studies have documented the inequality

in level of educational achievement and quality of educational inputs in different regions of the country.[20] To the extent that the educational process produces "human capital" which is supplied to the labour market, this means that in different regions of the country the supply of labour services will be of lower quality - implying both lower wages to current workers and a disincentive to the location of high technology industries in such depressed areas. In some areas the problem of physical access to schools has long contributed to the dislocation of family life, to the fatigue and poor learning of students, and to a disincentive to continue formal education. In other areas, the low level of the education of teachers has contributed, probably, to a lower level of educational input. Both problems interact to produce a low level of educational attainment and a disadvantaged labour force with poor jobs in their present locations and poor prospects elsewhere in Canada. Potentially, educational television and interactive telecommunications could bring higher quality education to our more isolated and more depressed regions. A vast literature exists on the economic benefits of education, the productivity of different inputs in the educational process and television and telecommunications as a teaching aid.[21] Case studies of the use of telecommunications in education in isolated areas may well be a real guide to the potential of telecommunications in this area. A fuller answer would, however, probably require a longer term cross-sectional study and the use of field trials.

3.2.0 The Demand for Labour: Telecommunications and Location Decisions

3.2.1 There is a voluminous literature on location theory, i.e., theory which attempts to explain why business locates where it does.

No attempt will be made here to review this literature but two general comments will be offered:

a) Transportation costs, although assigned differing roles by different theories, are most commonly singled out as a primary determinant in a firm's location decision. Telecommunications is typically regarded as being of secondary importance if it is regarded at all.

b) Although one can cite various ways in which telecommunications might influence location decisions, it nonetheless remains true that telecommunications are, at best, only one factor involved in the location decision and an enhancement of telecommunications in a region may do little to induce economic development if such enhancement fails to alter more fundamental location factors.

3.2.2 Telecommunications may be expected to have a major influence on location decisions in areas where the nature of the business enterprise or sub-component of a business enterprise is such that telecommunications are a primary and fundamental factor in the business operation.

3.2.3 The most important component of the spatial distribution of economic activity is the distribution of employment between and within economic regions. For the purposes of present analysis one can consider economic activity and employment to occur in one of three services;

(1) the production of goods and physical services;

(2) the distribution of goods; and

(3) the production and processing of information.

Table 3 indicates the current industrial breakdown of employment in Canada. The relatively small role played by goods producing industries (approxi-

Table 3

Full-Time and Part-Time Employment by Industry,
Canada - February 1978

| | Total | Full-time | Part-time |
|---|---|---|---|
| | | (thousands) | |
| All industries | 9,577 | 8,326 | 1,252 |
| Agriculture | 405 | 322 | 83 |
| Goods-producing industries (excluding agriculture) | 2,641 | 2,547 | 94 |
| Forestry, fishing and trapping | 81 | 78 | --- |
| Mines, quarries and oil wells | 161 | 160 | --- |
| Manufacturing | 1,861 | 1,798 | 63 |
| Construction | 538 | 512 | 27 |
| Service-producing industries | 6,531 | 5,457 | 1,075 |
| Transportation, communication and other utilities | 837 | 793 | 44 |
| Trade | 1,686 | 1,326 | 360 |
| Finance, insurance and real estate | 535 | 493 | 42 |
| Community, business and personal service | 2,777 | 2,186 | 592 |
| Public administration | 696 | 659 | 37 |

NOTE: Full-time employment consists of persons who usually work 30 hours or more per week, plus those who usually work less than 30 hours but consider themselves to be employed full-time; part-time employment consists of all other persons who usually work less than 30 hours per week.

SOURCE: Statistics Canada, The Labour Force, February 1978.

mately 35% of the labour force) is particularly apparent. For purposes of this study, however, it is important to distinguish as well between those service activities that involve the production of physically beneficial services (e.g. preparation of a meal in a restaurant) and those which essentially involve manipulation of symbols for the production and processing of information (e.g. the operations of banks, educational institutions, or most government departments). In fact, if one of the chief potential impacts of telecommunications is the geographical dispersal of functions within the same industry, then the occupational distribution of the labour force becomes the more appropriate breakdown. Table 4 presents a rough breakdown of the labour force along these dimensions, and one can note that almost 40% of the labour force are in managerial/clerical occupations, or the information processing sector of the economy. Sections 4.1, 4.2 and 4.3 of the report discuss the impact of telecommunications on each of these sectors in turn.

3.2.4 Telecommunications has been defined as "communication modes involving the transmission of electrical impulses".[22] As such it is only one of a number of alternative methods of transmitting information between human individuals or economic units. Potentially one can communicate by

a) face to face contact and conversation,

b) physical transmission of a written message; or

c) telecommunications.

To each of these alternative methods of transferring information is attached a cost in resources and time. It is natural, therefore, for an economist to see the choice of alternative methods of transferring information as being determined by the relative costs attached to each alternative method of transferring information.

Table 4

Full-Time and Part-Time Employment by Occupation,
Canada - February 1978

| | Total | Full-time | Part-time |
|---|---|---|---|
| | | (thousands) | |
| All occupations | 9,577 | 8,326 | 1,252 |
| Managerial, professional[1] | 2,275 | 2,048 | 227 |
| Clerical | 1,689 | 1,410 | 280 |
| Sales | 1,042 | 846 | 196 |
| Service | 1,229 | 881 | 348 |
| Primary occupations[2] | 530 | 444 | 87 |
| Processing, etc.[3] | 1,456 | 1,417 | 39 |
| Construction trades | 576 | 562 | 14 |
| Transportation | 401 | 379 | 22 |
| Materials handling and other crafts | 378 | 339 | 39 |

NOTE: Full-time employment consists of persons who usually work 30 hours or more per week, plus those who usually work less than 30 hours but consider themselves to be employed full-time; part-time employment consists of all other persons who usually work less than 30 hours per week.

1 Includes managerial and administrative, natural sciences, social sciences, religion, teaching, medicine and health, artistic and recreational occupations.

2 Includes farmers and farm wrokers, fishermen, trappers and hunters, loggers and related workers, miners, quarrymen and related workers.

3 Includes processing, machining, and product fabricating, assembling and repairing.

SOURCE: Statistics Canada, The Labour Force, February 1978.

3.2.5 Technological development has produced in recent years a dramatic decrease in the costs and an equally dramatic increase in the quality of telecommunications as a method of transferring information. Some cost declines have also occurred in transportation, but certainly the relative price of telecommunications services have fallen dramatically. This trend can be expected to continue in future. Given these trends in relative prices two questions become apparent:

(1) What impact have declining costs and improving quality of telecommunications had on the spatial distribution of employment in each sector of the economy - i.e. on the regional development of Canada, by sector?

(2) What impact will further declines in cost and improvements in the quality of telecommunications have on regional development of employment in each sector of the economy?

4.0.0 Goods Producing Industries

4.1.1 Historically goods producing industries have been the sector to which greatest attention has been paid in the literature on regional development. At least partially this is probably due to the ease of analysis with which goods producing industries can be approached. A profit maximizing firm will attempt to minimize the total cost of all factor inputs. The costs of transportation inputs are both easily quantified and much larger as a proportion of sales for goods producing industries than for either of the other two categories of industries. It is noteworthy that industries such as iron and steel manufacturing or motor vehicles and equipment manufacturing purchase far fewer telecommunications services than industries such as banking or insurance.[23] One can note that telecommunications purchases as a percentage of intermediate inputs are one-twentieth as large in manufacturing sector industries as in financial service industries while transportation inputs are as large in the same industries.[24] Plainly goods producing industries are far more affected by the costs of transportation inputs than by the costs of telecommunications inputs.

4.1.2 Indeed, for over 40% of good producing industries the cost of relocation from their current sites is probably almost infinite. Agriculture, forestry, fishing, trapping, mining and construction are all fairly immutably tied to their resource or market base. Other manufacturing industries differ widely in their location and flexibility but it

is likely that, for the vast majority, the costs of physically transporting inputs and outputs to and from markets have dominated considerations of telecommunications costs in the past and will continue to do so for the foreseeable future. Hence it is unlikely that telecommunications has appreciably affected the location or relocation decisions of goods producing industries or that this fact is likely to change in the foreseeable future.

4.1.3 The argument can, however, be made that the telecommunications network can have dynamic effects on the regional pattern of economic activity in goods producing industries. The incorporation of out-lying areas of a country into a network of telecommunications facilities and the increasing quality and decreasing costs of information flows has meant that these areas have become increasingly integrated into the national economy. This integration, as previously noted, may act either to produce heightened regional disparities or the attenuation of the same disparities.[25]

4.1.4 In recent years there has been a dramatic expansion in the economic literature on "the economics of information".[26] This literature has been developed to yield a series of implications on the size distribution of firms, the market structure of industry, the dispersion of prices, and the stability of market equilibria but it does not directly confront the issue of choice of mode of transmission of information between individuals or firms.

4.1.5 If, however, one is willing to see the development of telecommunications technology as essentially implying a decrease in the costs of the acquisition of information, this literature can be seen as having some potential relevance. In particular, the literature on search

behaviour can be interpreted in the light of a declining cost to the acquisition of information. One practical example of the use of telecommunications in this regard has been the establishment of INWATS lines for regional or provincial tourism departments.[27] Since these facilities decrease the costs of acquiring information about potential accommodation or amusements for tourists from relatively distant areas they can be seen as opening the local tourist market to a wider pool of potential visitors. Comparable schemes have also been urged for spreading of market information to farmers or to small businessmen. A new marine service introduced by Maritime Tel in southwestern Nova Scotia offers fishermen a reliable communications system that will permit boats to better plan their length of stay on the fishing banks, the best port to head for when coming in, to coordinate their arrival with land based equipment such as trucks, and so on. In all of these schemes, telecommunications facilities are seen as ways for increasing the flow of information to economic actors.

4.1.6 Telecommunications availability and/or cost is unlikely to have greatly affected the location decisions of goods producing firms but seen from a dynamic perspective wherein firms in a given region grow over time, telecommunications may add to this growth. Given that the physical goods sector, either primary resources or secondary manufacturing, is not likely to be influenced in its initial location decision by telecommunications availability or price versus the site of the resource to be mined or such factors as transportation cost, it may still be true that telecommunications can add to the growth of such firms over time. The type of examples given above of tourist lines, farm information systems

and marine services for fishermen are all particularly noteworthy because they primarily involve specialized adaptation of the existing telecommunications network to the particular needs of the industry being served. Investment in network capital equipment is clearly a different issue whose dynamic effects are more difficult to trace. The system as it is now in place in Canada is obviously of benefit to the marketing and distribution functions of firms as is noted in more detail in section 4.2. These dynamic growth effects, at the production level versus distribution level, may, however, be more likely with such specialized adaption than with general network investment.

4.2.0 Distribution Sector

4.2.1 Transportation, wholesaling and retailing of goods currently occupy approximately 15% of the labour force of Canada. These industries are relatively high consumers of telecommunications and one can expect telecommunications to have an impact on the spatial distribution of their activities.

4.2.2 It is likely that the primary impact of telecommunications on the distribution sector of the economy comes through its impact on the regional dispersion of inventories (and consequent warehousing and handling employment). When variations in demand are stochastic is nature, the law of large numbers dictates that the total size of inventory holdings necessary to meet stochastic fluctuations in demand is minimized by the centralized holding of inventories. When orders from inventory must be met within certain time periods, the cost and the speed of communications and physical transport of goods become substitutes that can be traded off at the margin. In recent years one has been a decline both in

the cost of telecommunications and in the transportation costs of filling orders at dispersed locations from centralized inventories. It appears that a substantial number of Canadian firms have centralized to a fairly large degree their distribution and wholesaling facilities.[28]

4.2.3 Economizing on inventories has real benefits to the national economy. Some part of the greater savings in inventories which are possible in the centralized distribution network are likely to be due to decreased cost and increased quality of telecommunications services. Therefore, the sample frame should include an example of firms which are largely engaged in the distribution of goods in order to quantify the impact of telecommunications on inventory savings. Section 8.9 sets out a theoretical structure for describing this inventory effect. Adaptation of this model to specific firms would permit an assessment of the magnitude of change involved.

4.2.4 In addition to these inventory effects, which it must be noted would not probably work in favour of employment in underdeveloped regions but might, due to the lower cost of consumer goods implied, lead to an increase in the economic welfare of such regions, telecommunications might play a role with regard to marketing efforts by business firms. A firm already located in an underdeveloped region might, with telecommunications, be able to broaden the effective market area served. Being more remote from its market, it might find that telecommunications allows for more effective planning of marketing activities by complementing its travel - phoning ahead for appointments, follow-up communications and so on.[29] Such influences also imply a complementary with transportation infrastructure, an issue which is addressed in section 5.1 below.

4.3.0 Information Sector

4.3.1 "The U.S. is now an information based economy. By 1967, 25% of G.N.P. originated in the production processing distribution of information good and services. In addition, over 21% of G.N.P. originated in the production of information services by the private and public bureaucracies for purely internal uses. By 1970, close to half of the U.S. work force was classified as "information workers", holding a job where the production processing or distribution of symbols was the main activity. This group of workers earned over 53% of all labour income."[30] From one point of view the over 140,000 employees of chartered banks and deposit taking institutions in Canada can be said to be engaged in the acquisition, storing, and processing of the information which is required to determine who can withdraw how much money from financial institutions. Most government officials are similarly engaged in the acquisition and processing of information. All of these groups, and others, can be said to be part of the information processing sector of the modern economy - and it is worth noting that these are the growth industries, in terms of employment, of the past two decades. Indeed, it is the information processing sector of the economy to which many refer when they speak of the "post-industrial society".

4.3.2 By a rough estimate, approximately 40% of the labour force are members of the information sector of the present day Canadian economy. The chief function of such persons is the storage and manipulation of symbols - it is not therefore surprising that the industries in which they are employed are currently the industries which are most dependent on the purchase function of telecommunications services.[31] One can expect that these are the industries

which are inherently most susceptible to influence by telecommunications policies and development of telecommunications technology.

4.3.3 Relatively little research has however been done on the impact of telecommunications on the regional distribution of information processing activities. To date five main bodies of literature in this area have been identified:

(1) the work of Tornquist and Pred and the Lund group on Swedish regional policy;

(2) the work of Goddard and others with the Location of Offices Bureau, London, England;

(3) the "New Rural Society", research programme of Peter C. Goldmark and the U.S. Department of Housing and Urban Development at the University of Connecticut;

(4) the work of R.L. Day and the business planning group of Bell Canada; and

(5) the studies surrounding the proposed decentralization of offices within Toronto - especially the work of Code and Gad.

Most of the output of these research efforts is not widely available in published journals, and it is necessary to contact the authors directly - a process which is not yet complete - and it is not therefore possible to fully recap their research at the present time. The work that is available does however make two points:

(1) In the past, the increasing use and availability of telecommunications services has probably produced more tendencies to agglomeration than to regional decentralization.

(2) It is highly conceivable that telecommunications can offer

an increasingly effective substitute for face-to-face meeting and therefore enable much greater future decentralization of economic activity than currently exists.

4.3.4 Goddard, has for example, argued that "the emergence of the so-called 'post-industrial society' with its associated relative decline of employment in purely manufacturing activities and increase of employment in 'non-productive' administrative, research, and technical functions has resulted in an increase rather than an amelioration of regional inequalities, especially in certain key occupations".[32] Goddard has documented the increasing concentration of managerial and administrative occupations in the relatively prosperous and central counties of England. A recent study of the Economic Council of Canada[33] has indicated that similar under-representation of services employment is present in the out-lying regions of Canada. To a certain extent one can see this development as a variation of the "inventory problem" to which reference has already been made. It has become increasingly easy for large enterprises to centralize their "inventory" of highly skilled, specialized personnel, to increase their degree of specialization and to use these personnel in out-lying regions on an as and when required basis. Telecommunications between the metropolis and the hinterland can substitute for face-to-face supervision in most routine cases. Emergencies can be attended to with a combination of notification of headquarters (telecommunications) and the increased speed of personal travel.

4.3.5 It is noteworthy that the primary justification that is usually given for the very existence of the large metropolis within its associated hinterland is an informational one - that of rendering possible the face-to-face

contact necessary for the coordination of upper level economic activities. Informational audits tend to indicate that the advantages of physical proximity to suppliers of highly specialized services (such as corporate lawyers or high level accountants) and the importance of face-to-face contacts in complex negotiations and communication characterized by considerable ambiguity and uncertainty will continue to ensure that these functions are performed in large metropolitan centres. The interest in telecommunications as a possible means of regional dispersion of employment arises, however, from the possibility that advances in telecommunications may soon make possible (if they have not already) the physical separation of specialized head office functions and those parts of private and government bureaucracies that are concerned with more routine information flows.

4.3.6 Where face-to-face supervision of parts of the organization are only really required on an occasional basis, regional decentralization of organizations could have substantial benefits. Firms which locate in the hinterland areas of the economy can expect to pay considerably lower labour costs than if they are forced to compensate their employees for the higher costs of metropolitan living. In 1976, for example, keypunch operators in Halifax-Dartmouth (a relatively high wage area for the Maritimes) earned 12.7% less than similar workers in Toronto; female file clerks earned 15% less.[34] More highly skilled operatives had lower wage differentials (partly because they tend to be more mobile workers) but it is these "lower-level" information processing jobs which are most amenable to relocation. It has also been suggested that regional decentralization may increase the efficiency of some types of information processing functions.[35]

From a social point of view, the regional decentralization of office employment would be a substantial boost to the regional economies of presently depressed areas. Against these private and social benefits one must put the increased cost of telecommunications services consumed. It could be that the relative price of telecommunications already offers the incentive to decentralize parts of a firm in this fashion but that attitudes to use of telecommunications, or lack of awareness of the telecommunications system's potential in this regard, or simply traditional styles of management have inhibited this tendency. Alternatively the relative price of telecommunications may not yet be sufficiently low to have created this option, but future price trends may soon make it more viable than it has been.

4.3.7 The possibility of such decentralization hinges on the possibility of substituting telecommunications for face-to-face contact and/or the transmission of written messages. A major aim of the research programme would therefore be to attempt to estimate the "elasticity of substitution" with respect to both price and quality of information transferred between telecommunications versus face-to-face communication or written communication. It appears, even from the present literature, that a number of variables may affect this substitutability. Driver and Mock[36] have found, for example, that management style has substantial impact on the processing of information. "Irrational" prejudices against the use of high technology telecommunications equipment may impede the operation of a decentralized system (although Rappaport[37] cites a case where video terminals have been successfully substituted for written reports in a medium sized American corporation).

4.3.8 In addition, the potential for telecommunications use may well be very industry specific. Industries as superficially similar as banking and insurance may be quite different in their potential for decentralization by telecommunications. Nilles and Carlson[38] indicate that insurance can be considered as a "stand alone" industry which does not require a geographical proximity to other insurance groups. In banking, however, the need to transfer large numbers of cheques makes the decisions of one firm dependent upon the decisions of the rest of the industry. (However, the development of chequeless banking may well obviate this difference.) In short, since a large number of potentially important variables may differ across information processing firms, it will be necessary to both select the case study firms with care and to be circumspect in the interpretation of the observations generated.

5.0.0 Infrastructure Complementarity

5.1.1 Impacts on the supply of and demand for labour may be one method of approaching the influence of telecommunications but one can in addition see a more general role for telecommunications. Apart from the direct role which telecommunications may play with respect to any particular industry or firm, telecommunications may also impact on a region through "complementing" other infrastructure components. With transportation, for example, telecommunications may be highly complementary in facilitating planning for business travel, in coordinating a physical distribution network and generally in enhancing the utility gained in using the transportation network. For example, more effective inventory planning and warehousing (Section 4.2) is likely to be realized only if an adequate transportation

network exists which permits quick inexpensive shipment of goods when orders are placed.

5.1.2 Telecommunications may have a certain complementarity as well with other service sectors which are part of infrastructure.[39] Sectors such as education and health services have the potential for being significantly augmented by telecommunications for delivery to remote areas. Experiments in so-called tele-medicine are already underway as are experiments involving telecommunications and education. Educational television has been with us for sometime and, in the future, particularly if we see a greater use of broadband telecommunications networks, possibilities will develop for two-way interactive educational uses of telecommunications. The results of these uses in health care delivery and education would then be to raise the level of these services being delivered to remote areas. This in turn could influence regional development by making remote areas more attractive as places to live, thus enhancing the willingness of many employees to move to remote areas.

5.1.3 This discussion of possible complementarity suggests that there may be a need to look at infrastructure investment and planning in a coordinated framework. If transportation and telecommunications do indeed exhibit a complementarity, maximum benefit of each may only be obtained if there exists some minimum "threshold" level of the other. Promoting optimal use of telecommunications and hence the realization of maximum benefits from telecommunications may imply investing in transportation rather than telecommunications. Alternatively simple adding more and more roads may confer little marginal benefit if the telecommunications network is below some "threshold" level. This complementarity also implies that

the same service, health care or education, for example, may be delivered in alternative ways with possible significant cost differences between the various options. Telecommunications suggests itself, on account of cost, as perhaps the only way to significantly augment education or health care facilities in remote regions. Government simply can't afford to build a hospital or school in every town, or to equip and staff every hospital and school at equal levels unless it does so by accepting a low standard of delivery.

5.1.4 It is proposed to study this question of complementarity by analyzing, along the lines of traditional cost-benefit analysis, experiments in tele-medicine and in educational use of telecommunications which are currently in progress in parts of North America. The question of telecommunications/transportation complementarity will be partially addressed in the inventory studies recommended. In addition, the attitude survey (see Section 8.8) will be designed to offer data on this question by addressing the issue of transportation requirements and use as well as telecommunications use.

## 6.0.0 The Case of Less-Developed Countries

6.1.1 Sections 2 to 5 have discussed some of the problems and the potential of estimating the impact of telecommunications on regional development in Canada. In addition many developing nations are currently engaged in an expansion of their telecommunications network and physical plant - and the question arises "to what extent can Canadian regional development experience with telecommunications be generalized to yield lessons for the development of less-developed countries?"

6.1.2 In 1867 a famous German philosopher/economist noted "The country that is more developed industrially only shows to the less developed the image of its future".[40] Ever since, economists have debated the applicability of the experience of the developed countries to the situation of the presently less developed countries. Currently, two schools of thought argue that the experience of development can be easily generalized but most practitioners of development economics are considerably more cautious. Rostow[41] has argued that societies pass through the following stages: the traditional society; the pre-conditions for take-off; the take-off; the drive to maturity; the age of high mass consumption. Such a schema implies that all nations pass through the same historical process, hence the examination of the economic history of currently developed countries can tell us the stages and processes which lie in the future of nations which are as yet underdeveloped. This approach has, however, been widely attacked[42] as being excessively mechanistic and not in accordance with the wide variation that exists in the economic conditions of both developed and less developed countries and it is by now largely discredited. Alternatively, one can view economic development as a long and gradual process of economic growth, involving a continuous process of technological change or transition from one "stage" to another. Solow[43] and Koopmans[44] both provide examples of some of the seminal work in this tradition. The literature on growth economics is by now voluminous and continually expanding, but its relevance to the real world has been vigorously attacked. The high level of mathematical abstraction involved and the restrictiveness of the assumptions imposed on these models make them extremely unsatisfactory

as explanations of either current developments in developed countries or the future path of less developed countries.[45]

6.1.3 Even authors such as Kuznets[46] whose basic theme is the commonality of various strands in development experience are highly cautious in interpreting what appear to be similar trends in statistical aggregates in the process of economic development. Economists who consider also the political and social dimensions of economic development typically also stress much more heavily the differences in initial conditions between the less developed countries of today and the now developed countries. Myrdal for example, declares that "the differences (in initial conditions) are in many instances of such a nature as to prohibit a pattern of growth analogous to that experienced by the developed western countries".[47] Myrdal emphasizes the great differences between the period at which presently developed countries were underdeveloped and the current period of less developed countries - "In many respects the period of comparison (when both countries were underdeveloped) should be fixed centuries before the industrial revolutions in the west. In other respects conditions in South Asia are comparable to those in western countries at any time in recent history. And in still some other respects conditions are more comparable to those now existing in the west or at least in periods much later in the western development process".[48] Presently less developed countries have in place some aspects of the most developed technology in combination with some aspects of the most primitive technology - in India, for example, cow dung and nuclear reactors coexist as sources of energy. Furthermore, presently less developed countries must operate in a world where the pace of technological development has quickened enormously and

where most of that technological development occurs in the developed countries and is necessarily oriented to their needs and problems. As Myrdal notes, much of the research and development occurring in developed nations (such as that involved in the development of synthetic substitutes for the natural products of less developed countries' agriculture - e.g. rubber, jute) "has had and is having an impact on the South Asian countries that is very detrimental to their development prospects."[49] Currently developed countries have for the past 200 years been technological leaders in the international economy and the situation of less developed countries is fundamentally different.

6.1.4 In addition, a large body of literature[50] argues that economic development in Europe and North America depended upon an expansion of international trade which, in the context of political imperialism, impoverished the nations of Asia, Africa and Latin America. Whatever the weight one attaches to the importance of these colonial relationships during the 19th and early 20th century there is no doubting that in the early years of its economic development Great Britain traded in an international market very different from that in which presently less developed countries participate. In short, even from the most general perspective there are grounds for caution in applying the experience of presently developed countries to the situation of the currently less developed countries.

6.1.5 In the particular case of the telecommunications sector there are at least two additional grounds for caution in generalizing from the Canadian experience - (a) the very different costs and benefits involved in extending the network versus improving a largely comprehensive network

and (b) the high rate of technological progress in the telecommunications sector. The telecommunications networks of most less developed countries are accessible only to a small percentage of the population. Authors such as Artle and Averous, Rohlfs and Squire[51] have emphasized that as such a system expands it confers benefits not only upon new subscribers who gain access to the system, but also upon existing subscribers who gain access to a larger pool of potential contacts. When a system is largely complete (as is the case in Canada) investment in telecommunications plants produces benefits in improvements in the quality of telecommunications services rather than in improved accessibility to the service. Clearly the nature of benefits to be derived from the investment in telecommunications is likely to differ very appreciably if one is considering the expansion of a system or the improvement of a largely complete system. The Canadian experience that might be most relevant to the present situation of less developed countries is, therefore, not the experience of the recent past but the experience of the more distant past (say the period before the Second World War) when the Canadian telecommunications system was in a comparable stage in the expansion of its network.

6.1.6 Clearly, however, the technological options open to presently less developed countries are considerably different from the technological options open to Canada in the 1930's. Such advances as the introduction or planned introduction of satellite transmission for long haul telecommunications not only offers increased quality at a drastically lower real cost than was available to pre-war Canadian companies but also changes fundamentally the economics of long distance transmission - from

a network where real costs of transmission depend directly on distance of transmission to a network where physical distance is essentially irrelevant. Expansion is therefore occurring in a fundamentally different technological environment. Not only does this change drastically alter the economics of the system, it also accentuates the gap between the technology required by system hardware and the technological skills present in the populace. Canadian switching systems in the 1930's could be understood by individuals with mechanical know-how and a fairly rudimentary knowledge of electronics; modern switching systems and transmission technology are far closer to the frontiers of a rapidly expanding science. In addition one can point out that the level of literacy and technical education in the Canada of the 1930's was higher than in many less developed countries today. Both because of the different technological options open to telecommunications systems today and the wider gap between technological requirements of those systems and the skill level of the labour force, the spinoffs from expansion of the telecommunications sector are likely to be very different as the less developed countries expand their systems than was the case in Canada.

6.1.7 All this points to the need for a careful structuring of research and the use of great caution in interpreting the results if one is to use the experience of Canada with telecommunications as a guide to the use of telecommunications in the development of presently less developed countries. One will have to make full allowance for the differences between the Canadian situation and the situation of less developed countries but, that having been done, some guide is required to the elaboration of telecommunications policy and investment in less developed countries and

historical experience may be a useful approximation in certain carefully specified areas. In particular, the impact of telecommunications on regional disparities in Canada may be a guide to the impact of telecommunications on similar disparities in less developed countries - not in a quantitative, but in a qualitative sense. Regional disparities are a critical problem in many less developed countries and one might expect that telecommunications might have similar direction of influence in encouraging agglomeration of business and government in the capital cities of these countries. Similarly, telecommunications offers the potential for regional decentralization within less developed countries as within developed countries. Qualitatively, the influence of telecommunications may be similar but since technological progress has drastically altered the cost functions of the telecommunications sector, one would be treading on very dangerous ground indeed if one were to use estimates of the impact of telecommunications in Canada derived from historical Canadian data to predict, quantitatively, changes in less developed countries of the present day.

6.1.8 Since however, Canada is a leader in the implementation of a good deal of new telecommunications technology the practical results of such implementation may be of very great interest to less developed countries. Practical demonstration of the economies of satellite transmission in Canada, for example, would be of very great interest to presently less developed countries. If an assessment of attitudes or awareness regarding telecommunications use in Canada suggests that this is a limiting factor in regional decentralization, such a result would

hold an even stronger lesson for less developed countries and suggest strongly the need for telecommunications improvements to be accompanied by an "education" programme so as to maximize potential benefits. To the extent that on an individual firm or exchange basis, some answer will be sought in Canadian experience to the question of whether telecommunications causes or merely accommodates economic growth, this too could have strong suggestive implications for government planning of telecommunications services in less developed countries. In particular it would lend some evidence to the discussion of how far in advance of demand telephone plant should be provisioned, although it would not provide a definitive answer on this point for LDC experience.

6.1.9 There is at this point a small but growing literature on the potential role of telecommunications in assisting the development efforts of less developed countries.[52] Very little of this literature, however, offers much in the way of concrete evidence on what the size of this impact might be or indeed, the way in which this impact will work on the economies in question. An examination of Canadian regional experience in this regard could then offer at least some suggestions and, perhaps more importantly, a framework within which the particular experience of underdeveloped countries might be directly tested. One of the essential requirements for an assessment of the importance of telecommunications to the process of economic growth at a regional or a national level is the development of appropriate methodologies to permit such an assessment to be made. These are outlined in Section 7 for the Canadian context.

## 7.0.0 Proposed Methodology

7.1.1 Preceding sections have made clear (1) the difficulties implied if one approaches a study of the impact of telecommunications on regional development at too high a level of aggregation and (2) the paucity of professional literature and empirical evidence on this relationship. Consequently it is necessary to approach this topic on two levels simultaneously - at the 'macro' level with examination of the econometric evidence on economy - wide changes and at the 'micro' level with examination of particular case studies. Since the former is fraught with the difficulties outlined in Sections 2.1 and 2.2, more emphasis has been placed here on the case study approach. These case studies will be selected so as to yield the maximum of implications for macro-economic trends, but one must, of course, always bear in mind the difficulty of generalizing from small samples.

## 7.2.0 Specific Hypotheses To Be Tested

7.2.1 In the preceding discussion of the potential role of telecommunications in regional economic development, several hypotheses were advanced. These hypotheses as to the role of telecommunications in regional economic development, will be examined in the case studies and can be listed as follows:

1. that the benefits of improved telecommunications cannot be totally contained in the region where such improvements take place and the benefits derived from telecommunications in any one region cannot be solely attributed to the telecommunications system within that region;

2. that telecommunications has played an "accommodating" role in economic development in Canada, not a "causal" role;
3. that telecommunications may contribute to a reduced rate of labour turnover and a more stable community environment in isolated regions;
4. that the use of telecommunications in education may contribute to an increase in labour force quality in isolated regions and hence make such regions more attractive to the employees of potential firms looking to locate in isolated areas. In other words, telecommunications may make isolated areas more site-attractive for firms via their use in education;
5. that, for firms or parts of firms which are heavily dependent upon telecommunications for routine job performance, telecommunications, particularly the relative price of telecommunications, may permit cost-effective relocation of whole firms or office units within firms to remote or underpriviledged areas;
6. that firms in the distribution sector may, with an adequate, cost-effective, telecommunications system, be able to centralize inventory holdings;
7. that internal growth of firms already located in a given region may be enhanced by new telecommunications plant investment, specialized adaptation of telecommunications to individual firm needs, or changes in the relative price of telecommunications;
8. that attitudes to the use of telecommunications or awareness of the usefulness of telecommunications may have inhibited the realization of the full benefits of telecommunications on economic development in Canada to date;

9. that telecommunications may contribute to growth in an economy not only by its direct role but also by complementing other infrastructure components (e.g. transportation, medical care delivery, and education) and enabling a higher level of productivity to be obtained and

10. that future trends in the relative prices and quality of telecommunications may create many of the above effects even if they have not to date been realized.

7.2.2 An alternative way of looking at this set of hypotheses, is to group them into four main areas corresponding to different aspects of the telecommunications system: 1. plant investment, 2. prices, 3. specialized uses and 4. attitudes/awareness factors. As case studies are undertaken to test each of the above set of hypotheses, within each case or group of cases, each of these latter four factors or aspects of the telecommunications system will be separately considered.

7.2.3 Within this list of specific hypotheses it is proposed that 1) and 2) not be dealt with directly at this time. One of the advantages of doing micro-level studies is that one can attempt to measure the importance of telecommunications to specific users without questioning what part of the national telecommunications plant is responsible for the benefits being measured, i.e. without questioning whether it is investment in Region A or Region B in the language of section 2.1. The question of telecommunications as an accommodating versus causal factor in the growth process will not be confronted in an aggregate sense but will be partially incorporated at a micro level, particularly in the exchange study to be proposed. More specifically the hypotheses

that will be tested is that of whether certain location decisions would have been taken if the telecommunications plant had not been in existence and/or what additional cost would have been imposed on existing users if they had had to find substitutes for the existing telecommunications plant. This hypothesis does not precisely correspond to the accommodating vs. causal hypothesis but does at least seek to look at the "essential feature" characteristic of telecommunications in the growth process.

7.2.4 The section dealing with recommended case studies will, in its concluding part, indicate a priority listing for the various case studies and thereby, implicitly, a priority listing for the various hypotheses advanced above. In the remaining portion of this section, discussion is focussed on describing methodologies appropriate to testing these hypotheses.

7.3.0 Decentralization

7.3.1 Typically one thinks in terms of choosing between time series or cross-section approaches to economic studies. In this case it is necessary to choose between longitudinal studies (i.e. before/after comparisons of an office which is engaged in decentralization) or comparisons of a number of economic units, some of which have decentralized regionally and used telecommunications intensively and some of which have not decentralized and continued to rely on face-to-face visits.

7.3.2 Before/after comparisons might be made, for example, for some of the federal government departments which are being decentralized currently. This process of governmental decentralization is already under way and hence would provide a study of organizational decentrali-

zation more generally. Care would have to be taken to select operations within the federal government which are at least somewhat comparable to operations within private firms that potentially could be decentralized (for example, computer-based operations and the shift of the Unemployment Insurance Commission's computer operations to Belleville, Ontario).

7.3.3 In the private sector, two alternatives may be open:

(1) examining the decentralization experience of firms in Canada such as those who have recently moved their head offices (but perhaps not much of their staff) from cities like Montreal to cities like Toronto[53], or who have decentralized regionally;

(2) examining such international experience as:

a) the experience of the Location of Offices Bureau, London, England, and

b) the split established in many major American corporations whose corporate head offices remain in Manhattan while their administration is carried out in the suburbs of Greater New York or elsewhere in the United States.

7.3.4 Cross-sectional studies would be particularly useful in industries in which some firms have engaged in substantial regional decentralization while other firms have not. One could then ask the very interesting question of why similar firms have these different strategies. It may well be that banks differ in the degree of regional decentralization; certainly provincial governments do. The difficulty

with the cross-sectional approach is its greater requirements in terms of access to individual economic units. It would seem to be easier to negotiate access to one economic unit on a repeated basis for before/after comparisons than to negotiate access to a number of economic units sufficient to make cross-sectional comparisons.

7.3.5 If the "applied economics of information" approach is adopted, then there are two basic issues:

(1) to measure information flows into and out of the economic unit being considered;

(2) to measure changes in the productivity of this economic unit.

Data gathering procedures will have to be supplemented by extensive interviews with managers and employees both within the affected unit and within the units with which it communicates. Only by face-to-face interviews will it be possible to get reliable information on the subjective/morale aspects of changes in location and on the qualitative dimensions of the change in information flows which would result from a change in centralization or decentralization. This project is itself an exercise in the processing of information and it will be necessary to "scan" the environment in which firms operate to identify the ambiguous and the unexpected aspects of information flow. Once these have been identified, the data can then be assembled in a more routine, more easily comparable fashion.

7.3.6 For a before/after study, the technique would be essentially to log information flows in and information flows out of the affected economic unit. (The work of Goddard and the Lund group[54] will be of great

assistance in the details of the methodology.) A telephone log is relatively simple, and could be installed either to work automatically - recording the origins and destinations of calls, their length, and their frequency, or on a diary basis, including also the subject of the call. Physical flows of mail or inter-office memos into or out of the unit are also relatively simple to enumerate - for each "package that crosses the cordon which is established around the unit being examined, one can easily obtain the time in transit both before and after the decentralization (after all, it may turn out that the real obstacle to regional decentralization of office functions is postal service and not telecommunications at the current state of the art). "Visits log", both of outsiders visiting the unit and of members of the unit visiting other offices, complete the audit of the information flows into and out of an economic unit.

7.3.7 A government department which decentralizes some of its operations to the Maritimes, for example, is essentially engaging in changing the flow of information into and out of those sub-departments. Previously in those sub-departments, workers could communicate by phone or mail with other government departments in Ottawa or they could "drop in" on other departments - and other departments could return these favours. Now that these functions are being shifted, information flows will change. Information that was communicated by face-to-face visits, or via the "grapevine", may receive one of four fates:

(1) it may not be transmitted;

(2) it may continue to be transmitted face-to-face through travel;

(3) it may be mailed; or

(4) it may be telecommunicated.

The important question is the degree to which telecommunications can substitute for the previous face-to-face mode of communication.

7.3.8 It will be difficult to get any firm measure of the output of most office units. It will be somewhat more easy to obtain estimates of the capital equipment tied up in office functions or the number of employees. If all of this information was obtained for a sufficiently large number of units, it could conceivably estimate a production function which apportioned the changes in output of these productive inputs. From such a production function estimates of the elasticity of substitution between communication modes could be generated.

7.3.9 The proposed studies will be possible only if co-operative firms can be found. A crucial objective in the methodology proposed is to estimate the elasticity of substitution between telecommunications, or types of telecommunications use (e.g. voice, data, facsimile) and other information - transfer modes. This will require the type of information-audit procedure described above and this, of course, requires cooperating firms prepared to assist in the collection of the basic data. The price paid by business subscribers for telecommunications is not necessarily indicative of the benefit derived from telecommunications. A better measure of benefit is the opportunity cost of telecommunications i.e. the price of competing information - transfer modes. To properly assess this opportunity cost, however, it is necessary to have some notion of the relevant elasticities of substitution so that the full cost implications of using more telecommunications instead of other information - transfer modes can be calculated.

7.3.10 In terms of much of the existing literature on the role of telecommunications, the explicit treatment of this substitution issue is a somewhat unique way of looking at the whole question of the impact of telecommunications. It recognizes explicitly that the role of telecommunications may be quite different than the role of other modes of communications to business users. One of the important questions to then be asked is the substitutability of the telecommunications system at the margin with other information - transfer modes.

7.3.11 This methodology proposed here also places great emphasis on the cost of information transfer by alternative modes (including time of personnel, reliability and price). To the extent that the bulk of the existing literature concentrates attention on less-developed country experience, the problem of telecommunications tends to be regarded as a problem of plant investment. While this aspect of the question cannot be ignored, it is also certainly the case than for any country, but especially one like Canada where the physical network is now virtually complete, that use and usefulness may be more a function of cost than of network size or accessibility.

7.4.0 Attitudes

7.4.1 It has been argued in preceeding portions of this report that attitudes to, or awareness of, use of the telecommunications sector may have affected the impact which telecommunications have exerted on economic development generally and on regional economic development specifically. In order to more accurately test this hypothesis that attitudes or awareness have inhibited the impact of telecommunications on development, it is proposed that a cross-sectional survey be undertaken to assess these

attitude and awareness questions.[55] Such a study would be primarily undertaken by mail questionnaire, reenforced by individual interviews where possible. It would also, insofar as it proves possible, attempt to incorporate time as a factor in order to assess not only where attitudes/awareness currently stand but also how they have changed overtime. The survey, would thus be constructed so as to allow for longitudinal cross-sectional analysis of the firms surveyed.

7.4.2 As an attitude survey is one of the projects proposed for Phase II, a more detailed look at this question is left for the next section of this report. In terms of methodology, however, one can note that if attitudes or awareness issues have inhibited the growth impact of telecommunications to date this implies one must explicitly integrate attitudes into an analysis of the importance of telecommunications in regional economic growth in Canada.

7.5.0 Plant Investment

7.5.1 Although previous sections of this report have raised doubts as to how far it is possible to go in assessing the historical role played by telecommunications plant investment, (i.e. system or network growth) it is possible to address this issue on a micro scale. As is noted in more detail in the discussion of specific case studies recommended for Phase II, individual exchange experience, where changes in plant and consequent changes in local economic activity occur over time and where the timing of changes has varied considerably, open possibilities of exploring this issue. One may also look at individual firm experience and consider to what extent, and with what cost, other information transfer modes could substitute for telecommunications - in other

words, look at the question of what might happen if individual firms had to operate without the telecommunications system as it now exists. The preferred methodology for such a study would involve many of the same components as were outlined above for assessing the potential for decentralization, i.e. monitoring information flows and computing both the degree of substitutability between telecommunications and other information transfer modes and the cost implications of having to do without telecommunications. A comparison of the actual costs of information flows to firms with the system in place and the estimated cost of such flows without the system, i.e. assuming substitutes have to be found and used, would represent the impact that the physical plant investment in place has for the firms in question. This could lead to conclusions on the influence of telecommunications on market area served, marketing and distribution systems, profitability and location influences.

7.5.2 In general terms, the methodology being discussed here is known as the "counter-factual" technique. It is a technique that has been reasonably well-developed at this point, particularly in the area of economic history.[56] Essentially, the methodology operates by taking a part of some actual experience, in this case, an existing telecommunications network, and removing it, while assuming that all other parts of the experience remain in-tact. One then proceeds to reestimate the magnitude of the experience with the one element removed and the difference between the new estimate and actual experience is then attributable to the element removed. The questionable assumption in all of this is whether the experience would otherwise be the same if even one of its parts were altered. Would existing firms, for example, be located in their

present sites if there were no telecommunications system? The counterfactual methodology assumes they would be although it may well be questioned if this would necessarily be the case. In addition, because it is a conjectural model building exercise, there is no way to independently test the results which the model generates.

7.5.3 These problems notwithstanding, however, the technique is a powerful one for answering otherwise insoluble questions. Certainly (1) the fact that telecommunications service in Canada has been available virtually on demand, subject to financial implications for the carriers, and (2) the fact that we are, at present, faced with a virtually complete system roughly comparable in quality and accessible across the country (except for the Canadian North) make it difficult to evaluate the role of plant investment in any other way. The main alternative is the study of individual exchange experience (see Section 8.11 ).

7.6.0 Regression Analysis

7.6.1 Several of the case studies proposed in the next section involve the use of regression analysis as the primary statistical tool. No attempt will be made here to detail the features of regression analysis; for this a useful intermediate source is Johnston's Econometric Methods.[57] One must, however, emphasize that regression results imply no necessary causal relationship; however good the data "fit" might turn out to be. Correlation, even sophisticated correlation, is not causation. Regression techniques, therefore, require in addition some "a priori" theoretical base which indicates "ex ante" the direction of influence to be expected between the different variables being used, and regression

results can then be used to test these hypotheses.

7.6.2 In the specific case of telecommunications in Canada, this problem may be further accentuated by the fact that the need for system compatibility across Canada and the need for every carrier to maintain minimum quality of service standards as required by the toll network have resulted in a limited range of variation in quality and level of service across Canada. One would therefore expect to find a relatively low level of variation in the independent variables included in the regression analysis and this, in turn, might affect the interpretation of the causal role played by each of the variables.

## 8.0.0 Recommended Case Studies

8.0.1 This section outlines a set of case studies which are recommended for Phase II of this project. The list of studies provided represents a greater number of cases than it is likely will actually be included in Phase II. The number listed here is larger than the number expected to be included partly to provide some choice and partly because within the time available for undertaking Phase I, it was not possible to fully determine a precise set of priorities for Phase II. Following the descriptions of each individual case study, Section 9 suggests groupings of the case studies representing packages of the proposed cases which form coherent units and in combination test the hypotheses generated in the conceptual framework (Section 7.2).

8.0.2 It should also be pointed out that in line with the terms of reference of Stage I no detailed work has been undertaken on these studies to this point. The task of the research team in Phase I was to define the "general scope" of the studies. The detailed examination is to be the major component of the Phase II work.

8.0.3 The preceeding section on methodology outlined a specific set of hypotheses to be tested and commented on the general methodological frameworks that would be used for this purpose. In this section, the proposed specific test vehicles are outlined and a somewhat more detailed comment is made on the specific methodology to be employed in each case. As was previously noted, in some instances this specific detail must await the detailed undertaking of the case itself.

8.1.0 Project A: A Study of Telecommunications Use in Banking

8.1.1 The banking sector is currently one of the most highly centralized of Canadian industries. It has evolved from a network of dispersed financial institutions with headquarters and senior management staff scattered across the country to an industry dominated by a very small number of centralized multinational corporations whose primary head office functions are located in a limited number of regional and national centers. This sector is one which experienced an extremely high rate of growth of employment opportunities during the post War period. With total employment at over 140,000,[58] chartered banks and other deposit taking institutions are directly responsible for a substantial amount of employment. Banking is also a sector which is very likely soon to be revolutionized by developments in telecommunications and computer technology. These changes are likely to come in three main areas: (1) the increasing foot-loose nature of some accounting and office functions within the banking industry; (2) the probable breakdown of the existing network of branch banks and; (3) electronic transfer of funds.

8.1.2 Within the large Canadian chartered banks, significant changes in operating procedures can often be merely internal reorganizations which attract little public attention. In the United States, with its more competitive banking sector, similar changes often show up as the growth of some types of banks at the expense of others or in the growth of subcontracting or other arrangements between banks. In the U.S. banking system, for example, economies of scale in the processing of credit cards mean that some banks contract to do this work - e.g. City National Bank and Trust Company of Columbus, Ohio processes paper for

some 85 other banks in the U.S., including a credit union in Anchorage, Alaska which sends account information to Columbus, Ohio via satellite.[59] This development in banking indicates two phenomena: (1) the economies which can be derived from centralized processing of much accounting data and (2) the "foot-loose" nature of where that centralization actually occurs. City National is also experimenting heavily with electronic funds transfer and the opening of small "mini-branches" or cash dispensers whose basic accounting functions are computer centralized. Telecommunications, coupled with centralized computer facilities, are likely soon to mean that local branches can be decentralized even within cities. The development of mini-banks and cash-dispensing outlets to handle routine banking business and the potential dispersed location of these outlets (e.g. in supermarkets) may mean a revolution in banking very similar to the revolution that occurred in entertainment when TV made obsolescent thousands of local movie theatres.

8.1.3 This study of the banking sector will be composed of two main parts, an historical survey and a projection of the impact of telecommunications on information flows within the banking sector. The historical survey would attempt to trace the development of means of telecommunications on the growth of employment in banking and the degree of centralization that has occurred over time in banking functions. As such, it would be largely an exercise in applied business history, with a distinct emphasis on one central theme - the impact of technology on information flows within what is an essentially information processing organization and the resulting changes that have taken place in the demand for telecommunications services by the banking sector.

8.1.4 At this stage there has not been time to negotiate access to the operations of any of the major chartered banks or trust companies. Two alternative methodologies (see Sections 7.3.1 and 7.3.2 above) are therefore presented for dealing with the future impact of telecommunications on the Canadian banking system. Hopefully it will be possible to negotiate with one of the major chartered banks sufficient access to their information flows so that estimates may be made of the degree of substitutability between face-to-face communication and telecommunication in their current set-up and therefore the potential for future agglomeration or decentralization within this organization. A second best alternative would be to survey the chartered banks and trust companies as a group (with clear promise of confidentiality) in an attempt to gauge their telecommunications needs present and future and the state of their current corporate planning with respect to telecommunications.

8.1.5 The proposed information-audit methodology for this study has already been discussed in the Section 7.3.6 of this report. Should a detailed "information-audit" of a single bank prove impossible, then a survey of financial institutions as a group would be less precise but should nonetheless allow for a set of crude estimates of the elasticity of substitution to be generated. It is expected that estimates of future price trends for telecommunications and other information transfer modes can be generated by projection of past trends coupled with input solicited from the carriers on the impact of new technologies. One will then estimate the cost impact on the bank of a move of parts of its office operations to a more remote region of the country, given current prices.

If such a move proved not to be cost-effective at the present time, the estimates would be projected forward in time using the future price estimates made in order to see whether such moves might prove cost-effective in the future. The analysis would show both for the present and the future how far the relative price of telecommunications versus other information transfer modes would have to move to make relocation of offices to underprivileged regions cost-effective.

8.2.0 Project B: Government Office Decentralization Study

8.2.1 The Canadian Federal Government has over the immediate past been undertaking a series of office decentralizations, moving sections of Federal Government departments to underprivileged regions or areas of the country. Several of these moves have taken place or have been announced while still others are presumably yet to come. In suggesting that a study of one of these decentralizations be undertaken in the context of the present work on telecommunications, it is recognized that these moves have not been prompted by economic motive but rather are essentially political decisions. The motive for the moves does not, however, change the fact that these moves, once undertaken, will produce economic effects and, as such, represent a suitable vehicle for studying many of the questions raised by this study. First is the fact that unlike many private industry decentralization studies which have taken place within larger metropolitan areas or relocation decisions of entire firms, these government decentralizations involve movement of part of a department to a totally separate, distant location. They thus incorporate a greater spatial dimension which most private industry decentralizations have to this point lacked. Second, these moves, once they take place, must have implications for telecommunications cost and use which will have certain parallels with private industry potential in this regard.

8.2.2 A study of the banking industry would be a study of an industry several of whose members have not as yet undertaken a conscious policy of regional decentralization and an industry whose approach to such

decisions is likely to be motivated almost entirely by profitability considerations. The current process of government decentralization is fundamentally different. If, however, within the Federal Government, the study could isolate departments whose functioning is peculiar neither to the Federal Government nor to governments in general, then the lessons to be learned would be applicable to comparable private market units. A potential candidate would be the Department of Veterans Affairs, many of whose operations can be likened to the operation of a pension fund. The Department of Veterans Affairs is currently scheduled to move part of its operation to Charlottetown by 1981.

8.2.3 The methodology to be employed in this study would be essentially the same as for the banking study just described. The purpose would be to quantify the cost implications of a regional office decentralization, thus providing a basis for assessing how cost-effective such moves might be for comparable private sector units. The problems of undertaking an information audit would, of course, be present in this case as well. To the extent that there have been government offices already decentralized, e.g. DREE, it might prove useful to broaden the study to include one of these moves which has already occurred in order to assess the actual substitution which has taken place. This might prove somewhat easier to undertake than the full information-audit and could additionally provide a check against the estimates generated on an "ex ante" basis, e.g. the planned move of Veterans Affairs.

8.3.0 Project C: Counterfactual Study of Private Firm Use of Telecommunications

8.3.1 In order to study the question of what role is played by plant investment in telecommunications, this study would adopt a counterfactual technique and assess the impact on the selected business firm of having to operate without the use of the telecommunications system. Its aim would be to provide an estimate, at the micro level, of the economic benefits of telecommunications.

8.3.2 A firm having to operate today, or at any other point in the past when there was a telecommunications system, without the telecommunications network would have to find other ways of processing the volume of information flows currently routed through the telecommunications network. A calculation of the additional cost of conveying the information actually carried by the telecommunications sector by the least expensive alternative means would represent a measure of the direct benefit of the system. Assuming for illustrative purposes that the alternative mode is mail, let

$p^m$ be the price per message unit, weighted by distance, of mail as charged by the carrier.

$p^t$ be the price per message unit, weighted by distance, of telecommunications as charged by the carrier.

R be the total message units weighted by distance.

I be the extra costs per message unit weighted by distance incurred in the use of mail on account of the slower speed, risk of incomplete delivery, higher insurance costs, and so on.

K be the investment in physical telecommunications plant.

d be the depreciation rate on telecommunications plant.

$i$ be the time rate of discount - i.e. the opportunity cost of capital.

$MC^m$ be the marginal cost of a message sent by mail, which is assumed constant.

$MC^t$ be the marginal cost of a message sent by telecommunications, which is assumed constant.

Then, if there is a single firm using the telecommunications system, the financial savings to the firm of using telecommunications, the savings which would be lost in the absence of the telecommunications system, would be given by the expression

$$(p^m - p^t)\ R + IR$$

8.3.3 The social savings to society from this firm's use of the telecommunications system would be given by the expression

$$(MC^m - MC^t)\ R - [dK + iK] + IR$$

This latter expression would represent the extra resources that are "freed up" by use of the telecommunications system and summed over the whole economy would represent the contribution of the telecommunications network to national income. The assumptions of a single firm in the economy, the assumption of a single alternative information transfer mode, the assumption of constant marginal cost, and the assumption that telecommunications is a homogeneous good are not necessary ones, and all would be relaxed in the proposed study. They are incorporated here merely to simplify the illustration of the model.

8.3.4 It is proposed that this study be done for an individual firm based on the information audit technique previously described. This

would generate elasticities of substitution between different modes which would then allow for appropriate translation of the volume variable according to mode. It would, however, by being firm-specific, not be directly generalizable to the business sector of the economy as a whole.

8.3.5 No decision has been made at this point on the most desirable firm to study with this approach. A transportation industry firm might be a good possibility, however, given the relative high consumption of telecommunications services by the transportation sector. Transportation and storage account for 10.9% of total industry purchases of telecommunications output in Canada[60], and thus represent a significant sector to study.

8.4.0 Project D: A Study of Toll-Free Tourist Lines in Prince Edward Island and Nova Scotia

8.4.1 For several years, Prince Edward Island has operated a toll-free reservation system for tourists travelling to Prince Edward Island and in May of this year, Nova Scotia will be introducing a somewhat analogous service. These experiments are suggested for study both because they represent instances of specialized adaptation of telecommunications to specific industry needs and because tourism, as an export-based sector of the economy, represents a good example for testing the internal growth generating effects of telecommunications on industries which are tied to a specific location and are dependent on external markets for their sales.

8.4.2 The Prince Edward Island system is operated primarily within the Maritime Provinces between late June and early September. WATS lines are in place for Nova Scotia and New Brunswick. In 1977 a WATS line was installed for the month of May to service part of Ontario. The P.E.I. system is a manual operation where the call is placed to a tourist department operator who in turn calls the hotel, motel or campground to arrange reservations. The party calling is either held on the line or called back at a later time which is usually no longer than a half hour. The system is primarily designed for tourists already travelling in the Maritimes.

8.4.3 The Nova Scotia system, CHECK-INNS, which is due to begin operations in May of 1978 is somewhat different. WATS lines will be installed to provide toll free calling from Newfoundland, New Brunswick,

Prince Edward Island, Nova Scotia, Quebec, Ontario and the Northeastern United States. The geographic coverage will thus be much broader than in the P.E.I. case. The system itself will be computerized so that there will be a relatively instantaneous confirmation of reservations. The system is also geared more to agents than is the P.E.I. system and various tour packages are being assembled to operate in conjunction with the reservations system. These tour packages are presently being wholesaled in New York.

8.4.4 At this stage there would appear to be some advantage in studying the Nova Scotia system rather than that of P.E.I. Its computerization means that detailed and accurate logs will be available both with respect to origin of calls and place or places of destination. Since the programme is geared more to agents, the reservations volume is likely to be a better proxy for actual shows. A large portion of the work would involve a study of the tourist industry and its economic impact on N.S. (or P.E.I.). An assessment of the impact of tourism on the economy coupled with an assessment of the incremental effect of the toll-free reservation system would produce a measurement of the impact of the reservation system on the economy.

8.4.5 The basic approach used would be a cost-benefit analysis. Regression analysis will probably be necessary to assess the expected number of tourists without the reservations system (given trends in gasoline prices, the impact of foreign exchange rates, and changing tourist tastes) and, by comparison of the expected and actual number of visitors, to estimate the increase due to the new system.

8.5.0 Project E: Marine Service for Southwestern Nova Scotia Fishermen

8.5.1 In April 1978, Maritime Telegraph and Telephone will introduce a Community Repeater Service - Marine (CRS-Marine)[61] for fishermen in Nova Scotia. Initially the service will be available to fishing communities along the South Western Shore of Nova Scotia. If successful the service will be expanded into the Yarmouth and Digby areas and subsequently to other parts of the province.

8.5.2 Up to this point, fishermen have lacked a reliable communications capability with shore based points. The most commonly used communications equipment at present is Citizens Band radio. Options such as VHF service have been available but are costly and hampered by regulation.

8.5.3 CB radio has proven to be a very ineffective communications medium. The transmission band for CB makes long range transmissions totally unreliable and short range transmissions are quite prone to interference. Sensitivity of the signal to ionization in the atmosphere caused by solar flares or sunspots produces a skip problem which can cause messages to be intercepted 100's or 1000's of miles from the intended receiver. In 1979, sunspot interference will be at its worst level in an eleven year cycle and will limit effective communications to a range of 1 mile instead of the normal 5 to 10 miles. In addition, growing popularity of CB sets is producing a serious congestion effect on CB channels, further impairing reliable communications capability for the fishermen. Further, for fishing boats, CB sets have a very

short life, usually 1 year, on account of salt corrosion.

8.5.4 The new CRS-Marine service is designed to overcome these problems and provide a cost-competitive option for fishermen presently using CB radio. It has a solid range of coverage 60 miles out to sea on a VHF spectrum and thus avoids the spectrum problems of CB transmission. Unwanted interference can be effectively controlled, congestion is not likely to be a problem, and the sets to be used have a life expectancy of five to seven years.

8.5.5 The interest of this study for this project is in the operational and marketing uses which the system offers. It does, of course, offer a safety feature which by itself might be sufficient justification for the system. By providing ship-to-ship communication, fishermen on different boats, working cooperatively, will be able to efficiently and quickly relay information regarding fishing conditions. By providing ship-to-shore communications, the most unique feature of the service, fishermen will be able to obtain up-to-date price information allowing them to choose the best time to come in to port, the best port to go to, and to coordinate their arrival with the arrival of land based equipment such as trucks.

8.5.6 The general methodology is again a cost-benefit framework. Within this, detailed examination of price differentials in different ports before and after introduction of the service will be necessary to assess the impact which the new "more perfect" information environment has on prices. Monitoring of boats using the service with respect to the type of use and intensity of use will allow for assessment of the

differential impact the service produces on information flows. Part of the work will involve a detailed examination of fishing operations and the assignment of costs to these different operations such as maintaining land based equipment. From all of this it will be possible to arrive at a net measurement of productivity and/or profitability change attributable to the new marine service. As a study of a specialized application of telecommunications adapted to an individual industry's needs and a primary goods producing industry, the study is of considerable interest.

8.6.0 Project F: A Study of the Impact of Telecommunications on Labour Turnover Rates in the Canadian North

8.6.1 The chief employment problem in the very remote areas of Canada is not in many instances a lack of jobs but rather the high level of labour turnover in existing jobs, as discussed in Section 3. Telecommunications may, by reducing the relative isolation of such areas and by providing a means of offering services to inhabitants such as education, medical services, and government, contribute to a lowering of the labour turnover rate and a greater community stability.

8.6.2 The study proposed here would be a test of the hypothesis that for geographically remote areas, telecommunications can reduce the relative isolation of inhabitants and contribute to a more stable labour market environment, i.e. reduced labour turnover rates, and hence aid regional development. The Northwest Territories are recommended as the specific focus for the study. The N.W.T. are obviously a remote area of the country which is rich in resources but still relatively underdeveloped economically. It is also an area which has received telecommunications services within the relatively recent past, primarily as a result of the use of satellite transmission facilities.[62]

8.6.3 The study would undertake to examine the labour turnover rate of selected Northern communities for the period spanning the introduction of telecommunications services. Regression analysis using pooled cross-section and time series data would be used to assess the impact of the introduction of telecommunications services on labour-turnover rates.

Estimates would also be made of the savings attached to decreased turnover rates, both in decreased relocation costs and increased productivity. The magnitude of impact on turnover and the savings implied would provide an estimate of one aspect of the benefit of telecommunications service in the North. Such a study would assess the impact of overall network investment involved in bringing service to the communities examined but would not look at individual business or consumer users.

8.6.4 Because the North is so remote, both in absolute and relative terms, and because the telecommunications service to be examined was virtually a first time offering of service rather than an upgrading of quality, the results to be generated will primarily be relevant to the remote areas of Canada whose chief labour problem is attracting and keeping labour. Other areas will find the results of limited usefulness but given the future potential of the North as a new resource-rich frontier, it is a meaningful question to study however specialized its applicability.

## 8.7.0 Project G: An Econometric Analysis of the Impact of Telecommunications on Rates of Economic Growth

8.7.1 Telecommunications are by now so much a part of our modern lives that it is difficult to imagine what our society and our economy would be like without them. It is therefore difficult to measure quantitatively their economic impact. Normally, in a market economy, the impact of an industry on G.N.P. or on G.N.P. growth can be estimated by the criterion of the market - i.e. the contribution at the margin of a particular industry to Gross National Product is what individuals are willing to pay at the margin for the product of that industry. Many people, however, feel that in the case of telecommunications the "consumer surplus" of telecommunications services is so large that simply examining the total revenues of telecommunications companies would be a gross under-estimate of the impact of telecommunications on G.N.P.

8.7.2 It is often contended that expansion of the telecommunications network and improvements in the quality of service of telecommunications have both resulted in an increased efficiency of operations and a consequent higher rate of technological progress and G.N.P. growth in areas favoured by telecommunications investment. Within the Canadian context, that would imply that if one estimated a production function for each of the regions of Canada (e.g. a CES or a Cobb-Douglas production function) that such production functions would show differential rates of growth of G.N.P. over and above the growth of factor inputs - i.e. factor augmenting technological progress would increase at a

different rate in regions and at a rate that would be functionally related to telecommunications systems use on past investment. This econometric exercise might well produce an estimate of the impact of telecommunications investment on the rate of growth of labour and capital productivity and therefore an explanation of part of the difference between regional incomes in Canada today.

8.7.3 Such an econometric exercise, however, would be wrought with difficulties. First and foremost, would be the problem of collinearity - if telecommunications companies in Canada have historically followed a policy of service on demand, the investments they have made in the past may be based on extrapolated trends, i.e. they may be simply a lagged function of past G.N.P., which is somewhat the function being estimated. There is also the problem that a limited range of variation in quality and level of service has existed in Canada - the need for system compatibility across Canada has dictated a relatively low level of variation of independent variables. One would have to be cautious not to interpret the finding of a statistical correlation (if obtained) as the finding of a causal impact, as it is not clear in which direction the causal influence would run. Data constraints may well make it very difficult to attach much significance to the statistical results obtained. For all these reasons this promises to be a difficult and expensive project.

8.7.4 Where data on sub-provincial service areas are available, this might also be incorporated in cross-sectional work although data on other variables (e.g. income levels) might be difficult to find.

8.8.0 Project H: Attitude Survey

8.8.1 The purpose of the attitude survey is to assess the hypothesis that attitudes or awareness factors have inhibited the impact of telecommunications on regional economic development in Canada. The 'a priori' arguments that might be made to support this hypothesis are:

1) The business community, including to a substantial degree the information processing sector, has failed to recognize information flows as a good or factor input comparable to labour and capital. Thus, while it has been true for centuries that firms will move in response to differences in labour costs or capital costs, firms have generally to date failed to look at the cost of transmission of information flows in comparable fashion.

2) Telecommunications is a 20th century phenomenon and, in terms of present day telecommunications technology, a post W.W.II phenomenon. Prior to the advent of modern telecommunications, firms, of necessity, tended to agglomerate in urban centres. Telecommunications technology may have removed this necessity for substantial parts of the firm but "traditional" ways of doing business have meant a great slowness in recognizing that conditions have changed.

3) In support of (1) above, in most firms there is no communications or information processing department or indeed budget. Each operating department of a firm typically looks after its own needs in this regard. The result is that there is typically no overall control or monitoring and in most cases a very imperfect idea of communications costs,

especially if the opportunity cost of time is included in this calculation.

4) Traditional management styles have fostered the idea of everybody being under one roof or if under different roofs, at least close enough that management can maintain a watchful eye on its employees.

5) The rapid advances in telecommunications technology of recent years have opened up many new options for efficient employment of telecommunications by business firms but may also have left many managers unaware of what the system can do for their particular firm. This "ignorance" factor may have contributed strongly to a failure to fully realize the growth potential offered by telecommunications growth and improvement in the past.

8.8.2 It is not being suggested that any of the above assertions have necessarily been true in the Canadian case. Rather the point of the attitude survey is to test whether any or all of the above are true.

8.8.3 The survey would be a combination of time series and cross sectional analysis. A cross sectional sample of firms would be drawn and each of those firms would be polled as to attitude/awareness questions over time. Depending on the present life of the firms sampled and the length of experience of the respondents within each firm, the time series analysis may prove weaker than the cross-sectional analysis.

8.8.4 The survey would be primarily conducted by mail questionnaire with telephone follow-up on non-respondents and with selective reinforcement through personal interviews. The design of the questionnaire will be an obviously crucial element and work on this

would constitute the major initial work of this study.[63]

8.8.5 Such a survey may also be used to collect data on telecommunications/transportation complementarity to third party users, i.e. complementary use of both sectors by parties belonging to neither in a production sense. An assessment of this question depends on having first hand information on a firm-specific basis of the use which the firm makes of both the transportation and telecommunications sectors and the manner in which they are tied together.

## 8.9.0 Project I: Inventory Study

8.9.1 Previous reference has been made to the possible role of telecommunications in allowing firms in the distribution sector or the distribution units of goods producing firms to economize on inventory holdings and distribution costs by centralizing their operations. There are at the moment few references in the literature that treat the inventory problem in a spatial dimension.[64] Thus, a major part of the effort of this study will involve the construction of an appropriate model. At this point, a very simple inventory model is presented to illustrate the hypothesis being advanced.

8.9.2 Assuming a single good firm, let

$x$ be the stock on hand before ordering

$y$ be the stock on hand after ordering

$y-x$ be the amount ordered $(y>x)$

$E$ be the demand for the good

$P(E)$ be the probability distribution for the demand variable E, where $P(E)$ is assumed identical within each checking interval and where checking intervals are assumed equidistant

$f_n(x)$ be the expected total cost of an n-stage process starting with an initial supply $x$

$r$ be the per unit holding cost

$c$ be the per unit penalty cost if inventory levels during any period prove insufficient

then for a 1 stage process, to achieve optimal inventory levels, the firm should seek to find that y which minimizes $f_1(\chi)$, which will be described by the function

$$f_1(\chi) = \int_0^y b(y-E)\,P(E)dE + \int_y^\infty c(E-y)P(E)dE$$

For a n stage process where $n \geq 2$, the cost function becomes

$$f_n(\chi) = f_1(\chi) + \int_0^\infty f_{n-1}(y-E)P(E)dE$$

The objective of the firm is to find that level of y which minimizes this total cost function (for $y \geq \chi$) and that y will then be the optimal inventory level for the firm.

8.9.3 This simple model outlines the essential characteristics of the inventory problem. It makes no explicit provision for multi-product or multi-depot situations and assumes a continuous functional form when, in practice, a discrete functional form is more likely. It can, however, illustrate the hypothesis in the following manner.

8.9.4 For a single firm operating a decentralized warehouse-distribution network, i.e. maintaining a multi-depot network, the above equations would describe the determination of optimal inventory holdings for each depot location with the cost variables possibly differing from one location to another and the demand variable possibly being of different magnitude depending on the market size of the regions served by each depot. In such a case the firm's total inventory cost would be given by a summation of all of the individual depot cost functions as specified above.

8.9.5 If centralization of warehousing and distribution now took place, if the demand variable E is truly stochastic, then there would be a kind of "economy of scale" effect realized. Instead of provisioning inventory in each case for the same probability of occurance, it would now be provisioned only once for the given probability of occurance. At the same time, new costs would be added in the form of higher communications costs and possibly higher transportation costs if more expensive transportation modes had to be used to guarantee quick delivery from a centralized location. On balance there is good reason to expect however that inventory levels would be reduced and that total versus per unit holding costs would diminish further due to the decrease in depots and employees.

8.9.6 The point of the proposed study would be to develop a formal model which fully accounts for the multi-depot case and to test it with a particular firm which has centralized its inventory holdings. This would be a test of this particular inventory effect and by looking at the distribution sector, provide an additional basis from which to generalize as to the overall economic impact of telecommunications. In the process of doing the study some greater understanding might also be gained about transportation/telecommunications complementarity as both good telecommunications and a good transportation network would appear to be prerequisite conditions to such centralization.

## 8.10.0 Project J: A Study of Educational Uses of Telecommunications

8.10.1 The issue of telecommunications use in education has been previously discussed in this report. Specifically it has been pointed out that

a) there is currently an inequality in levels of educational achievement and quality of educational inputs in different regions of the country;

b) this results in indigenous labour services being of different quality in these different regions - with the lowest quality in the relatively most depressed areas;

c) this results in lower wages and an unwillingness on the part of high technology industries to locate in such depressed areas and in a decreased labour mobility by the indigenous population, i.e. they not only have poorer job prospects at home but elsewhere in the country as well; and

d) telecommunications is a potential way of addressing this problem since theoretically it would permit the use of more qualified teachers (using telecommunications to reach the students); a more varied educational programme; reduce the problem of physical access to schools for remote areas; and may be the only cost-effective way to achieve these results.

8.10.2 There is already in Canada and other countries a considerable experience with educational television. There has to date been less experience with interactive telecommunications use in education but experiments have taken place.

8.10.3 The point of this study would be to examine one of the experiments in interactive telecommunications use that has taken place and/or some of the broadcasting educational experience and assess the specific impact of this on labour force quality, mobility, and enhanced attractiveness of the area to skilled-worker employers. There has been insufficient time to this point to allow for a complete investigation of the experiments which have taken place in this area. Thus, no particular experience has yet been identified as most suitable for this study.

8.10.4 The methodology of the study would, generally, be that of a cost-benefit technique. The focus would be on measuring the benefits and on translating this into probable impact on location decisions of firms, wage rates, and so on. This would be a major difference of this study from the assessments that otherwise seem to be available in this regard. In most cases, the current literature assessing telecommunications use in education, as opposed to the literature which assesses education's impact on the labour force, focuses on describing the experience versus quantifying the impact.

8.10.5 It should also be pointed out that most interactive telecommunications in an educational setting would require a broadband, coaxial cable, network. Because such a system does not exist universally, any experiments undertaken to date are unlikely to have operated on a sufficiently broad sample to generate results of any general applicability. This study is therefore not assigned a very high priority at this time.

## 8.11.0 Project K: A Study of the Charlottetown Exchange - Prince Edward Island

8.11.1 Study of an individual exchange or community experience provides a potentially useful vehicle for assessing the immediate impact on industrial or business development following a significant upgrading of the physical telecommunications plant in the exchange. Charlottetown Exchange in P.E.I. was upgraded by Island Telephone in 1973 and afterwards, in 1974 there was a new industrial park which located in that exchange.

8.11.2 In 1975 Island Telephone installed a computerized switching centre for the toll network operating in its Charlottetown exchange. Previously the exchange had been served by step-exchange equipment. The decision to install the new equipment was made in late 1973. The new equipment was an electronic-switching centre and provided resident subscribers with complete automatic dial, DDD, and data transmission capability. 85.9% of all long distance traffic handled by Island Telephone is currently routed through this switching centre indicating the important central position it occupies not only to the Charlottetown exchange but to the entire telecommunications use of P.E.I.[65]

8.11.3 The industrial park, West Royalty Industrial Park, was announced for construction in 1974. In other words its placement in P.E.I. came after the new investment referred to above had been announced. There are currently forty-three firms operating in the Park most of them involved in light manufacturing of various kinds. The

range of products produced runs from piece parts in electronics (Northern Telecom, for example, produces telephone fuses at a plant in the Park), to luggage carts, to aluminum automobile wheel discs, to sheet metal working, to cabinet making, to denim jeans. With few exceptions these firms are all new to P.E.I., i.e. most of the firms now in the industrial park did not previously operate in P.E.I. The emphasis of the Park is on small industry. By 1980 it is estimated that 900 persons will be employed in plant operations located at the site with an estimated payroll of $9 million.

8.11.4 It is, of course, not obvious that the Park came to P.E.I. because the telephone plant had been upgraded. Further, Island Tel. indicates that they would have made any possible changes to the system necessary to accommodate the Park if the new equipment had not already been there, as long as it was economical for them to do so. The question which can be tested however, is whether the telecommunications needs of the occupants of the Park made the new investment necessary. The fact that it was there and so is used or even the fact that the carrier would have put the new plant in if it had not already been there are not proof of the necessity of the telecommunications plant to the location decision for the Park or its tenants. The focus of the proposed study of this exchange experience is to answer this question of necessity. The study is proposed to operate through a process of interviews and data collection from firms occupying the Park and from this, to generate an estimate of the contribution of the new telecommunications investment made by Island Tel. to the location decision and in turn to relate this to the overall development status of P.E.I.

during this period. On an 'a priori' basis one might expect telecommunications to be more crucial to small business than to large, in the goods producing sector at least, because the option to telecommunications is most likely to be travel which has very high costs. These high costs of travel, given budget limitations are likely to be a more serious constraint for small business than for large. The relative remoteness of P.E.I. makes this opportunity cost of telecommunications a high one and the small business character of the Park occupants makes the relative burden of this opportunity cost even higher. Thus it seems to be a particularly good example to study. Further investigation may, however, produce a better example than the Charlottetown exchange experience. The unique aspect of this study is the investigation of an individual exchange experience rather than the particular exchange chosen.

## 9.0.0 Conclusions and Recommendations

9.1.1 The eleven case studies in the preceding section have been included because each has certain merits to recommend its undertaking. The cases are, however, of differing order of merit and of difficulty. In this section, the studies are ranked and suggestions are made on sub-groupings of the cases where the groupings indicate the recommended sequential ordering for the undertaking of the case studies.

9.1.2 With respect to degree of difficulty, each of the cases as presently conceived would involve a substantial amount of effort. While some stand out as potentially more difficult than others, the differences may not be very large and are potential differences only until more detailed work is accomplished that will provide better indication of the difficulty involved in the data collection, measurement, and model building than is known at present.

9.1.3 With these caveats in mind, the following listing is offered as a ranking of the eleven projects in order of presumed difficulty, with the ordering going from least difficult to most difficult:

1. Project K: A Study of the Charlottetown Exchange - Prince Edward Island
2. Project E: Marine Service for Southwestern Nova Scotia Fishermen
3. Project D: A Study of Toll-Free Tourist Lines in Prince Edward Island and Nova Scotia
4. Project F: A Study of the Impact of Telecommunications on Labour Turnover Rates in the Canadian North
5. Project G: An Econometric Analysis of the Impact of Telecommunications on Rates of Economic Growth

6. Project I: Inventory Study
7. Project B: Government Office Decentralization Study
8. Project H: Attitude Survey
9. Project C: Counterfactual Study of Private Firm Use of Telecommunications
10. Project A: A Study of Telecommunications Use in Banking
11. Project J: A Study of Educational Uses of Telecommunications

9.2.1 The criterion of merit adopted here is the potential for generalization from the study described to the larger issue of the impact of telecommunications on regional development. Furthermore, there is no existing empirical work available to indicate which hypotheses are most likely to be proven by testing and it is difficult, at this point, to conjecture.

9.2.2 With this caution in mind, certain of the studies do seem less appealing than others. The proposed study of educational uses of telecommunications, Project J, is the one which is perhaps the least well defined at this point, and is also an area in which a fair amount of work has already occurred. As previously noted, most of this existing work is not of the same nature as that proposed here, but it is nonetheless true that work in this area is available. Perhaps most importantly, the fact that interactive telecommunications use in education is not yet available in Canada across any broad cross-section of the population makes it unlikely that any strong generalizations could be made from such a study.

9.2.3 Project H, the attitude survey, is one which would be very interesting but is rated low in merit primarily because the background of the present researchers in this project is not particularly suited to this sort of work. Potentially, recruitment of an additional member of the research team with experience in survey methodology and design would be a solution. The low priority attached to this project is thus a qualified one; certainly it is an area worthy of investigation.

9.2.4 Project F, the study on the impact of telecommunications on labour turnover rates in the Canadian North, is also ranked low because the results might be of extremely specialized applicability. Also, the relatively short time within which reliable telecommunications have been available to the North might well mean that the number of observations available for the regression analysis would be too small to be reliable.

9.2.5 The study of the marine service for fishermen, Project E, and the study of toll-free tourist line reservation systems, Project D, are both considered to be of merit but, to some extent, are substitutes. The one involves a resource industry which is export-based, while the other involves a service industry which is export-based, and thus are roughly comparable. With regard to telecommunications use, both involve a specialized adaptation of the telecommunications network to individual industry requirements.

9.2.6 Similarly, the government office decentralization study, Project B, is designed to test the same hypothesis as the banking study, Project A. Thus, it may be that only one of the two should be undertaken, depending on budget and time limitations. It should be kept in mind,

however, that undertaking more than one test of a given hypothesis may be quite desirable. The larger the number of individual experiences examined, the more probable it becomes that meaningful generalizations might be made about the aggregate impact of telecommunications.

9.2.7 The following listing represents a ranking of the recommended case studies by order of merit and/or interest as indicated by the hypothesis being tested. This list is divided into groups which represent a proposed sequential ordering for the undertaking of the cases in Phase II. Depending on budget and time constraints, one would move down the list as far as these constraints allow, attempting, if possible, to move by whole groups as indicated.

| | | |
|---|---|---|
| Group 1: | Project A: | A Study of Telecommunications Use in Banking |
| | Project C: | A Counterfactual Study of Private Firm Use of Telecommunications |
| | Project I: | Inventory Study |
| | Project G: | An Econometric Analysis of the Impact of Telecommunications on Rates of Economic Growth |
| Group 2: | Project K: | A Study of the Charlottetown Exchange - Prince Edward Island |
| | Project E: | Marine Service for Southwestern Nova Scotia Fishermen |
| | Project D: | A Study of Toll-Free Tourist Lines in Prince Edward Island and Nova Scotia |
| | Project B: | Government Office Decentralization Study |
| Group 3: | Project F: | A Study of the Impact of Telecommunications on Labour Turnover Rates in the Canadian North |
| | Project H: | Attitude Survey |
| | Project J: | A Study of Educational Uses of Telecommunications |

9.3.1 This report has described, at a conceptual level, the potential impact and hence importance which telecommunications might have on regional economic development in Canada; has proposed methodologies which might test these conceptual links in the context of a set of specific case studies; and has recommended a set of eleven case studies from which a selection could be made for future work.

9.3.2 The conceptual discussion demonstrates that there is solid reason to believe that telecommunications has already affected all parts of the Canadian economy and that, in the future, this impact is likely to increase.

9.3.3 The discussion in this report also emphasizes that, while many influences can readily be identified at the conceptual level, there is little existing empirical work to indicate how real or how large these influences are in practice.

9.3.4 The discussion has further emphasized that, not only has there been little empirical work to date, but also the characteristics of telecommunications, especially in the Canadian context, present major problems in formulating an appropriate methodology, or framework, for testing the impact which telecommunications does have on economic development.

9.3.5 The case studies which have been proposed and the methodologies which they will employ will, if undertaken, mark a beginning to gaining a better understanding of the importance of telecommunications in regional economic development in Canada.

## Footnotes

1. Carl Beigie, "An Economic Framework for Policy Action in Canadian Telecommunications", in H. English (ed.), Telecommunications for Canada (Toronto: Methuen, 1973), p. 44.

2. R. Babe, Cable Television and Telecommunications in Canada (East Lansing: Michigan State University, 1975), p. 149, fn. 1.

3. This does not mean that actual usage must be two way but merely that it have such capability. Broadcasting, at present, does not have such capability. In stressing point-to-point transmission, we are not ruling out multi-point interactive systems as, for example, would be represented by a teleconferencing system. Such a system still retains as its primary focus an emphasis on message delivery as opposed to message creation.

4. It has been suggested (Edgar Hoover, An Introduction to Regional Economics (New York: Knopf, 1975), p. 151) that a region "means an area which a researcher gets a grant to study".

5. Gavin McCrone, Regional Policy in Britain (London: Allen & Unwin, 1969), p. 15.

6. Walter Isard, Introduction to Regional Science (Englewood Cliffs: Prentice Hall, 1975), p. 3.

7. Department of Communications, Telecommission Study 2(d): Telecommunications and Regional Development (Ottawa: Information Canada, 1971), pp. 25-25.

8. International Telecommunications Union, Telecommunications Economic Studies, Part II - "Influence of Telecommunications on the Development of the National Economy", Geneva, 1972, pp. 5-6.

9. Telecommission Study 2(d), op. cit., p. 24.

10. For a theoretical discussion of the externalities of telephone service see R. Artle and C. Averous, "The Telephone System as a Public Good: Static and Dynamic Aspects", The Bell Journal of Economics and Management Science, Vol. 4, 1, 1973; L. Squire, "Some Aspects of Optimal Pricing for Telecommunications", The Bell Journal of Economics and Management Science, Vol 4, 2, 1973; and Jeffrey Rohlffs, "A Theory of Interdependent Demand for a Communication Service", The Bell Journal of Economics and Management Science, Vol. 6, 1, 1975.

11. G.M. Davidson, Physical Location of Industry of Canada, Ottawa, 1966 (unpublished manuscript); referenced in Telecommission Study 2(d), op. cit., p. 12.

12. Ibid., pp. 12-13, 55.

13. D. Clark, "Communications and the Urban Future: A Study of Trunk Telephone Call Patterns in Wales", Regional Studies, 7, No. 3, 1973, p. 320.

14. Economic Council of Canada, Living Together, A Study of Regional Disparities: Highlights, Ottawa, 1977. p. 11.

15. Ibid.

16. S.E. Chernick, Interregional Disparities in Income, Economic Council of Canada Staff Study No. 14, Ottawa, 1966.

    A similar conclusion is reached by R. Marvin McInnis in "The Trend of Regional Income Differentials in Canada", CJE, I, No. 2, May 1968.

17. Carriers, in provisioning plant, will plan ahead for anticipated growth in the short run. An "economic-engineering interval" is typically calculated reflecting the trade-off between temporary excess capacity and the cost of having to reprovision a plant in a relatively short time. The resulting excess capacity is, however, highly short-run and entirely cost-based.

18. Telecommission Study 2(d), op. cit., p. 49.

19. The greater use of satellite transmission facilities, for example, offers the possibility of considerable cost reductions for long haul transmissions.

20. See, for example, D. Forcese, The Canadian Class Structure (Toronto: McGraw-Hill, 1975), pp. 62-63.

21. See, for example, M. Blaug (ed.), Economics of Education (Harmondsworth: Penguin, 1968)

22. Beigie, op. cit.

23. Statistics Canada, The Input-Output Structure of the Canadian Economy, 1961-1971, Ottawa, 1977.

24. Ibid.

25. An analogous argument is to be found, historically, in the linking of the Maritimes with Central Canada by a railroad. It was hoped in the Maritimes that the railroad would open up central markets to Maritime producers. Instead, it is more probable that the railroad produced the opposite result. "Though it is difficult to reach a precise conclusion, improved transportation appears to have been more successful in opening the Maritime market to Central Canada than in opening the Ontario and Quebec markets to the Maritime Provinces." (W.A. MacIntosh, The Economic Background of Dominion-Provincial Relations, Carleton Library No. 15 (Toronto: McClelland & Stewart, 1964), p. 153.)

26. See, in particular, the symposia reported in The Review of Economic Studies, October 1977; Journal of Political Economy, December 1973; or The Quarterly Journal of Economics, November 1976.

27. Prince Edward Island has operated such a system for several years and the Nova Scotia government has just announced such a system to begin operation for the summer of 1978.

28. Automobile parts distributors are a good example of where this centralization of inventories has already taken place.

29. Trans-Canada Telephone System, in fact, runs an advertising campaign which stresses this point.

30. M.U. Porat, "Global Implications of the Information Society", Journal of Communications, 28, No. 1, 1978, p. 70.

31. See Table 5, above.

32. R. Goddard, "Organizational Information Flows and the Urban System", Economie Appliqué, (1), 1975, p. 126.

33. Fernand Martin, Regional Aspects of the Evolution of Canadian Employment, Economic Council of Canada, Ottawa, 1976, esp. pp. 33-39.

34. Labour Canada, Wage Rates, Salaries and Hours of Labour - Toronto, October 1976; Wage Rates, Salaries and Hours of Labour - Halifax-Dartmouth, October 1976, Supply and Services, Ottawa, 1977.

35. Goddard, op. cit., p. 144.

36. Driver and Mock, "Human Information Processing, Decision Style Theory, and Accounting Information System", Accounting Review, July 1975, p. 419.

37. R.N. Rappaport, Information for Decision Making: Quantitative and Behavioural Dimensions, (New York: Prentice-Hall, 1975).

38. J. Nilles, et al., The Telecommunications Transportation Trade-Off (Baltimore: John Wiley, 1976).

39. For a more complete discussion of this issue of infrastructure complementarity, see Walter Buhr, "Toward the Design of Intraregional Infrastructure Policy", Papers of the Regional Science Association, 31, 1973.

40. Karl Marx, Das Capital (Chicago: Charles Kerr Publishers, 1905), Vol. 1, p. 13: quoted in I.L. Horowitz, Three Worlds of Development (New York: Oxford University Press, 1972), p. 3.

41. W.W. Rostow, The Stages of Economic Growth: A Non-Communist Manifesto (Cambridge, 1960).

42. C.A. Fishlow, "Empty Economic Stages?", Economic Journal, Vol. 75, No. 297, March 1965, p. 112.

    P.A. Baran and E.J. Hobspawn, "The Stages of Economic Growth: A Review", Kyklos, Vol. 14, 1961, p. 234.

43. R.M. Solow, "A Contribution to the Theory of Economic Growth", Quarterly Journal of Economics, Vol. 70, 1956, pp. 65-94.

44. T.C. Koopmans, "Economic Growth at a Maximal Rate", Quarterly Journal of Economics, Vol. 78, 1964, pp. 355-394.

45. For criticisms of applicability of growth theory to modern capitalist economies, see J. Cornwall, Advanced Capitalist Development (London: Oxford University Press, 1977).

46. Simon Kuznets, Modern Economic Growth, Rate, Structure and Spread (New Haven: Yale University Press, 1966). See especially pp. 490-509.

47. Gunnar Myrdal, An Approach to the Asian Drama: Methodological and Theoretical (New York: Vintage Books, 1970), p. 140.

48. Ibid., p. 141.

49. Ibid., p. 164.

50. See, for example, K. Griffin, Underdevelopment in Spanish America (London: George Allan and Unwin, 1969), pp. 31-48; or H. Bernstein, ed., Underdevelopment and Development of the Third World Today (London: Penguin Books, 1973).

51. See footnote 10.

52. See, for example, Bjorn Wellenius, "On the Role of Telecommunications in the Development of Nations", IEEE Transactions on Communications, Vol. COM-20, 1, 1972; Peter Shapiro, "Telecommunications and Industrial Development", IEEE Transactions on Communications, Vol. COM-24, 3, 1976; E.L. Bebee and E.J.W. Galling, "Telecommunications and Economic Development: A Model for Planning and Policy Making", Telecommunications Journal, 43, 8, 1976; and D. Marsh, "Telecommunications as a Factor in the Economic Development of a Country", IEEE Transactions on Communications, Vol. COM-24, 7, 1976.

53. Sun Life Assurance Company of Canada, for example, if the announced move of its headquarters is followed through, will nonetheless be leaving a sizeable labour group in Montreal.

54. See Section 4.3.

55. We have been told of a similar study already planned within DCC with regard to rural areas. If such a study is proceeded with, it would allow for some saving in effort in the context of Phase II of this project.

56. See, for example, Peter McClelland, Causal Explanation and Model Building in History, Economics, and the New Economic History (Ithaca: Cornell University Press, 1975).

57. J. Johnston, Econometric Methods (New York: McGraw Hill, 1963).

58. Labour Canada, Women in the Labour Force - Facts and Figures, Information Canada, Ottawa, 1975, p. 300.

59. Business Week, 1977.

60. Statistics Canada, The Input-Output Structure of the Canadian Economy - 1961-1971, March 1977.

61. The factual information in this section is taken from CRS Marine, an internal document of Maritime Tel & Tel.

62. A recent report of the Department of Communications (Research and Development in the Research and Space Sectors of the Department of Communications, Annual Review, 1976/77) makes the following statement relevant to this discussion:

> "Until recently, most telecommunications to and from small, remote communities in Canada's Northland were via HF radio.
>
> But several factors combine to render this relatively inexpensive mode of communications somewhat unreliable. And, in the light of inferior service quality, current utilisation of available HF technology is generally considered unacceptable." (pp. 15-16)

The Report goes on to briefly describe the Integrated Remote Communications System programme, a research project currently under way in DOC. It is hoped that this work in DOC would be of assistance to the study proposed here.

63. As previously noted (see fn. 55), the Department of Communications has indicated the possibility of conducting an attitude survey related to rural areas over the coming year. This work, if undertaken, might prove to be extremely effort-saving for the study being proposed here. Also, the DOC Report referred to in fn. 62, above, makes reference to a survey undertaken in 1976/1977 concerning high volume computer/communications users. The data base from this survey may prove useful if it can be made available.

64. For a study that does explicitly treat this question, see G.K. Rand, "Methodological Choices in Depot Location Studies", Operations Research Quarterly, 27, 1976.

65. This information and the information following was provided by Island Telephone personnel, in particular Mr. Walter Auld.

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