

Telecommunications, Telematics, and Regional Development

by

Rodolphe Lamarche

The Canadian Institute for Research on Regional Development

Université de Moncton

Moncton, New Brunswick

March 30, 1987

This study received financial support from the Canadian Federal
Department of Communications and the Canadian Institute for Re-
search on Regional Development.

P
91
C655
L3678
1987

Queen
P
91
C655
L3678
1987

27 Telecommunications, Telematics, and Regional Development

by

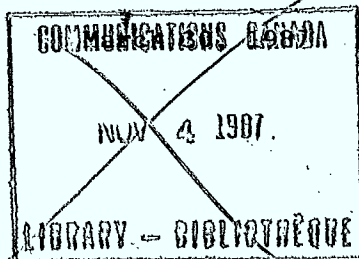
1.5 Rodolphe Lamarche

Industry Canada
Library Queen
JUL 21 1998
Industrie Canada
Bibliothèque Queen

The Canadian Institute for Research on Regional Development

Université de Moncton

Moncton, New Brunswick



This study received financial support from the Canadian Federal Department of Communications and the Canadian Institute for Research on Regional Development.

P
91
0655
L 3678
1987

DD 75/37460
75/3947-9m
DL
ALABAMA HONORARIUM
SUPERINTENDENT - TREASURER

Foreword

The author wishes to express his gratitude to Mr. Maurice Estabrooks, Senior Economist in the Federal Department of Communications, for his many enlightening comments and his most generous support during the course of this study.

The Canadian Institute for Research on Regional Development and the University of Moncton have been most generous in their support of this project and the author wishes to express his gratitude to the administrations of these two institutions as well.

Table of Contents

Telecommunications, Telematics, and Regional Development

Chapter I: Introduction.

Chapter II: Regional Development in an Information Economy.

- Introduction
- Regional Development Policies in Review
- Regional Development and Telematics
- Conclusion

Chapter III: Information, Telecommunications, and the Manufacturing Sector.

- Introduction
- Information Economy and the Manufacturing Sector
- Manufacturing Activities in Canada
- Information Indicators and Regional Industrial Activities
- The Information Component and Industrial Size
- Types of Organizations and Regional Manufacturing
- Conclusion

Tables

- 2-1 Federal Transfer Payments to Individuals
- 2-2 Transfer Payments to Individuals as a Percentage of Total Personal Income
- 2-3 Growth in Employment by Province
- 2-4 Unemployment Rates by Province
- 2-5 Economic and Regional Development Agreements by Region
- 3-1 Regional Distribution of the Labour Force
- 3-2 Manufacturing Activities (1975)
- 3-3 Manufacturing Activities (1984)
- 3-4 Information Workers: Canada (1984)
- 3-5 Information Workers: Atlantic (1984)
- 3-6 Information Workers: Quebec (1984)
- 3-7 Information Workers: Ontario (1984)
- 3-8 Information Workers: Prairies (1984)
- 3-9 Information Workers: British Columbia (1984)
- 3-10 Manufacturing Activities by Category (1984)
- 3-11 Selected Indicators: All industries (1984)
- 3-12 Selected Indicators: Food Industries (1984)
- 3-13 Selected Indicators: Wood Industries (1984)
- 3-14 Selected Indicators: Fabricated Metal Industries (1984)
- 3-15 Selected Indicators: Transportation Equipment Industries (1984)
- 3-16 Manufacturing Industries: Selected statistics by size group: Canada (1984)
- 3-17 Manufacturing Industries: Selected Statistics by size group: Newfoundland, Nova Scotia, and New Brunswick (1984)

- 3-18 Manufacturing Industries: Selected Statistics by size group:
 Quebec (1984)
- 3-19 Manufacturing Industries: Selected Statistics by size group:
 Ontario (1984)
- 3-20 Manufacturing Industries: Selected Statistics by size group:
 Prairies (1984)
- 3-21 Manufacturing Industries: Selected Statistics by size group:
 British Columbia (1984)
- 3-22 Ownerships, partnerships, and cooperatives (1984)

CHAPTER I

Introduction

The purpose of this study was to examine the impact of telecommunications innovations on regional development in Canada. A secondary objective was to perform a partial test of a model on regional development put forward by R. Lamarche in "Telecommunications and Regional Development" at the Ottawa conference on economic development and telecommunications held in November, 1986. The Proceedings of the conference are to be published by the Department of Communications in the summer of 1987 under the title:

Telecommunications and Urban, Regional, International, and Business Development.

The model was developed at the Canadian Institute for Research on Regional Development, Moncton, Canada.

Four reasons have prompted this study. The first was the perception that advanced countries are gradually converting to information economies and that more effort should be spent on understanding the nature and impact of this transformation. Secondly, there is already substantial evidence that the labour force is gradually being restructur-

ed to fit the new economy. There is also the possibility that as the new economy becomes more entrenched the Canadian urban system will undergo some changes as well and this could have tremendous impact on the regions. Thirdly, there has been very little research so far on the subject. Finally, regional disparities have persisted in spite of past policies and programs and it becomes imperative to search for new solutions to the problem of regional development.

The telecommunications agencies are not very active in this type of research as most of their efforts have centred on devising more satisfactory regulatory processes and on sustaining the engineering efforts of the Canadian telecommunication industry. Within the regional development community some work has sought to identify patterns of power concentration through telecommunications and the subsequent weakening of regional middle management. Other writers foresee some possible regional benefits as the new networks combined with local amenities provide a greater degree of freedom for industrial location. Finally, some initial work has been done on measuring labour force changes induced by the establishment of new telecommunication networks. The study presented here takes an empirical approach to the analysis of a single segment of the economy and it draws attention to the difficulties of devising effective regional policies and programs in the Canadian context as the country moves into the information age.

Chapter II discusses regional development issues within an information economy.

Chapter III examines some structural characteristics of the Canadian manufacturing industries and attempts to determine how these industries are likely to react to the new telecommunication technologies.

CHAPTER II

Regional Development in an Information Economy

Introduction:

In large countries such as Canada regional disparities are linked to a number of factors such as distance-related costs, inadequate industrial structure, poor regional, social, and physical infrastructures, and a heavy dependency on the primary sector. As the primary sector does not generate the buildup of a sophisticated urban network, this further weakens a region's capacity to promote its economic and social development. Since the 1960's, governments have devised a number of policies and programs to cope more or less effectively with regional development problems. The dramatic changes that were occurring in the business and economic circles in the late 1970's further increased the feeling of inadequacy of the existing development programs. The globalization of the market place, the deep recession of the 1970's which threatened even the heartland areas of the country and the persistent calls for complete deregulation in business and trade, all these factors shifted the attention away from the regions back to the national issues. By the 1980's it became quite apparent that regional problems were so complex that the existing policies and programs could not perform as expected and an atmosphere of despondency spread over the whole political, economic, and administrative community whose function it was to ascertain for all regions a measure of equity and prosperity.

Since 1984, there has been a resurgence in interest in promoting regional development. This new impetus has sprung from a political need first of all, but it has also been supported by an upturn in the economy and a renewed feeling that the market forces alone would not suffice. There was also a feeling that the regions could be made to contribute to national prosperity particularly if the policies stressed the development of human resources.

The coming of the "information revolution" is bound to have a profound impact on all aspects of the economies of advanced nations and make the formulation of regional policy that much more difficult principally because the new information technologies are transforming business strategies and decision-making processes, and regional development research has not yet come to grips with these transformations.

The literature on regional development has paid very little attention so far to the role of information networks on regional development.

This is quite understandable in the Canadian context. The two main objectives of Canadian regional policy have been to reduce income and employment disparities. Income disparities have been dealt with through unemployment insurance and old age pension payments. From 1974 to 1984 total transfer payments to individuals have increased from 9.2 billion to 36.6 billion dollars (Table 2-1). Income in the regions have been maintained at an acceptable level even though transfer payments have made the regions more dependent on Ottawa (Table 2-2). The unemployment problem has been addressed through a variety of programs such as subsidies to industry and the promotion of the service sector. As a result job build-up has been quite strong particularly from 1971 to 1981 with a ratio slightly over 16%. Unfortunately this has been offset somewhat by growth in active population and consequently the unemployment rates have remained high (Tables 2-3, 2-4).

Table 2-1
Federal Transfer Payments to Individuals
(in millions of dollars)

	<u>1974</u>	<u>1984</u>
Child care tax credits	0	1,300
Family Allowances	1,769	2,393
Old Age Pensions	3,303	10,999
Canada/Quebec Pension Plan	495	5,599
Unemployment Insurance	2,121	9,934
Manpower Training Programs	150	103
Other Programs	1,362	6,315
Total	9,200	36,643

Source: Statistics Canada, cat. 13-213.

Table 2-2
Transfer Payments to Individuals as a
Percentage of total Personal Income by Province:
1966-1984

	<u>1966</u>	<u>1971</u>	<u>1976</u>	<u>1981</u>	<u>1984</u>
Newfoundland	19.0	23.3	27.6	26.6	30.4
Prince Edward Island	17.9	20.2	22.6	22.4	26.4
Nova Scotia	12.1	14.8	17.2	16.7	19.0
New Brunswick	12.9	16.1	19.8	19.9	22.5
Quebec	8.2	12.0	15.1	15.0	17.8
Ontario	6.7	9.6	10.2	9.8	11.6
Manitoba	9.0	11.4	11.8	12.2	14.3
Saskatchewan	8.8	12.8	12.1	13.6	17.7
Alberta	9.1	11.4	10.3	9.7	14.0
British Columbia	8.7	10.7	12.1	11.1	15.3
All Provinces	8.2	11.2	12.6	12.2	14.9

Source: Statistics Canada, 13-213

Table 2-3
Growth in Employment by Province, 1961-1985
(Percentage)

	1966-	1971-	1976-	1981-
	<u>1971</u>	<u>1976</u>	<u>1981</u>	<u>1985</u>
Newfoundland	9.8	16.3	14.0	-1.7
Prince Edward Island	5.7	13.5	11.9	8.5
Nova Scotia	7.5	13.6	10.3	4.7
New Brunswick	5.9	14.7	11.9	1.9
Quebec	7.4	12.9	11.0	2.9
Ontario	14.7	17.0	14.5	5.5
Manitoba	8.0	12.1	8.5	4.1
Saskatchewan	2.1	13.2	12.4	6.4
Alberta	15.9	30.3	37.4	-2.5
British Columbia	21.9	22.4	24.4	-3.3
Canada	11.9	16.9	16.1	2.8

Source: Statistics Canada, 71-001

Table 2-4
Unemployment Rates by Province, 1966-1985

	<u>1966</u>	<u>1971</u>	<u>1976</u>	<u>1981</u>	<u>1985</u>
Newfoundland	5.7	8.4	13.3	13.9	21.3
Prince Edward Island	-	2.3	9.6	11.2	13.2
Nova Scotia	4.7	6.9	9.5	10.2	13.8
New Brunswick	5.3	6.0	11.0	11.5	15.2
Quebec	4.1	7.3	8.7	10.3	11.8
Ontario	2.4	4.9	6.2	6.6	8.0
Manitoba	2.8	5.7	4.7	5.9	8.1
Saskatchewan	1.4	3.6	3.9	4.7	8.1
Alberta	2.5	5.6	4.0	3.8	10.1
British Columbia	4.6	7.2	8.6	6.7	14.2
Canada	3.3	6.2	7.1	7.5	10.5

Source: Statistics Canada, 71-001

The reduction in income disparities and the job creation programs, effective as they have been, have not addressed the long-term fundamental question of transforming the peripheral regions into self-sustaining growth areas which is the ultimate objective of regional policy but they have prevented the widening of the gap between the central and peripheral regions. There is a bright side to the regional development efforts in Canada.

Regional development programs in Canada are generally the creations of federal-provincial cooperative efforts through Economic and Regional Development Agreements (ERDA). These programs deal with issues that are specific to each region. The committees that devise and manage these programs are generally highly competent and this undoubtedly explains why the regions have been able to maintain a satisfactory rate of growth in spite of the complex transformations that are taking place within Canada.

The ERDA agreements cover a wide range of immediate urgent problems facing the regions (Table 2-5). There is, however, one major criticism that can be levelled at these agreements. They have failed to consider the importance of the role of information networks and infrastructures to regional development. As of January 14, 1987 only 46 million dollars out of a total of 4.4 billion in these agreements have been earmarked for communications. Departments of Communications are not involved in these agreements as we enter a world information economy. It is rather astounding!

A large part of the blame can be attributed to the regional development community which has not addressed the issues of information networks and infrastructures in regional development. The federal and provincial Departments of Communications also carry some responsibility

as well. They also have failed in this regard with most of their attention focussed on the regulation of communications and the engineering aspects and little on the new business and decision-making processes that these new technologies are generating.

Table 2-5
 Economic and Regional Development Agreements (ERDA)¹
 by Region as of January 14, 1987
 (in millions of dollars)

Region	Planning	Mineral Develop.	Forestry	Fisheries	Agri. Food Incl.	Industry	Tourism	Transpor- tation	Communi- cation (2)	Other	Total
Atlantic	13.0	71.6	171.0	133.0	73.0	347.2	76.0	312.4		134.4	1331.6
Quebec		100.0	300.0			350.0	100.0	170.0	40.0	140.0	1200.0
Ontario	2.0	30.0	150.0				44.0			50.	276.0
Prairies	5.0	31.1	78.2		198.3	83.2	116.3	187.7	6.0	331.4	1037.2
B.C.		10.0	300.0		40.0	125.0	30.0			91.8	596.8

(1) These sums represent the total amounts to be spent by the federal, provincial and other agencies.

(2) Does not include cultural programs for Quebec, Ontario and Manitoba worth 105 millions.

Source: ERDA agreements: Ministry of State for Economic and Regional Development, Ottawa.

Regional Development Policies in Review

As Richardson pointed out the two dominant theories of regional development have long been the neoclassic and cumulative-causation theories (58). In the neoclassic approach market mechanism are expected to force spatial readjustments to economic imbalances and public intervention is deemed unnecessary. The cumulative-causation theory sees a gradual concentration of economic activity within a few larger centres and the steady decline of the weaker areas. The Economic Council of Canada in its 1977 annual report outlined how various forms of these two theories had been instrumental in spawning regional development programs in Canada (17).

Even though regional development programs have been operational since the 1960's, regional disparities have remained largely unchanged and this has led to calls for a complete re-examination of policies and programs (61). The failure of past programs has been attributed to a number of factors. Some authors believe that market adjustment mechanisms have been undercut by government transfer payments and tariff policies (13) and conflicting place-versus-people welfare functions (35) and that there exists an inherent conflict between regional development and national efficiency (13). Other authors claim that investments in regional development have been far too dispersed (61) and too limited (Leger *) to have a lasting impact on the regions.

* Leger, P.: In a forthcoming review of Regional Development efforts in Atlantic Canada, Paul Leger has noted that financial assistance to the Atlantic Region though it is appreciated is inadequate in relation to the size of the economy it is intended to influence.

Finally, others believe that the recession of the late 1970's and early 1980's have so altered the perception of regional problems that old paradigms no longer suffice to describe the present situation (3).

These conflicting interpretations of the persistence of regional disparities have had a threefold effect. First, central governments have had a tendency to reduce funds for regional programs. Secondly, a great effort is being made to develop more sophisticated models of regional analysis (57). Thirdly, within the research community a growing interest in evaluating the regional impact of new technology on spatial development has emerged. The researchers engaged in this work feel that the economic structure of advanced nations will be reshaped by high technology and new information systems, that solutions to regional disparities in the coming decades will be related to this post-industrial structure which is already transforming the labour force and will likely transform, to a degree, the urban system as well (32, 38). Since increases in industrial productivity will rely on high technology and modern information infrastructures, some writers feel regional development will be determined by the capacity of peripheral regions to gain access to the growth axes of modern urban systems (32, 54). Rubin states that economic and social changes brought on by the information revolution will be so pervasive that regions lacking in information technology and services will be in a situation akin to one of "disenfranchisement" (59).

Following the failure of earlier approaches, researchers have turned to high technology and local development programs as the two most likely factors to promote the development of peripheral regions.

A number of studies have attempted to assess the effects of high technology on regional economic and occupational structures. The impact of new technology in the semiconductor industry in Britain was found to vary according to the origin of the technology. Foreign technology tended to concentrate on production while domestic innovators tended to establish research facilities as well as production plants (12). All provinces in Canada have set up federal-provincial programs to provide financial assistance to high tech firms in the hope that the introduction of a few high tech establishments into peripheral areas would serve as a catalyst to launch their economic revitalization and as an immediate short-term solution to unemployment. One should beware of placing too much hope in high technology, however. Subsidies to high technology follow the old pattern of industrial support policies which have not succeeded very well in the past. High technology is even more fragile than older technologies in that they require constant information flows which are not often easily available in peripheral areas. In any event, it is unlikely that these installations alone could rejuvenate declining regions. Local entrepreneurship and dynamism are required as well.

The concept of local development was first put forward in the 1960's. Later Stöhr envisioned a national integrated system built from the bottom up in a complete reversal of the core-periphery concept, an approach which is also supported by Higgins (27, 67). Perrin proposed "la théorie de la dynamique locale" where national growth is viewed as the optimization of regional development. It is an attempt to integrate the regions into the national economy. The recent innovations in telecommunications and telematics should play a major role in setting

up urban and regional networks required by local development theory.

Planque points out that a number of these local development concepts can better be defined as doctrines rather than theories. However, he does note that a number of economic functions can be drawn to peripheral regions to promote growth (47). Local development implies the existence of a minimum level of local entrepreneurial spirit which is one of the most difficult elements to promote through government policy (11, 41).

The Atlantic Development Council of Canada in its 1978 report envisioned the development within the Atlantic region of an industrial sector that could compete on the national market. The Council recognized that strong local development implied national economic integration. This was a complete reversal of the position it put forward in its 1971 report where local industries aimed at local markets held a high priority. (1, 2).

Apart from the two themes of high tech and local development that have held the attention of researchers in the recent years, there is a third theme of importance that has received considerable attention recently in Canada: management of regional policy. Probably because the ERDA programs have been set-up and managed by competent teams of experts very little attention has been given to the discussion of the management issues in regional development circles apart from the publications by Savoie. In fact, Savoie's main contribution to the regional development in Canada has certainly been in this area (61). His work emphasizes the reduction of political input at the management level and the increase in the long-term stability of the institutions created to ensure regional

growth. In effect, he stresses the need to create more effective models of policy implementation.

As Wadley has put it in Restructuring the Regions "we have to reexamine our whole rationale of public intervention" in the spatial distribution of the national economy (71). There are less footloose plants to move about and the manufacturing sector no longer requires massive inputs of labour and therefore cannot serve to cut down unemployment rates. Another important factor which demands careful scrutiny from the research community is the rise of telematics in economic management at a time when the industrialized world is moving into an information-based economy where the "strategic raw material" is information (37).

Regional Development and Telematics

It took almost fifteen years after the works of Perroux and Isard on regional development before attention was drawn to the role of information activities in regional development. Tornqvist put forward in 1968 the concept of two entirely different streams of information flows: the personal contact interactions between high-level administrators and the regular business information flows. The first type even though lesser in volume was the determinant growth force capable of transforming systems while the second type served only to maintain the existing systems (69). Pred later published a number of interesting papers on the importance of information networks in the transmission of growth impulses (54). Goddard and Gillespie also demonstrated the importance of intra and inter-firm networks in urban growth patterns (22). All of these studies

were important contributions to the field of regional development theory. However, if regional policies and programs have practically ignored the role of information in regional development, it can be attributed principally to two factors. First, the lure of high technology as a cure to regional disparities. As was pointed out earlier, provision for the location of high tech firms in depressed areas is found in all government development programs. Because high tech is based on high quality human resources, it commands a rapid increase in earned income and leads to the production of high-cost goods which are not too adversely affected by distance costs. It is also likely that support for high tech firms are well viewed because they follow the traditional pattern of subsidies to manufacturing. The second reason why information activities have such a low priority in policies and programs stems from the fact that information activities did not become truly determinant in economic development until the advent of the information economy and telematics.

Telematics is defined as the integration of information technologies for the purpose of gaining access and controlling information on a large scale usually as a means of improving management productivity and gaining some market advantage over one's competitors. The two principal technologies involved are those relating to telecommunication and computer operations. A major factor in the development of telematic services has been the introduction of digital transmission of data as this provided the means for direct efficient long distance inter-computer links whereby large amounts of information could be quickly sorted and analyzed in a economy where knowledge has become the principal resource. The development of telematics was made possible through three factors. The

first determining factor was the development of new microchip technology which greatly reduced the costs of manipulating and transmitting information. The second was the subsequent decrease in telecommunication costs and the third factor was the deregulation of telecommunication networks which led to the creation of new networks and innovative services.

Telematics is a most promising new source of wealth as evidenced by the capital investments that are now being made by the large telecommunications and computer companies in the U.S., Japan, and Europe (15).

Even though telecommunication networks and computers have been part of the economic scene for several decades, it is only recently that it became possible through telematics to use these technologies for the development of business strategies (28). Essentially, telematics is the infrastructure on which a company can build a business intelligence network and gain substantial competitive advantage (28). Previously, computers had been used in business principally for accounting and statistical purposes and telecommunication networks had served to keep the business systems operational. But the capacity to centrally control large volumes of information has given head offices the possibility to develop innovative decision-making processes that give the firms marked advantages in the market place. Expenditures on information networks which were once viewed as necessary liabilities are now considered as investments in strategic assets. The conduct of business has been profoundly altered as a consequence. In effect telematics is leading us towards an "on-line economy" (26).

It could well be that the single most important consequence of the telematic innovations will be the increase in productivity in management

processes. Just as microelectronics has led to increased productivity in manufacturing, telematics will perform a similar function for the management side. The banking and financial institutions have been the first to see and harness the potential of telematics. These new processes are being applied to market strategies, inventory control, and purchase policies (4, 5, 28, 37).

From the regional development perspective there is a great difference between the high tech, local development, and telematic approaches. If a high tech firm can be induced into a region, the effects are immediately visible in job creation and in plant investment but telematics services are only as good as the management personnel that use them. It is also important to consider that it is quite a simple matter to train management to use telematic services effectively whereas it is practically impossible to create programs to stimulate entrepreneurial development. It is also worth noting that the larger firms have the capacity to implement their own private networks but the smaller firms who make up a larger share of regional establishments are often incapable of establishing their own systems. They would be the first to benefit from policies devised to support regional telematic infrastructures.

Conclusion

The increased dependency of the economy on its capacity to manage large information flows is exerting strong pressure on the economy in general and on regional development in particular. The labour force is already feeling its effects as it is gradually being transformed to meet the challenge of information handling and large capital investments are being made to provide it with an adequate infrastructure for this purpose. As was stated earlier, the most striking feature of the information economy is the appearance of a new type of decision-making process which requires expensive telematic networks to operate properly. The regions are going to have difficulty in setting up these systems for a number of reasons. First, the systems are costly. Secondly, there is a higher proportion of smaller firms in the regions and they will find it difficult to pay for systems of this type. Thirdly, the government programs are not addressing these issues because the telecommunication and regional research communities are not working together on these questions.

The fact that in Canada the telecommunication authorities are provincially based could serve to the advantage of the regions. The telecommunication institutions could either take the lead in providing these new services or respond to regional demand. Regions where these companies initiate them will be enhanced while the others will face additional problems. Establishing new telecommunication infrastructures could lead to a certain restructuring of the urban system as some centres will gain ascendancy over others. Pred, Goddard and Gillespie have

demonstrated the role of information networks in urban growth but it seems to us that the most recent element to influence urban patterns will be the networks that control the newer forms of decision-making processes that are making their appearance in the new information economies.

In the next chapter we examine how the manufacturing activities in the Canadian regions are likely to cope with the information age.

CHAPTER III

Information, Telecommunications and the Manufacturing SectorIntroduction

In countries that have a long tradition of regional development policies such as Canada, manufacturing industries have been considered the pivotal element of regional development planning and hence the numerous programs aimed at promoting regional manufacturing activities either by subsidies to firms willing to locate outside the central manufacturing zones or by regional grants to improve the overall infrastructure of a region in the hope that this will attract firms. It was only when these efforts seemed to falter that government programs turned to the tertiary sector as a possible solution to regional disparities (61, 71). In spite of this tactical rather than strategic change in government planning, industrial activity still remains paramount in the minds of regional planners. It is no wonder that the coming of the information economy and the introduction of telematics to the production and managerial processes in manufacturing raised the spectre of an exodus of manufacturing firms out of the regions. Telematics, the interlocking of telecommunication and computer technologies, would lead to greater productivity, increased competition and market aggressiveness. It would also lead to a weakening of the industrial base of the peripheral regions in the opinion of some authors.

The literature on the regional impact of telematics is divided. Some authors argue that metropolitan concentration will be inevitable as plants become more high-tech oriented and telecommunication and computer

technologies make it possible to concentrate all management decisions within the head offices. Other researchers find some evidence that these new technologies will allow for more flexibility in location choices and the possibility of moving away from the old industrial centres to more pleasant sites either in the smaller towns surrounding the larger metropolitan areas or to medium-size metropolitan areas that provide more amenable conditions (25). There is also some evidence that telematics will generate a new dichotomy between information and production functions in certain industries as some information activities will be centralized in large metropolitan centres and part of the production activities will be moved to the peripheral centres (26). In short then, the picture remains unclear as to the manner in which a particular region will be affected by the introduction of telematic technologies in the manufacturing sector.

The purpose of this chapter is to determine the likely impact of the new telematic processes on the regional development of manufacturing activities in Canada.

The Information Economy and the Manufacturing Sector:

Although the information revolution has already transformed the financial institutions of Western countries (28), it is only beginning to exert a strong impact on the manufacturing sector. The power behind this transformation stems from the greater economic returns that can be achieved through production processes that rely on information-based units that are less dependent on labour and more adjustable to changing demand.

There are at least three major phases in the transformation of manufacturing activities in an information economy.

The first phase might be called the microelectronic phase or the computerization of the production processes. In the early stages of this phase computers and robots were used to eliminate the most hazardous and repetitive jobs within the production process. As computers became more sophisticated, they were used to speed up production and reduce direct human involvement. Investment in computerized production became the main element in the drive to increase productivity.

A second phase was soon to follow. Computer and telecommunication technologies were combined to control the production and management processes of manufacturing. Thus, telematics was introduced to the manufacturing sector. Telematics became the means of optimizing inventory, purchase, and marketing management (5). The success of two large international firms, I.B.M. and Bell Northern Research, seems to have provided the initial impetus to this second phase (5, 26).

Jonscher already foresees a third phase of this transformation. If the production worker has felt the brunt of the first phase, it will be the office worker that will be hit by this third one. Telematics will be used to increase the productivity of the office worker. This could well mean the disappearance of intermediate levels of management both in central and peripheral areas. Jonscher sees a drop in information workers from 50% to 46% in all economic sectors within a relatively short period in developed countries as a result of the introduction of telematics within the office environment (29).

In short, the introduction of telematics could have a drastic effect on manufacturing activities. It has meant a decrease in the ratio

of production workers in the first phase, an increase in the information workers in the second phase which will be followed by a slight reduction of information workers in the third phase. It could also induce a greater concentration of manufacturing activity within a few large centres in the central regions of the country. The main question for the regional analyst is whether or not manufacturing activities in the regions will be able to keep pace with these transformations and maintain a significant share of the country's manufacturing activities.

Manufacturing Activities in Canada:

The total labour force in Canada increased by 22% going from 9,974,000 in 1975 to 12,183,000 in 1983 (Table 3-1). However, the regions fared unevenly in the increases. The Western provinces experienced higher than average gains while the Atlantic and Central regions had below average increases in total labour force.

The manufacturing labour force increased by only 7.3% over the same period. The regions of Quebec and the Prairies had substantially higher gains than the other regions in terms of growth in the manufacturing sector. British Columbia and the Atlantic Provinces had the smallest increases. An indicator of structural change which seems at least as important as absolute growth in the manufacturing labour force is the decrease in the relative importance of manufacturing employment within each region.

The relative importance of manufacturing employment dropped by 2.5% for Canada as a whole over the 1975-83 period. Only British Columbia had a greater shift in the distribution of its labour force. In Quebec, manufacturing maintained its 20.3% share of the labour force. The Atlantic, Ontario and Prairie regions experienced decreases of 1.5%.

Table 3-1

Regional Distribution of the Labour Force

1975, 1983

Region	Tot.L.F. ¹ (000)		% ² inc.	% of ³ total	M. L.F. ⁴ (000)	% ⁵ inc.	% of ⁶ Reg. tot.	% Decrease ⁷
Canada	1975	9974		100.0	2020		20.3	
	1983	12183		100.0	2167		17.8	
			22.4			7.3		-2.5
Atlantic	1975	787		7.8	107*		14.4	
	1983	928		7.6	120		12.9	
			19.7			.8.4		-1.5
Quebec	1975	2647		26.5	537		20.3	
	1983	3069		25.2	624		20.3	
			15.9			16.2		0.0
Ontario	1975	3818		38.3	939		24.6	
	1983	4570		37.5	1054		23.1	
			19.7			12.2		-1.5
Prairies	1975	1635		16.4	164		10.0	
	1983	2227		18.3	191		8.6	
			36.2			16.5		-1.4
Brit.Col.	1975	1087		10.9	169		15.5	
	1983	1389		11.4	178		12.8	
			27.8			5.3		2.7

(1) Total Labour Force for 1975 and 1983.

(2) Percentage increase in total Labour Force from 1975 to 1983.

(3) Percentage of the Canadian Total Labour Force.

(4) Labour Force in Manufacturing Industries.

(5) Percentage Increase in Manufacturing Labour Force, 1975-1983.

(6) Manufacturing Labour Force as a percentage of the total regional Labour Force.

(7) Decrease in the regional share of the Labour Force in Manufacturing Industries.

(*) Adjusted for incomplete data

Source: Statistics Canada: Labour Force Annual Averages, Cat. 71-529, 1984.

It would seem from these preliminary analyses that the Western regions experienced about average increases in total labour force. It is also apparent that manufacturing employment has decreased its share, in all regions, by about 1.5% of the regional labour force. Table 3-1 seems to indicate that the introduction of telematics into manufacturing activities has not yet forced the existing regional manufacturing industries to relocate in the central provinces in the 1975-1983 period as some authors had feared. The figures of Tables 3-2 and 3-3 confirm these findings.

Tables 3-2 and 3-3 show that the manufacturing activities are performed for the most part in Central Canada. Ontario and Quebec have 71% of the manufacturing establishments, 79% of the employees, 79% of the value of shipments and 79% of the Head Office labour force. The Western provinces have 23% of the manufacturing establishments and the Atlantic region only 5.5%. These tables provide other important information as well. They indicate that the regional distribution of the manufacturing activities has remained the same over the 1975-1983 period. The new telematic processes have yet to make their presence felt in the regional distribution of manufacturing industries.

There are several possible explanations for the stability of the distribution outlined in Tables 3-2 and 3-3. It might well be that telematic processes are still too new to have had an impact or that the type of manufacturing activities in the peripheral regions cannot be easily transferred to the central regions, or again that the regional entrepreneurs, on their own or with the help of government programs, have been able to counter in time the effects the telematic processes were beginning to exert. It is quite conceivable that the larger firms

located in Central Canada have opted to pursue the greater returns offered by foreign markets rather than invest in taking over the regional markets. However, it is worth recalling here that the peripheral regions have a very small share of the Canadian manufacturing sector and that any changes in industrial employment would touch only a small proportion of the total labour force. It is also logical to infer that any changes in regional distribution of the manufacturing activities due to the telematic processes would affect the Western regions much more than the Atlantic as they have a manufacturing labour force four times as large. The very nature of the manufacturing activities in the Atlantic region, as we shall point out in detail later, make this region a little more immune to take-over by centrally located firms.

Table 3-2
 Manufacturing Activities
 (1975)

Region	Establish- ments	% of total ¹	Labour Force	% of total ¹	Value of shipment (\$000)	% of total ¹	Office Emp.	% of total ²
Canada	30100.	100.0	1741545	100.0	102178371.	100.0	469494	27.0
Atlantic	1635.	5.4	82018.	4.7	4704572.	4.6	19794.	24.1
Quebec	9375.	31.1	532932.	30.6	26921984.	26.0		
Ontario	12245.	48.8	850291.	48.8	53355887.	52.2	237546.	27.9
Prairies	3689.	12.3	138901.	8.0	9274839.	9.1	38068.	27.4
British Columbia	3131.	10.4	137138.	7.9	7905664.	7.7	35437.	25.8

1. The regional share of establishments, labour Force and Value of Shipments.

2. The percentage of regional office workers as opposed to regional total number of workers.
 This serves as an indicator of the strength of the regional information sector in the
 manufacturing industries.

Source: Statistics Canada: Manufacturing Activities, 1984, Cat. 31-203.

Table 3-3
Manufacturing Activities

(1984)

Region	Estab- lish- ment	% ¹	Labour Force	% ¹	Value of Shipment (\$000)	% ¹	Office Employ- ees	% ²	Head office employees	% ¹
Canada	36464.	100.0	1722044.	100.0	264236955.	100.0	481228	27.9	99129	100.0
Atlantic	1994.	5.5	82425.	4.8	11402194.	4.3	20110	24.4	-	-
Quebec	10649	29.2	484883.	28.2	61537263.	23.3	129299	26.7	23544	23.6
Ontario	15265.	41.9	880927	51.2	147105588.	55.7	253410	28.8	54907	55.4
Prairies	4549.	12.5	141612.	8.2	24935784.	9.4	43071	30.4	-	-
B.Columbia	3981.	10.9	131912.	7.7	17979295.	6.8	35285	26.7	-	-

1. See footnote 1 in Table 3-2.

2. See footnote 2 in Table 3-2.

Source: Statistics Canada: Manufacturing Activities, 1984, Cat. 31-203.

Manufacturing Activities in the Region:

As was pointed out earlier some analysts feared that telematics would force industries to relocate within Central Canada as a means of maintaining their share of the national market. For the Atlantic region it would be a repetition of the exodus that occurred in the decades following the creation of Canada. The investments required for the computerization of the production and management processes would be too high for the regions. Eventually they would become totally uncompetitive and their only role in the manufacturing sector would be that of consumers.

However, the telematic revolution has yet to make a strong impact on the regions. This undoubtedly is due in part to the fact that investments in information support structures still lag far behind investments in industrial equipment (29).

We postulate in this study that regional manufacturing activities can be classified into two major categories. In the first category, Category A of Table 3-10, we find industries that are by their very nature highly resistant to relocation. The two main types of industries that fall within this category are industries that process natural resources and industries that require constant contact between the producer and his client (i.e. Printing, Newspaper). The second category, Category B, regroups industries that produce complex goods. The production processes involved in the industries of this category are highly dependent on information channels and innovation. Industries of this nature are much more subject to relocation pressure.

The viability of regional manufacturing will depend on two principal factors: the nature of the industries on the one hand and the capacity of regional entrepreneurs to develop and maintain strong competitive information networks on the other.

The regional distribution of industries of categories A and B is highly instructive. Tables 3-4 to 3-9 and Table 3-10 show how different the regions are in this regard.

The Atlantic region's industrial composition is such that 66% of its establishments are not very likely to be easily assailable from competitors located elsewhere. Only 20% of the establishments belong to category B and are therefore more directly threatened.

The industrial composition of the Western regions is entirely different with only 48% of the establishments in Category A. Close to 30% of the establishments are in Category B and subject to outside competition.

It is not argued here that industries in Category A are totally safe but that they have a marked regional advantage. Product substitution, decreasing productivity or a combination of both could destroy these regional firms. The same is true of industries of Category B. They will not necessarily be forced out of the market by the larger centrally located firms, but their survival is tied to their capacity to maintain high productivity and aggressive management policies. The ability of firms of both categories to maintain their market share will depend largely on their access to innovation and information channels. We stress here that the role of the information workers will increase as the information economy moves deeper into the manufacturing sector. The viability of the firms is now more and more tied to their information

capacity (59). The increase in the proportion of the manufacture labour force that deals with information processes is not solely due to increased government regulations but to a radical change in production processes (43).

Information Workers and Manufacturing

To maintain competitiveness and market share as well as to keep informed on new manufacturing developments and shifts in consumer demand, the manufacturing sector must rely on its information workers, its office employees. Information activities are necessary in all industries but more so in those that are more likely to face outside competition such as industries in category B of Table 3-10. The distribution of information workers in manufacturing varies widely from region to region in Canada as Tables 3-4 to 3-9 point out.

In 1984 the Canadian manufacturing industries had an average of 27.9% of their employees in the information sector.

Table 3-4
Information Workers
Canada - (1984)

Industry	No. of Establ.	Total Workers	Office Workers	Off. Workers %	Ranking (1)
Food	3250.	187009.	56895.	30.4	9/40
Wood	3561.	102941.	16736.	16.3	1/40
Paper	678.	115799.	27572.	23.8	4/40
Printing	5280.	113447.	48190.	42.5	2/40
Fabricated Metals	5329.	129.	29533.	22.9	1/40
Machinery	1689.	72777.	22461.	30.9	2/40
Transporta- tion	1446.	195629.	46402.	23.7	5/40
Electricity	1345.	135951.	51407.	37.8	2/40
Non-Metallic	1621.	48893.	12738.	26.1	*
Chemicals	1263.	87802.	42234.	48.1	5/40
Total	36464.	1722044.	481228.	27.9	

(1) Number of industries in this category that are ranked amongst those having the highest value of shipments.

* Some of the data were unavailable.

Source: Statistics Canada: Manufacturing Industries, 1984, Cat. 31-203.

Table 3-5
Information Workers
Atlantic - (1984)

Industry	No. of Establ.	Total Workers	Office Workers	Office Workers %	Ranking (1)
Food	465.	30797.	6534.	21.2	5/19
Wood	421.	5924.	876.	14.8	3/19
Paper	40.	*	*	*	1/19
Printing	230.	*	*	*	2/19
Fabricated Metals	169.	2773.	667.	24.1	3/19
Machinery	35.	*	*	*	*
Transporta- tion	123.	5304.	1501.	28.3	1/19
Electricity	24.	2059.	1012.	49.2	*
Non-Metallic	127.	*	*	*	1/19
Chemicals	48.	1899.	739.	38.9	*
Total	1994.	82425.	20110.	24.4	*

(1) Number of industries in this major category that are ranked amongst those having the highest value of shipments.

* Some of the data were unavailable.

Source: Statistics Canada: Manufacturing Industries, 1984, Cat.31-203.

Table 3-6
Information Workers
Quebec - (1984)

Industry	No. of Establ.	Total Workers	Office Workers	Off.workers %	Ranking (1)
Food	898.	45107.	14220.	31.5	8/38
Wood	1159.	28603.	5186.	18.1	1/38
Paper	207.	41107.	9640.	23.5	3/38
Printing	1343.	28955.	11213.	38.7	3/38
Fabricated Metals	1169.	30959.	6588.	21.3	1/38
Machinery	336.	13324.	4022.	30.2	1/38
Transportation	267.	32200.	12041.	37.4	1/38
Electrical	333.	34580.	11677.	33.8	2/38
Non-Metallic	394.				
Chemical	334.	24420.	11524.	47.2	6/38
Total	10649.	484883.	129299.	26.7	

(1) Number of industries in this major category that are ranked amongst those having the highest value of shipments.

* Some of the data were unavailable.

Source: Statistics Canada: Manufacturing Industries, 1984, Cat.31-203.

Table 3-7
Information Workers
Ontario - (1984)

Industry	No. of Establ.	Total Workers	Office Workers	Off. Workers %	Ranking (1)
Clothing	620.	33634.	4885.	14.5	*
Furniture	706.	24952.	4364	17.5	*
Paper	311.	41690.	9884.	23.7	3/38
Primary Metals	232.	65045.	14470.	22.2	2/38
Fabricated Metals	2837.	75331.	16847.	22.4	3/38
Machinery	870.	43147.	13321.	30.9	2/38
Transportation	667.	143855.	28260.	19.6	6/38
Electrical	766.	87260.	32822.	37.6	4/38
Refined Petroleum	43.	9468.	6797.	71.8	1/38
Other	1435.	40320.	13301.	33.0	*
Total	15263.	880927.	253410.	28.8	

(1) Number of industries in this major category that are ranked amongst those having the highest value of shipments.

* Some of the data were unavailable.

Source: Statistics Canada: Manufacturing Industries, 1984, Cat.31-203.

Table 3-8
Information Workers
Prairies - (1984)

Industry	No. of Establ.	Total Workers	Office Workers	Off. Workers %	Ranking (1)
Food	539.	24186.	7646.	31.6	6/32
Wood	382.	8673.	1507.	17.4	3/32
Paper	57.	*	*	*	*
Printing	817.	*	*	*	4/32
Fabricated Metals	639.	12076.	3179.	26.3	6/32
Machinery	279.	*	*	*	*
Transportation	155.	8176.	2979.	36.4	2/32
Electrical	109.	7762.	3618.	46.6	2/32
Non-Metallic	301.	6203.	1767	28.5	
Chemical	129.	6590.	1499.	22.7	3/32
Total	4549.	141615.	43073.	30.4	

(1) Number of industries in this major category that are ranked amongst those having the highest value of shipments.

* Some of the data were unavailable.

Source: Statistics Canada: Manufacturing Industries, 1984, Cat.31-203.

Table 3-9
Information Workers
British Columbia - (1984)

Industry	No. of Establ.	Total Workers	Office Workers	Off. Workers %	Ranking (1)
Food	287.	14430.	4654.	32.3	10/32
Furniture	133.	1515.	289.	18.6	*
Printing	577.	8791.	4050.	46.1	3/32
Primary Metals	39.	6982.	1923.	27.5	*
Machinery	169.	4301.	1404.	32.6	2/32
Transportation	234.	6094.	1621.	26.6	1/32
Electrical	113.	4290.	2278.	53.1	*
Non-Metallic	198.	4220.	1247.	29.5	1/32
Refined Petroleum	12.	1035.	375.	36.2	1/32
Other	435.	2983.	720.	24.1	*
Total	3980.	131969.	35285.	26.7	

(1) Number of Industries in this major category that are ranked amongst those having the highest value of shipments.

* Some of the data were unavailable.

Source: Statistics Canada: Manufacturing Industries, 1984, Cat.31-203.

Some industries had a very high ratio of information workers, industries such as refined petroleum, chemical, printing, electric & electronic, and food and beverage industries. Other industries had a very small ratio of information workers, such as the clothing, leather, wood, and furniture industries.

In the Atlantic region the overall ratio of office workers was only 24.4%. Although 66% of the establishments belonged to category A, the ratio of information workers of these industries was below the regional average. Either the establishments felt no need to maintain a strong information contingent for various reasons, or else were incapable of doing so. In either case, it is likely that this deficiency in the information support will increase the vulnerability of these industries in spite of their regional comparative advantage. The industries that had the highest proportions of information workers in Atlantic Canada were those of Category B, those that faced the greatest outside competition.

Generally, the Prairie region had a much higher ratio of information workers (30.4%). Contrary to the Atlantic industries, the Prairie industries had high ratios of Office workers in Food and Non-metallic industries of category A as well as in the category B industries.

The ratio of information workers in British Columbia was only slightly lower than the Canadian average. The proportion of office workers in category A were similar to those of Ontario but in category B there were a number of British Columbia industries which had a much lower

ratio. The difference might be attributable to the fact that Ontario has over 55% of the Head and Sales Offices which of course are information workers. But the differences might also indicate that some British Columbia industries of category B are weak in information infrastructure and therefore vulnerable to outside competition.

Table 3-10
 Manufacturing Activities by Category
 (1984)

Region	Establish- ments Total	Establish- ments in Category A	%	Establish- ments in Category B	%
Canada	36464.	14687.	40.3	11072.	30.4
Atlantic	1994.	1312.	65.8	399.	20.0
Quebec	10649.	4088.	38.4	2439.	22.9
Ontario	15365.	5227.	34.2	5777.	37.8
Prairies	4549.	2148.	47.2	1311.	28.8
B.Columbia	3980.	1919.	48.2	1146.	28.8

Category A: Food, Wood, Paper, printing and non-metallic production.

Category B: Fabricated metal, machinery, transportation equipment, electric and electronic and chemical production.

Source: Statistics Canada: Manufacturing Activities, 1984, Cat. 31-203.

Information Indicators and Regional Industrial Activities

Tables 3-11 to 3-15 provide a number of useful indicators about the manufacturing activities in the regions. Particular attention is drawn to the four following indicators for the major industries of categories A and B: the ratio of Value Added to the total Value of Shipment and Other Revenues, the Value of Shipment per production worker, the Value of Shipment per office worker, and the relative size of the office work force.

The most striking feature of Table 3-11, is that the Atlantic region falls below the national average value on all four indicators. The region has a very small ratio of Office workers although the value of shipment per office worker is higher than that of the regions of Quebec, British Columbia and the Prairies. Undoubtedly some of these differences in indicator values are attributable to a variety of factors such as plant size, the nature of the market (regional, national, or international) and the managerial and information infrastructures. However, there is still the problem that the Atlantic region is below the national average in this regard and this is cause for concern.

Since we have found that the survival of regional manufacturing is in part dependent on the types of activities performed, we shall review the indicators of Tables 3-11 to 3-15 according to categories A and B outlined earlier.

The Food industries of Category A offer sharp contrasts in regional structure. The Atlantic region is slightly above the national average on the ratio of Value Added/Value of Shipment, above the average in the Value of Shipment per Office Worker but far below in Value of Shipment

per Production Worker and percentage of office workers. Because food industries account for 37% of all manufacturing in Atlantic Canada, any weakness in any segment of these industries is potentially disastrous.

Because such a large proportion of the Atlantic Food industries are in fish processing and because fish consumption is likely to increase by at least 20% in the next decade, the most important indicator, it seems to us, is the low percentage of information workers within this industry. National and international competition in this market sphere will certainly increase over the next decade and it seems essential to us that the Atlantic region provide itself with an adequate information infrastructure if it is to compete on the national and world markets.

The Western regions are close to or above the national average on almost all the indicators in the Food industries. The only real weakness lies in the poor ratio of Value Added/Value of Shipment. Since the Meat, Poultry and Feed industries make up 81% of the Prairies Food industries some transformation of these industries would be necessary.

The Wood industries form the second most important group of industries in category A at least with respect to the number of establishments. The Office workers form only 16% of this industry's labour force when the average ratio for all Canadian industries is 28%. The Wood industries have higher ratios of Value added/Value of Shipment than do the Food industries.

The regions contrast sharply with regards to the Wood industries as well.

Table 3-11
 Selected indicators
 All industries (1984)

Region	No. of establ.	Prod. workers	Office workers	Total Emp.	Val. of ship. (\$000)	Value added	Value/ ship.	Ship./ prod.W.	Ship./ Off.W.	% off. workers
Canada	36464.	1240816.	481228.	1722044.	264237000.	94044700.	.3559	185.	71.	27.95
Atlantic	1994.	62315.	20110.	82425.	11402190.	3559153.	.3121	163.	62.	24.40
Quebec	10649.	355584.	129299.	484883.	61537260.	24507160.	.3982	160.	35.	26.67
Ontario	15263.	627517.	253410.	880927.	147105600.	50962100.	.3464	194.	100.	28.77
Prairies	4549.	98544.	43071.	141615.	24935940.	7624159.	.3057	235.	41.	30.41
Bri.Col.	3980.	96624.	35285.	131909.	19201560.	7369023.	.3838	186.	35.	26.75

Source: Statistics Canada: Manufacturing industries, 1984, Cat. 31-203.

Table 3-12
 Selected Indicators
 Food Industries (1984)

Region	No. of establ.	Prod. workers	Office workers	Total Emp.	Val. of ship. (\$000)	Value added	Value/ ship.	Ship./ prod.W.	Ship./ Off.W.	% off. workers
Canada	3250.	130114.	56895.	187009.	37234540.	10126580.	.2720	243.	99.	30.42
Atlantic	465.	24263.	6534.	30797.	3302176.	1007050.	.3050	101.	129.	21.22
Quebec	898.	30887.	14220.	45107.	9395992.	2450632.	.2608	275.	64.	31.53
Ontario	1061.	48648.	23841.	72489.	14922630.	4578407.	.3068	255.	105.	32.89
Prairies	539.	16540.	7646.	24186.	6791306.	1248542.	.1838	360.	110.	31.61
Bri.Col.	287.	9776.	4654.	14430.	2822439.	841950.	.2983	238.	107.	32.23

Source: Statistics Canada

Table 3-13
 Selected Indicators
 Wood Industries (1984)

Region	No. of establ.	Prod. workers	Office workers	Total Emp.	Val. of ship. (\$000)	Value added	Value/ ship.	Ship./ prod.W.	Ship./ Off.W.	% off. workers
Canada	3561.	86205.	16736.	102941.	10279610.	4050734.	.3941	116.	18.	16.26
Atlantic	421.	5048.	876.	5924.	474659.	174640.	.3679	87.	42.	14.79
Quebec	1159.	23417.	5186.	28603.	2474496.	1045422.	.4225	102.	17.	18.13
Ontario	838.	17524.	3316.	20840.	1873539.	774791.	.4135	102.	23.	15.91
Prairies	382.	7166.	1507.	8673.	821725.	337489.	.4107	109.	25.	17.38
Bri.Col.	761.	33050.	5851.	38901.	4635194.	1718392.	.3707	138.	11.	15.04

Source: Statistics Canada: Manufacturing Industries, 1984, Cat. 31-203.

Table 3-14
 Selected Indicators
 Fabricated Metal Industries (1984)

Region	No. of establ.	Prod. workers	Office workers	Total Emp.	Val. of ship. (\$000)	Value added	Value/ ship.	Ship./ prod.W.	Ship./ Off.W.	% off. workers
Canada	5329.	99669.	29533.	129202.	13135640.	6001063.	.4569	122.	32.	22.86
Atlantic	169.	2106.	667.	2773.	268156.	117329.	.4375	108.	62.	24.05
Quebec	1169.	24371.	6588.	30959.	3392223.	1394472.	.4111	133.	24.	21.28
Ontario	2837.	58484.	16847.	75331.	7476963.	3586774.	.4797	119.	31.	22.36
Prairies	639.	8897.	3179.	12076.	1104579.	501942.	.4544	110.	41.	26.32
Bri.Col.	515.	5811.	2252.	8063.	893722.	400545.	.4482	136.	45.	27.93

Source: Statistics Canada: Manufacturing Industries, 1984, Cat. 31-203.

Table 3-15

Selected Indicators

Transportation Equip. Industries (1984)

Region	No. of establ.	Prod. workers	Office workers	Total Emp.	Val. of ship. (\$000)	Value added	Value/ ship.	Ship./ prod.W.	Ship./ Off.W.	% off. workers
Canada	1446.	149227.	46402.	195629.	51305180.	13447220.	.2621	254.	289.	23.72
Atlantic	123.	3803.	1501.	5304.	806673.	186415.	.2311	211.	2.	28.30
Quebec	267.	20159.	12041.	32200.	4505379.	1993067.	.4424	214.	17.	37.39
Ontario	667.	115595.	28260.	143855.	44593450.	10550360.	.2366	273.	463.	19.64
Prairies	155.	5197.	2979.	8176.	654573.	341767.	.5221	114.	21.	36.44
Bri.Col.	234.	4473.	1621.	6094.	745101.	375620.	.5041	160.	17.	26.60

Source: Statistics Canada: Manufacturing Industries, 1984, Cat. 31-203.

The Atlantic region is below average in the Value Added/Value of Shipment ratio, in the Value of Shipment per Production worker and in the ratio of Office workers. The Prairie region is above average in the ratio of Value Added/Value of Shipment, the ratio of Office workers. British Columbia is below average on three of the four indicators. Only the ratio of Value of Shipment per Production worker is above the national average.

The disparities are sharp. If information infrastructure is essential in maintaining productivity and market share, the lower capacity of all three peripheral regions to react to market change will undoubtedly create some problems for these regions.

The newspaper, printing, and non-metallic mineral industries are more regionally dependent in terms of market. The Atlantic and Prairie regions are below the national average on a number of the indicators.

The indicators for the industries of Category B show patterns which contrasts with those of Category A. In general, the indicators show that these industries have higher information ratios, presumably because the survival of these industries is linked directly to their innovative capacity and market aggressiveness and these industries are forced to keep pace with those of Central Canada in this regard.

Fabricated Metal Product industries in the Atlantic, Prairie, and British Columbia regions are generally close to or above the national average. The Transportation Equipment industries are strongly concentrated in Central Canada. The regional establishments that do exist maintain a higher than average information work force. The Value Added/-Value of Shipment for the Western regions is twice as high as the national average.

The Electrical and Electronic product industries are also almost exclusively centrally located (82%). The regional establishments maintain a high ratio of Value Added/Value of Shipment and a high percentage of Office workers.

The Chemical industries in the regions do not generally have above average values for all four indicators. This does appear as a major weakness of this type of regional activity.

In summary, the industries of Category A offer sharp contrasts. The Food industries have a better information ratio than do the Wood industries. Coupled with the fact that they often also have a regional comparative advantage, the Food industries that maintain an adequate information sector should be able to retain their markets. The Wood industries seem the weakest of all industries of both categories in terms of informational support.

The industries of Category B have better informational infrastructure but they also face greater outside competition.

All industries, particularly the smaller size establishments, require a strong information infrastructure to remain viable entities and yet they are less likely to be able to afford an adequate information infrastructure.

The Information Component and Industrial Size

Close to 50% of all industrial establishments in Canada have less than 10 employees (tables 3-16 to 3-21). In British Columbia 61% of the establishments have less than 10 employees.

In general, the proportion of Office workers increases with the size of the establishment. For all regions the larger establishments attain a ratio of 27% of Office workers but in Atlantic Canada the average high is only 22%. This low value is partly attributable to the fact that the region has fewer large establishments and may also be tied to an inadequate perception of the importance of the role of the informational infrastructure.

With an increase in size of establishment comes an increase in Value of Shipment per Employee. The Canadian average goes up to a value of 231, in the Prairies the indicator reaches a value of 261, but in the Atlantic region the indicator remains below 100.

Table 3-16

Manufacturing industries

Selected statistics

by size group (1984)

CANADA	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
No. empl.										
1 to 4	11391.	31.24	22818.	100.	21642.	104.	1176.	25.	3451.	20.28
5 to 9	6460.	17.72	42634.	86.	38485.	91.	4149.	43.	934.	11.92
10 to 19	5985.	16.41	82212.	97.	68130.	110.	14082.	36.	204.	17.38
20 to 49	6134	16.82	191464.	110.	148096.	131.	43368.	40.	71.	22.69
50 to 99	3031.	8.31	211070.	125.	160915.	150.	50155.	44.	41.	23.78
100 to 199	1878.	5.15	260358.	146.	199856.	175.	60502.	52.	6.	23.24
200 to 499	1189.	3.26	357376.	167.	268242.	206.	89134.	49.	0.	24.94
500 to 999	275.	.75	189545.	167.	140675.	212.	48870.	39.	4.	25.78
1000 +	121.	.33	265708.	231.	194775.	274.	70933.	115.	0.	26.70

(1): Number of establishments.

(2): Percentage of the establishments in this size group.

(3): Total number of employees.

(4): Value of shipment per employee.

(5): Production workers.

(6): Value of shipment per production worker.

(7): Office workers.

(8): Value of shipment per office worker.

(9): Number of working owners.

(10): Owners and Office workers as a percent of the total number of employees.

Source: Statistics Canada: Cat. 31-203.

Table 3-17
 Manufacturing Industries
 Selected Statistics
 by size group (1984)

NEWFOUNDLAND (1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	
NOVA SCOTIA & NEW BRUNSWICK										
No. empl.										
1 to 4	633.	34.25	1137.	74.	1095.	76.	42.	31.	298.	29.90
5 to 9	333.	18.02	2134.	80.	1912.	83.	222.	59.	66.	13.50
10 to 19	284.	15.37	3873.	84.	3194.	95.	679.	32.	11.	17.82
20 to 49	300.	16.23	9002.	104.	6948.	105.	2054.	102.	2.	22.84
50 to 99	129.	6.98	8982.	93.	6992.	105.	1990.	50.	0.	22.16

(1): Number of establishments.

(2): Percentage of the establishments in this size group.

(3): Total number of employees.

(4): Value of shipment per employee.

(5): Production workers.

(6): Value of shipment per production worker.

(7): Office workers.

(8): Value of shipment per office worker.

(9): Number of working owners.

(10): Owners and Office workers as a percent of the total number of employees.

Source: Statistics Canada: Cat. 31-203.

Table 3-18
 Manufacturing Industries
 Selected Statistics
 by size group (1984)

QUEBEC	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
No. empl.										
1 to 4	3022.	28.38	6323.	90.	6000.	94.	323.	19.	1080.	22.19
5 to 9	1939.	18.21	12575.	80.	11587.	85.	988.	26.	407.	11.09
10 to 19	1837.	17.25	25275.	97.	21355.	109.	3920.	35.	96.	15.89
20 to 49	1960.	18.41	62280.	99.	49523.	116.	12757.	36.	28.	20.53
50 to 99	938.	8.81	65458.	115.	51783.	133.	13675.	45.	8.	20.90
100 to 199	502.	4.71	68851.	112.	55586.	128.	13265.	43.	0.	19.27
200 to 499	336.	3.16	98743.	162.	74425.	197.	24318.	55.	0.	24.63
500 to 999	79.	.74	56083.	168.	40519.	83.	15564.	36.	0.	27.75
1000 +	36.	.34	65751.	156.	44806.	220.	20945.	18.	0.	31.86

- (1): Number of establishments.
 (2): Percentage of the establishments in this size group.
 (3): Total number of employees.
 (4): Value of shipment per employee.
 (5): Production workers.
 (6): Value of shipment per production worker.
 (7): Office workers.
 (8): Value of shipment per office worker.
 (9): Number of working owners.
 (10): Owners and Office workers as a percent of the total number of employees.

Source: Statistics Canada: Cat. 31-203.

Table 3-19
 Manufacturing Industries
 Selected Statistics
 by size group (1984)

ONTARIO	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
No. empl.										
1 to 4	4451.	29.16	8860.	94.	8405.	98.	455.	15.	1379.	20.70
5 to 9	2502.	16.39	16512.	92.	15182.	95.	1330.	54.	326.	10.03
10 to 19	2482.	16.26	34163.	93.	29103.	102.	5060.	40.	60.	14.99
20 to 49	2624.	17.19	82070.	114.	63729.	134.	18341.	41.	30.	22.38
50 to 99	1437.	9.41	100124.	126.	75016.	154.	25108.	44.	4.	25.08
100 to 199	952.	6.24	131868.	135.	98538.	163.	33330.	53.	6.	25.28
200 to 499	604.	3.96	181877.	159.	134030.	197.	47847.	49.	0.	26.31
500 to 999	146.	.96	100406.	155.	75308.	190.	25098.	49.	0.	25.00

(1): Number of establishments.

(2): Percentage of the establishments in this size group.

(3): Total number of employees.

(4): Value of shipment per employee.

(5): Production workers.

(6): Value of shipment per production worker.

(7): Office workers.

(8): Value of shipment per office worker.

(9): Number of working owners.

(10): Owners and Office workers as a percent of the total number of employees.

Source: Statistics Canada: Cat. 31-203.

Table 3-20
 Manufacturing Industries
 Selected Statistics
 by size group (1984)

PRAIRIES No empl.	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1 to 4	1528.	33.60	3137.	92.	2939.	94.	198.	49.	313.	16.29
5 to 9	903.	19.85	6020.	91.	5306.	95.	714.	64.	54.	12.76
10 to 19	815.	17.92	11232.	115.	8695.	137.	2537.	38.	13.	22.70
20 to 49	702.	15.44	21607.	122.	15962.	150.	5645.	43.	6.	26.15
50 to 99	309.	6.79	21406.	145.	15639.	185.	5767.	38.	0.	26.94
100 to 199	189.	4.16	26688.	228.	19912.	285.	6776.	59.	0.	25.39
200 to 499	77.	1.69	22772.	262.	16589.	336.	6183.	62.	0.	27.15

(1): Number of establishments.

(2): Percentage of the establishments in this size group.

(3): Total number of employees.

(4): Value of shipment per employee.

(5): Production workers.

(6): Value of shipment per production worker.

(7): Office workers.

(8): Value of shipment per office worker.

(9): Number of working owners.

(10): Owners and Office workers as a percent of the total number of employees.

Source: Statistics Canada: Cat. 31-203.

Table 3-21

Manufacturing Industries

Selected Statistics

by size group (1984)

BRITISH COLUMBIA	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
No empl.										
1 to 4	1694.	42.55	3255.	153.	3103.	159.	152.	34.	348.	15.36
5 to 9	736.	18.49	4819.	82.	4230.	89.	589.	31.	69.	13.65
10 to 19	541.	13.59	7320.	98.	5524.	121.	1796.	26.	22.	24.84
20 to 49	525.	13.19	15826.	123.	11464.	154.	4362.	42.	5.	27.59
50 to 99	206.	5.17	14220.	154.	10750.	186.	3470.	52.	29.	24.61
100 to 199	148.	3.72	20939.	232.	16336.	280.	4603.	61.	0.	21.98
200 to 499	108.	2.71	33556.	137.	27258.	166.	6298.	15.	0.	18.77
500 to 999	14.	.35	9250.	170.	6784.	223.	2466.	23.	0.	26.66

(1): Number of establishments.

(2): Percentage of the establishments in this size group.

(3): Total number of employees.

(4): Value of shipment per employee.

(5): Production workers.

(6): Value of shipment per production worker.

(7): Office workers.

(8): Value of shipment per office worker.

(9): Number of working owners.

(10): Owners and Office workers as a percent of the total number of employees.

Source: Statistics Canada: Cat. 31-203.

Table 3-22
 Ownerships, partnerships and cooperatives
 (1984)

Region	Est. ¹	%	Lab.Force	% ²	Value of Ship.	% ³
Canada	4312.	11.8	32979.	1.9	5557075.	2.1
Atlantic	394.	19.8	3028.	3.7	294153.	2.6
Quebec	1574.	14.8	12618.	2.6	2270763.	3.7
Ontario	1546.	10.1	7090.	0.8	982804.	0.07
Prairies	395.	8.7	5518.	3.9	1279886.	5.1
B.Columbia	396.	9.9	4585.	3.5	711364.	3.7

¹ Number of establishments that are of the property of individual owners, partners, or cooperatives.

² Percentage of the total regional labour force.

³ Percentage of the total value of shipments produced by these establishments.

Source: Statistics Canada: Manufacturing activities, 1984, Cat. 31-203.

Information and productivity are linked and the larger establishments have a distinct advantage in this regard. Since 50% of the establishments have less than 10 employees, it would be appropriate to devise regional policies that would provide adequate informational networks for these smaller firms, such as teleports or equivalent systems. Such policies are highly relevant to regional development issues as the "productivity enhancing office technologies now becoming available require the use of sophisticated national private or public telecommunications networks" (Jonscher, p.15, 1983).

Types of Organizations and Regional Manufacturing

In Canada, 11.8% of the manufacturing establishment are either individual ownerships, partnerships, or cooperatives (Table 3-22). They account for 1.9% of the manufacturing employment and 2.1% of the Value of Shipments.

The Atlantic region has a very high ratio (19.8%) of this type of organization and so does Quebec (14.8%). The Western regions are below the national average in this regard. It is difficult to calculate the percentage of the labour force in information activities as the owners and partners are likely to be involved in both production and office work. However, these small firms could also be the most vulnerable to changing market demand. Regional policy should consider providing adequate informational channels to these small firms that make up a fairly substantial proportion of the number of establishments particularly in the Atlantic and Quebec regions.

Conclusion:

The objective of this study was to evaluate the interrelationships between telecommunications, manufacturing activities, and regional development in Canada.

Because we are living in "Changing Times" (19), the highest priority of developed nations should be to maintain a satisfactory rate of growth in productivity if they wish to retain their rank within the hierarchy of the world economies (71). There is a number of events forcing this upon developed countries but the most important are the internationalisation of production, market competition, and customer demand (71). As a consequence of these changes developed countries have to raise their technological level of production and restructure the economies of their regions.

The capacity to maintain an adequate level of response to technological change is dependent upon the information resources of a region which in turn are dependent upon adequate information networks. As the information systems become more complex, they require more sophisticated private and public networks, networks which many firms will not be able to finance on their own. As a result of these changes growth in the peripheral regions will be stunted unless adequate provisions are made in regional development policy.

Canada has not had a satisfactory growth rate in productivity since 1973 and "the deterioration in performance was pervasive" in almost all industries (18). The peripheral regions in Canada experienced greater difficulties in growth than the core regions for a number of reasons, one being that a larger share of the firms were Canadian-owned and were less

prone to adopt innovations than the foreign subsidiaries (18). It seems quite obvious that growth in the manufacturing industries in the peripheral regions of Canada would come under greater stress still as the move towards an information economy intensifies.

From the analyses carried out in this study there are a number of conclusions that can be drawn. First the telematic processes that were to revolutionize production have not strongly affected the regions so far mainly because investments in the information segment of manufacturing have not yet been sufficiently large to provide the required networks. Secondly, the industrial composition of the Atlantic region in particular is such that the regionally imbedded industries form 66% of the total manufacturing activity. In the Western regions, there is a higher proportion of industries that produce complex goods that are more subject to outside competition, but these firms have been able to offset this with a larger information work force.

Most of the firms, whether they be in Category A or Category B, in Central Canada or in the regions, will face greater outside competition unless they have access to more sophisticated information networks. Firms in the peripheral regions which are generally smaller in size will not be able to afford these systems and will have to rely on government assistance. Regional development programs will have to address this issue in the near future if manufacturing activities in the regions are to remain viable. Because the telematic processes that are slowly being introduced to the manufacturing sector will require expensive information infrastructures, it may well be that only a few regional centres will be able to provide these sophisticated systems. The overall result of the information revolution could entail a restructuring of regional economic

and urban systems as well as its information networks. The Atlantic region could experience anew a number of profound transformations such as those that followed the creation of a Canadian Confederation.

References

1. Atlantic Development Council, A Strategy for the Economic Development of the Atlantic Region, 1971-1981. Fredericton: Department of Regional Economic Expansion, 1971.
2. Atlantic Development Council of Canada, The Atlantic Region of Canada: Economic Development Strategy for the Eighties. St. John's: Department of Regional Economic Expansion, 1978.
3. Aydalot, Philippe, "A la recherche de nouveaux dynamismes spatiaux", dans P. Aydalot (éd.), Crise et espace. Paris: Economica, 1984.
4. Bakis, H. "The Geographical Impact of Telecommunication Systems used within Firms: Reflexions on the Decentralization of Jobs and Activities", Proceedings, Meetings of the Commission on Industrial Systems, I.G.U., Sao Paulo: 1982.
5. Bakis, H. The Communications of Larger Firms and their Implications on the Emergence of a New World Industrial Order, Tokyo: Report to the Commission on Industrial Systems, I.G.U., 1980.
6. Bell, Daniel. The Coming of Post-Industrial Society. New York: Basic Books, 1973.
7. Boisvert, M. La correspondance entre le système urbain et la base économique des régions canadiennes, Ottawa: Conseil Economique du Canada, 1978.
8. Cherry, C. "Electronic Communication: A Force for Dispersal", Official Architecture and Planning, 33 (1970), 733-76.
9. Clark, Colin. The Conditions of Economic Progress. London: MacMillan, 1951.
10. Coffey, W.J., Geography, Towards a General Spatial Systems Approach, London: Methuen Pub. Co., 1981.
11. Coffey, W. and M. Polèse, "Local Development: Conceptual bases and Policy Implications", Regional Studies, 19.2, 1985.
12. Cooke, Philip, Kevin Morgan and David Jackson. "New Technology and Regional Development in Austerity Britain", Regional Studies, 18.4 (1984), 277-89.
13. Courchene, Thomas J. and James R. Melvin. "A Neoclassical Approach to Regional Economics", Paper presented at the International Conference on Regional Development and National Growth, Wolfville, N.S., July 25-28, 1985, Moncton: I.C.R.D.R., 1985.

14. Courchene, T.J. "A Market Perspective on Regional Disparities", Canadian Public Policy, 7.4 (1981), 506-17.
15. Cowhey, P., "Telecommunications and International Trade", in R. Lamarche and M. Estabrooks (eds.), Telecommunications, Urban, Regional, International and Business Development. Ottawa: Department of Communications, Proceedings of a November 1986 Conference, 1987.
16. Economic Council of Canada. The Bottom Line: Technology, Trade, and Income Growth. Ottawa: Supply and Services Canada, 1983.
17. Economic Council of Canada, Living Together. Ottawa: Supply and Services Canada, 1977.
18. Economic Council of Canada, Strengthening Growth, Ottawa: Supply and Services Canada, 1985.
19. Economic Council of Canada, Changing Times. Ottawa: Supply and Services Canada, 1986.
20. Fourastié, J. Le grand espoir du XXe siècle, Paris: Presses Universitaires Françaises, 1950.
21. Gertler, M.S., "Regional Dynamics of Manufacturing and Non-Manufacturing Investment in Canada", Regional Studies, Vol. 20.6, 1986.
22. Goddard, J.B. and A.E. Gillespie, "Advanced Telecommunications and Regional Economic Development", The Geographical Journal, Vol. 152, No 3, 1986.
23. Goddard, J.B. "Technology Forecasting in a Spatial Context", Revue d'Economie Regionale et Urbaine, No. 3, 1981.
24. Hanneman, G. "Telecommunications, Teleports and the New Urban Infrastructure", in R. Lamarche and M. Estabrooks (eds.) Telecommunications, Urban, Regional, International and Business Development. Ottawa: Department of Communications, Proceedings of a November 1986 Conference, 1987.
25. Hansen, Niles. "Small and Medium-Size Cities in Development", Paper presented at the International Conference on Regional Development and National Growth, Wolfville, N.S., July 25-28, 1985, Moncton: I.C.R.D.R., 1985.
26. Hepworth, M., "The Geography of Technological change in the Information Economy", Regional Studies, Vol. 20.5, 1986.

27. Higgins, Benjamin. "Regional and National Economic Development: A Trade-Off or Complementarity", Paper presented at the International Conference on Regional Development and National Growth, Wolfville, N.S., July 25-28, 1985, Moncton, I.C.R.D.R., 1985.
28. Irwin, M., "Telecommunications as a Strategy Weapon", in R. Lamarche and M. Estabrooks (eds.), Telecommunications, Urban, Regional, International and Business Development. Ottawa: Department of Communications, Proceedings of a November 1986 Conference, 1987.
29. Jonscher, C. "Information Resources and Economic Productivity", in Information Economics and Policy, New York: North Holland Publ., Co., 1983.
30. Lamarche, R., Measurement of Interaction Properties in the Canadian Metropolitan System, Ottawa: Dept. of Geography, University of Ottawa, Ph.D. Dissertation, 1979.
31. Lamarche, R., "Télécommunications et développement régional: Un nouveau modèle", Revue d'Economie Régionale et Urbaine. Printemps 1987.
32. Lamarche, R., "Telecommunications in Regional Development: A New Concept", in R. Lamarche and M. Estabrooks (eds.), Telecommunications, Urban, Regional, International, and Business Development. Ottawa: Department of Communications, Proceedings of a November 1986 Conference, 1987.
33. Maillat, Denis. "La région horlogère: Transformation de l'appareil de production et capacité d'adaptation", dans (3), 1984.
34. Malecki, E.J. "Technology and Regional Development: A Survey", International Regional Science Review, 8.2, (1983).
35. Martin, F., "Le rôle du secteur tertiaire dans la stratégie de développement économique", dans D. J. Savoie et A. Raynauld (eds), Essais sur le développement régional, Montréal: Les Presses de l'Université de Montréal, 1986.
36. Martin, Fernand. "The Basis of the Department of Regional Industrial Expansion (Canada) Interventions with Respect to the Welfare Theory", Paper presented at the International Conference on Regional Development and National Growth, Wolfville, N.S., July 25-28, 1985.
37. Misra, J. and B. Belitsos, Business Telecommunications. Homewood, Illinois: R. Irwin Inc., 1987.

38. Moss, M., "Telecommunications and the Future of Cities", in R. Lamarche and M. Estabrooks (eds.), Telecommunications, Urban, Regional, International, and Business Development. Ottawa: Department of Communications, Proceedings of a November 1986 Conference, 1987.
39. Moss, M.L. (ed.), Telecommunications and Productivity, London: Addison-Wesley Pub. Co., 1981.
40. Nora, S. et Minc, A., L'informatisation de la Société, Paris: La Documentation Française, 1978.
41. O'Farrell, Patrick, N., "Entrepreneurship and Regional Development: Some Conceptual Issues", Regional Studies. Vol. 20.6, 1986.
42. Office of Technology Assessment. Technology, Innovation and Regional Economic Development: Encouraging High-technology Development - Background Paper No 2. Washington, D.C.: U.S. Congress, OTA, 1984.
43. Organisation de Coopération et de Développement Economique. Les activités d'information, de l'électronique et des technologies des télécommunications, Vol. 1, Paris, 1981.
44. Perrin, J.C. "L'analyse spatialisée: Une nouvelle approche", Cahiers d'Economie Politique, 2-3 (1976), 1-60.
45. Perrin, J.C. "Les liaisons industrialisation-urbanisation et l'organisation régional en France", Economie appliquée, XXVIII (1975), 77-123.
46. Piatier, A., "Innovation et développement régional" dans Colloque sur le redéploiement industriel et le développement régional, RERU, Clermont-Ferrand, 1979.
47. Planque, Bernard. "Technologies nouvelles et réorganisation spatiale", dans (3), 1984.
48. Planque, B, "Une nouvelle organisation du développement" dans B. Planque (ed.) Le développement décentralisé, Paris: LITEC, 1983.
49. Planque, Bernard, Y. Lazzeri et R. Lazzeri. "Disjonction fonctionnelle et développement local", Revue d'économie régionale et urbaine, IV-I (1980), 51-73.
50. Polèse, M., "Le secteur tertiaire et le développement économique régional: vers un modèle opérationnel des activités motrices", dans D. J. Savoie et A. Raynauld (eds), Essais sur le développement régional, Montreal: Les Presses de l'Université de Montréal, 1986.

51. Ponsard, C., Un modèle topologique d'équilibre économique interrégional, Paris: Dunod, 1969.
52. Porat, M.U., The Information Economy. Stanford University: Center for Interdisciplinary Research, 1976.
53. Porat, M. U. and M. R. Rubin, The Information Economy, 9. Vols. Washington, D.C.: Government Printing Office, 1977.
54. Pred, Allan, City-Systems in Advanced Economies: Past Growth, Present Processes and Future Development Options. London: Hutchinson and Company Ltd., 1977.
55. Premus, Robert et al., Location of High Technology Firms and Regional Economic Development. A Staff Study prepared for the use of the Subcommittee on Monetary and Fiscal Policy of the Joint Economic Committee, Congress of the United States. Washington: U.S. Government Printing Office, 1982.
56. Ray, M.D., "Multi-Partitioning of Factors of Growth", In preparation, Ottawa: Carleton University, Department of Geography, 1986.
57. Richardson, Harry W. "A Review of Techniques for Regional Policy Analysis", Paper presented at the International Conference on Regional Development and National Growth, Wolfville, N.S., July 25-28, 1985, Moncton: I.C.R.D.R., 1985.
58. Richardson, Harry W. "Approaches to Regional Development Theory in Western Market Economies", in George Demko (ed.), Regional Development: Problems and Policies in Eastern and Western Europe. London: Room Helm, 1984.
59. Rubin, Michael Rogers. Information Economics and Policy in the United States. Littleton, Colorado: Libraries Unlimited, 1983.
60. Saunders, Robert J., J. Jeremy Warford and Bjorn Wellenius. Telecommunications and Economic Development. Baltimore: The John Hopkins University Press, 1983.
61. Savoie, Donald J., Regional Economic Development: Canada's Search for Solutions. Toronto: University of Toronto Press, 1986
62. Savoie, Donald J., "Courchene and Regional Development: Beyond the Neo-Classical Approach", Canadian Journal of Regional Science, 1986.
63. Savy, M. "Les territoires de l'innovation. Technopôles et aménagement: l'expérience française," Revue d'Economie Régionale et Urbaine (1986) 1:41-61.

64. Serafini, Shirley and Michel Andrieu. The Information Revolution and its Implications for Canada. Ottawa: Department of Communications, Communications Economic Branch, 1980.
65. Serafini, Shirley, M. Andrieu and M. Estabrooks. "Post Industrial Canada and the New Information Technology", Canadian Futures, 1.2 (1980), 81-91.
66. Stöhr, Walter B. "La crise économique demande-t-elle de nouvelles stratégies de développement régional?" dans (3), 1984.
67. Stöhr, Walter B. Center-Down-and-Outward Development versus Periphery-up-and-Inward Development: A Comparison of two Paradigms. Vienna: I.I.V.R.S. University of Economics, 1978.
68. Thwaites, A.T. "Technological Change, Mobile Plants, and Regional Development", Regional Studies, 12 (1977).
69. Tornqvist, G. "Flows of Information and the Location of Economic Activities", Geografiska Annaler, 50B (1968), 99-107.
70. Tyler, Michael. "Telecommunications and Productivity: The Need and the Opportunity", in Mitchell Moss (ed.), Telecommunications and Productivity. Reading, Massachusetts: Addison-Wesley Publishing Company, 1981.
71. Wadley, D., Restructuring the Regions, Paris: OECD Publications, 1986.



RUDOLPHE LAMARCHE
--Telecommunications, telematics,
and regional development

P
91
C655
L3678
1987

DUE DATE

30 NOV 1987

MAR 15 1989

201-6503

Printed
in USA

