

CANADA AND  
"THE INFORMATION ECONOMY"

an overview paper  
prepared for

The Department of Communications  
Government of Canada

prepared by

Canadian Economic Services, Ltd.  
Services Economiques du Canada, Ltée.

July, 1977

P  
91  
C655  
C33  
1977

91  
C655  
C33  
1977

Industry Canada  
Library Queen  
JUL 20 1998  
Industrie Canada  
Bibliothèque Queen

CANADIAN ECONOMIC SERVICES, LTD.

~~COMMUNICATIONS CANADA  
OCT 25 1984  
LIBRARY - BIBLIOTHÈQUE~~

**CANECs**

SERVICES ECONOMIQUES DU CANADA, LTEE.

Industry Canada  
Library Queen  
JUL 20 1998  
Industrie Canada  
Bibliothèque Queen

①  
CANADA AND  
"THE INFORMATION ECONOMY" 00

an overview paper  
prepared for  
The Department of Communications  
Government of Canada

prepared by  
Canadian Economic Services, Ltd.  
Services Economiques du Canada, Ltée.

July, 1977

~~COMMUNICATIONS CANADA  
OCT 26 1984  
LIBRARY - BIBLIOTHÈQUE~~

PREFACE

This study was prepared for the Department of Communications, Government of Canada. It presents a brief overview of information issues as they relate to the Canadian economy. Particular emphasis is placed on the concept of "information accounting" as developed by such economists as Machlup and Porat. Possible Canadian research priorities are discussed.

TABLE OF CONTENTS

	<u>Page</u>
I. Introduction.....	1
II. The Literature.....	4
III. Information Issues and Canada.....	20
IV. Summary and Conclusions.....	36

## I. INTRODUCTION

The information economy is defined as that sector of the economy involved in the production and distribution of knowledge. The sector includes research and development, data gathering and processing (e.g. as by computers), and all forms of communication. Information goods, such as typewriters and telephones, are goods which are directly used in these processes.

One doesn't need to be an economist to know that Canada's information economy has grown rapidly in the past decade. Five or six years ago, pocket calculators were curiosities used only by a few engineers and university professors. Today, they are routinely used by high school students. Similarly, colour televisions have become commonplace and even small businesses often have computerized cash registers. Table 1 gives some sample indicators of growth in the information sector.

The sector has attracted increasing interest from researchers in the social sciences. Chapter 2 of this study describes some of the existing literature. Particular emphasis is given to the thesis of Marc Porat, in which he constructs an information sector for the U.S. national accounts.

TABLE 1

The Growth of the Information Economy in Canada:  
Some Selected Indicators

	1971	1976	Average rate of annual growth (per cent)
Real Gross National Product (billions of 1971 dollars)	94.1	116.1	4.3
Real Domestic Product, Communication Industry (1971=100)	100	150.1	8.5
Real Domestic Product, Financial Insurance and Real Estate (1971=100)	100	128.3	5.1
Real Domestic Product, Services to Business Management (1971=100)	100	133.0	5.9
Number of Black-and-White Televisions Sold in Canada (thousands)	524	505	-0.7
Number of Colour Televisions Sold in Canada (thousands)	525	979	13.3
Number of Federal Government Employees (thousands)	401	576	7.5
Number of Employees, All Levels of Government (thousands)	998	1,166	3.2
Number of Telephone Receivers (millions)	10.3	12.8 <sup>1</sup>	4.4

<sup>1</sup> As of April, 1976

Source: Statistics Canada

This thesis is the focal point for a research program being proposed by the Organization of Economic Co-operation and Development. It is suggested that each country extract data on the information sector from its own national accounts and labour statistics. The methodology would be co-ordinated through the OECD to allow for international comparability.

Chapter 3 offers some comments on this proposal and discusses its merit and feasibility in the Canadian context. The emphasis of this chapter is on the conceptual problems involved in the proposed exercise. Chapter 4 presents the conclusions of the report.



## II. THE LITERATURE

Early economists had generally ignored information issues by assuming perfect information and homogeneous products. The result was often theoretical support for laissez-faire policies.

However, Lange and Lerner showed that under these same assumptions, central planning was as efficient as laissez-faire. F. A. Hayek's counter to this position was probably the first clear articulation of the importance of information in the economy. [ 4 ]<sup>1</sup>

Hayek argued that the "economic problem of society is a problem of the utilization of knowledge not given to anyone in its totality". [ 4 ; p. 519] The policy question was whether it was economic for the central planning agency to collect and use all the information needed for all the decisions in the economy.

Therefore, information is much more than a consumption good. It is a prerequisite for the planning process. As the planning units of our society (i.e. governments, corporations) become larger and more complex, the importance of information also increases.

A slightly different position was advanced by Stigler. [11] He argued that although there are seldom

---

<sup>1</sup>Square brackets refer to the reference number in the bibliography.

ownership rights over information, each agent can only obtain relevant information by incurring the costs of search. He uses an example where the usual one-price-in-market assumption is replaced by a frequency distribution of prices. Therefore, buyers who canvass more than one seller save money as they are likely to encounter lower prices. Search continues until the marginal cost of search is equated to its expected marginal return.

The implied conclusion is that information is a natural market function. As markets, technologies and consumption patterns become more complex, it is expected that the market for information will also expand.

Unlike these first two contributions, the remaining literature discussed here is not framed in conventional economic theory. There are two broad categories. The first is theoretical, including contributions by Bell, Drucker and Parker. These approaches focus on the qualitative changes in our society due to the new technologies in information production and distribution. There is also emphasis on the policy aspects of these changes. The second approach, due to Machlup and Porat, attempts to quantify the information sector in order to develop data for the discussion of information and technology issues.

Marshall McLuhan was one of the first to suggest that electronic communication was causing a basic structural change in our society. Because any single individual now had the potential to communicate very rapidly with distant places, the earth was now "smaller" -- i.e. a "global village".

Daniel Bell [ 1 ] and Peter Drucker [ 3 ] explored the social and economic implications of McLuhan's ideas. Bell compared the revolution in information technology (i.e. the development of radio, television and microwave broadcasting, satellite technology and computers) to the industrial revolution (i.e. the development of the steam engine).

Drawing on Marx's thesis that social structure was essentially determined by the state of technology, Bell argued that the "information revolution" would also have profound effects on society. According to Bell, the developed nations are now entering a new phase -- a "post-industrial society" -- where the most important economic activity is the production and distribution of knowledge.

To quote Bell, "Post-industrial society is organized around knowledge, for the purpose of social control and the directing of innovation and change; and this in turn gives rise to new social relationships and new structures which have to be managed politically." [ 1; p. 20] Note his

emphasis on the policy aspects of this basic social change.

Bell continues that society will need to promote a new intellectual technology to manage such a complex world. The constraint will be theoretical rather than empirical knowledge (as the storage and manipulation of data can be handled by computer). According to Bell, the community must replace simple intuitive judgments with problem-solving rules ("algorithms") in order to achieve efficient social control.

Peter Drucker [ 3 ] concentrates on the actual economic value of knowledge. He views knowledge as the primary industry and the crucial resource of the economy. As does Bell, he argues that knowledge is the foundation for skill as it substitutes systematic learning for exposure to experience. Moreover, the increase in knowledge is the most important factor behind economic growth.

There are several implications of the growing importance of knowledge in our society. Firstly, there are relatively more knowledge workers and they are tending to work longer hours, while non-knowledge workers experience more leisure. Secondly, specialization has led to group research, with the result that knowledge opportunities exist primarily in large organizations. This has been a cause of the formation of larger and larger economic institutions

(e.g. corporations, governments) within our society. Finally, because of the great increase in life span, workers in all occupations are acquiring more and more formal knowledge (i.e. education). For example, a sales position which today may be filled by a university graduate would probably have been filled fifty years ago by someone without a high school diploma.

Drucker, like Bell, concludes that effective management of our new "information society" has still not been achieved. Because knowledge is a kind of economic power, this may be impossible unless a technology (both scientific and social) is developed to allow equal access to information for all.<sup>2</sup>

Both Hirschleiffer and Parker examined these same issues as specific economic problems. Hirschleiffer [ 5 ] first categorizes the modes of behaviour to be explained. These categories are listed in Table 2.

The possessor can benefit by the private use of the information or he may sell it to others. Correspondingly, the seeker may produce information or purchase it from someone else.

---

<sup>2</sup>For example, corporations use research to obtain economic power. But if all research were government-sponsored, could we expect it to remain free of government manipulation?

TABLE 2

Information-Involved Modes of Behaviour

<u>POSSESSORS OF INFORMATION</u>	<u>SEEKER OF INFORMATION</u>
1. PRIVATE USE	1. PRODUCTION
2. SALE	2. PURCHASE
3. GRATUITOUS DISSEMINATION ("pushing")	3. MONITORING
4. DECEPTION/AUTHENTICATION	4. EVALUATION

---

Source: Adapted from J. Hirschleiffer [ 5 ].

---

The possessor may also disseminate some types of information (such as advertising) at a zero price (and, in fact, may incur some costs to do so). Because of the realization that the possessor has an underlying motivation, the seeker counters by monitoring the information.

The final possibility is the possibility of deception. This leads to the counter-activity of evaluation by the seeker, which in turn, leads to authentication (e.g. guarantees, warranties) by the possessor.

Hirschleiffer further categorizes the economically significant attributes of information (see Table 3). Certainty refers to the accuracy and believability of the information. The extent of diffusion affects the scarcity value of information. Applicability refers to the number of agents who can use the information. The content refers to the actual message or messages within the information. Finally, there are various degrees of relevance to potential decisions to be taken by the agent.

After categorizing the types of information-involved behaviour, Hirschleiffer discusses areas within the topic where traditional market structures may not be appropriate. The issues he mentions include:

*Jones*

TABLE 3

Economically Significant Information Attributes

1. Certainty
2. Diffusion
3. Applicability: particular vs. general
4. Content
5. Decision -- relevance

---

Source: Adapted from Hirschleiffer [ 5 ].

---

- (a) the under-investment issue -- there may be under-investment in new technological ideas because of imperfections in the patent system and the inherent risk involved in invention;
- (b) the disclosure problem -- if information is only of value to one agent, there is an unavoidable monopsony in the market. However, if it is of value to several agents, it may be impossible for the producer to prevent transfer after having sold the information to one buyer;
- (c) the quality problem -- buyers may not be able to obtain accurate information about the quality of the commodities they wish to buy.



Parker [ 8 ] suggests a very broad role for policy in the information sector. To quote one of his articles, "Policy analysis should begin, however, with the social problems and aims that need urgent attention, and both the technology and institutions controlling the technology should be structured to accomplish long-term objectives." [ 8; p. 4 ]

He also envisions an even more important role for the informational sector itself. Like the Club of Rome, he emphasizes the limitations to the world's supply of raw materials. However, Parker argues that economic growth can continue as there is no such limitation on technology. The task of policy in the information sector is to control the development of such technology for the achievement of social goals.

More specifically, Parker suggests that consumption patterns will shift relatively towards goods that are technology-intensive (such as televisions) and away from goods that are intensive in raw materials (such as automobiles). Like Hirschleiffer, he lists some economic problems associated with the information sector but goes further by asserting that the competitive system cannot cope with these pressures.

Parker argues that the existing legal basis for the information sector (e.g. patents, copyrights, privacy

laws) is already non-competitive and that the rising importance of technology will reinforce this tendency. As it is socially inefficient for information to be appropriated by one individual (as it can be transferred with virtually zero marginal cost), Parker maintains that co-operative rather than competitive strategies are more appropriate to the information sector. Moreover, "as the cost of the matter-energy component of information... continues to decline relative to the cost (primarily intellectual labour) of providing the information itself, the competitive marketplace will become less and less effective as an efficient allocation of investment resources". [8 ;p.11]

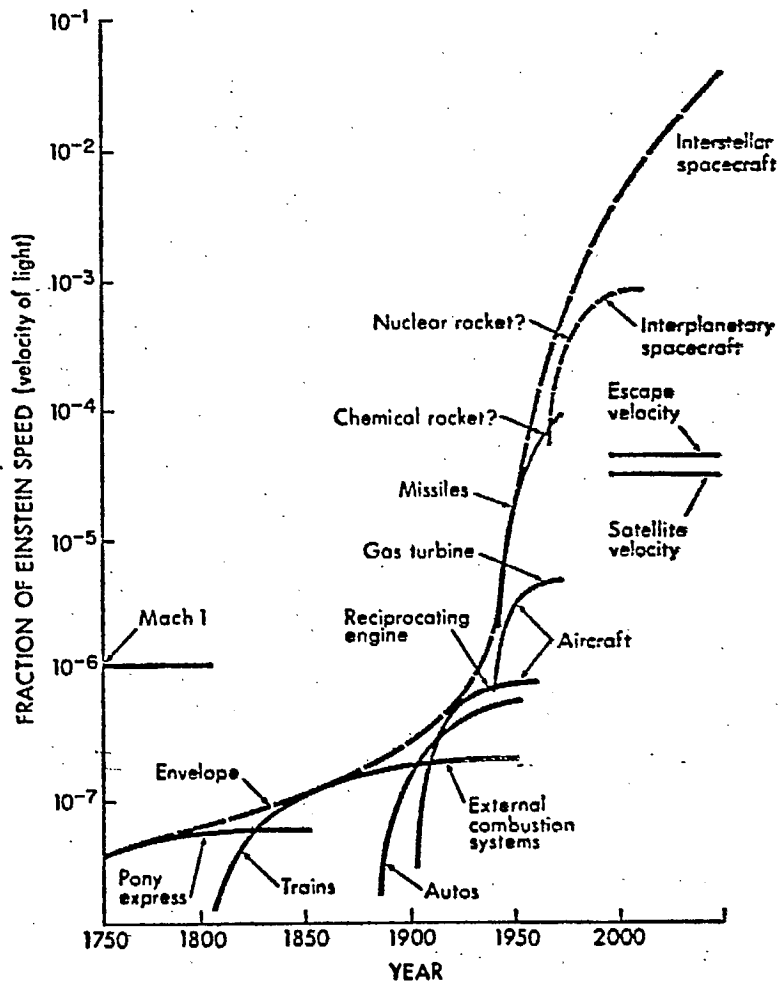
The theorists had no concise empirical framework which could be used to measure or test the concepts. For example, Bell was forced to use a wide spectrum of indicators such as the number of scientific periodicals published and the number of books in Yale's library.

Although these data are often interesting (e.g. see Charts 1 and 2), the wide variety of data can be confusing and even contradictory. For this reason, Machlup [ 6 ] pioneered the use of the national accounts as a basic framework for analysis. After defining and securing markets for education, research and development, communications media and information services, he eventually concluded that information industries accounted for 29 per cent of United States' GNP and employed

CHART 1

Speed Trend Curve

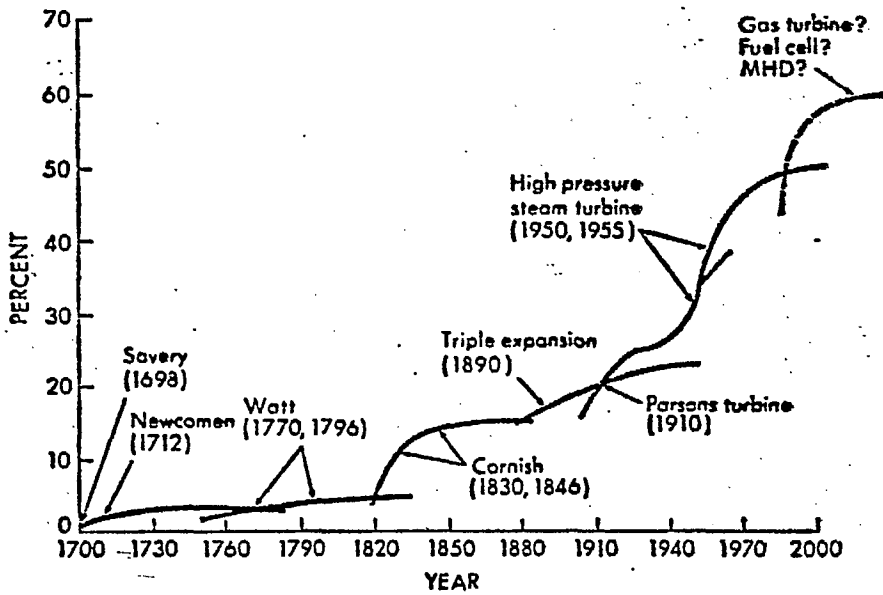
1750 - 2000



Source: Robert U. Ayres, Hudson Institute. Reprinted in Bell [1].

CHART 2

The Efficiency of External Combustion Energy Conversion Systems  
1700 - 2000



Source: Hans Thirring, Energy for Man, Indiana University Press, 1958. Reprinted in Bell [1].

31 per cent of the work force.

Machlup also made conceptual contributions to the study of information. Most important was probably his classification of knowledge into: (1) practical knowledge; (2) intellectual knowledge; (3) part-time knowledge; (4) spiritual knowledge; (5) unwanted knowledge. Implicit is that different types of knowledge have different values and that the value will not always be reflected by the market price.

Porat refined Machlup's work, developing more complex and detailed calculations. He also used the wider concepts of information suggested by Bell and others. He concludes that the information sector comprises about 46 per cent of the United States GNP and accounts for about 50 per cent of the civilian labour force. Because his thesis is the focal point of the research program proposed by the OECD, the following few paragraphs examine it in more detail. [9]

Porat first describes the policy-relevance of the information sector as a justification for this kind of work. Drawing on many of the authors reviewed here, his list of issues includes: (a) the tendency of imperfect information to shift the bargaining power in favour of the firm; *Concl.*  
(b) vertical integration as a method for firms to economize

*internationalize*

*On employment  
management  
Planning  
Buckley*

on information; (c) unemployment as an informational deficiency (i.e. "search" unemployment); (d) advertising; (e) under-production of information because of its public goods aspects; (f) bureaucracies; and (g) the effects of information on international trade.

The next step was to divide the information sector into two subsectors. The primary information sector includes all industries which produce information machines or sell information services on (established) markets. It includes all private sector industries which produce and sell information or the service of distributing information, as well as the risk management industries (i.e. insurance companies), the search and co-ordination industries (i.e. advertising), the industries which process information or manufacture information goods, government estimates that have direct private sector analogs such as education or the post office and support facilities such as office and education buildings. This sector contributes about 25 per cent of GNP, according to Porat's estimates.

The public bureaucracy includes all the planning and co-ordinating functions of all levels of government, except for those with direct private sector analogs. The private bureaucracy is that portion of every non-information

firm which engages in purely information activities. Together, the two bureaucracies comprise the secondary information sector.

Porat then measured the size of the primary information sectors in a national accounting framework. Much of the work was relatively straightforward extraction from the existing national accounts, but there were several industries where fairly difficult allocations had to be made. Some illustrative examples of such allocations are given including (per cent allocation of output to information sector in parentheses) banks (81 per cent), physicians offices (51 per cent), real estate (21 per cent) and construction (15 per cent). He calculated a time series for national income originating in the time series for 1929-1974.

Porat also calculated the number of information workers, or those whose occupations are primarily engaged in the production and distribution of knowledge. He produced a time series (with projections) for the period 1860 to 1980. He also disaggregated the total employee compensation given to both information workers and non-information workers into 108 industries. He used this latter calculation in measuring the size of the public and private bureaucracies, and thus the secondary information sector.

Input-output matrices for both the primary and secondary information sectors were also derived. He

performed a series of policy experiments with these matrices. He concluded his work with a general discussion of policy and the information sector.

To summarize, this section has described some of the key contributions to the literature on the information economy. Hayek argued that the chief advantage of the competitive system was its economy in the distribution of information. Stigler studied the response of the private market to informational needs. Bell, Drucker, Parker and Hirschleiffer emphasized the problems with the competitive market because of the public-good aspects of information. The first three also maintained that the development of new technology in the information sector was causing a fundamental change in our social structure -- the coming of a post-industrial society. Finally, Machlup and Porat studied the information sector of the United States within the framework of the national accounts. The most current and detailed empirical study is Porat's thesis, The Information Economy.



### III. INFORMATION ISSUES AND CANADA

The Porat thesis is a very interesting and informative piece of work. This chapter considers the task of performing similar calculations for the Canadian economy. The first section reviews the Porat Approach; the second comments on other approaches.

#### The Porat Approach

As noted, Porat made seven major types of calculations: (a) the size of the primary information sector; (b) the time series for national income, 1929-1977; (c) the number of information workers; (d) a time series for the number of information workers, 1860-1980; (e) a disaggregation of employee compensation by industry; (f) the size of the secondary information sector; (g) input-output matrices for both primary and secondary information sectors. The following discusses these calculations in a Canadian context.

The size of the primary information sector is probably best measured using the existing input-output matrices of the structure of the economy by industry. These are published every five years and the latest is available for 1971. The growth of the sector between these five-year intervals is probably best measured using the indexes of real domestic product (RDP), as these are disaggregated by industry.

Some additional information could be obtained from the expenditure side of the national income accounts. Real domestic product is a "constant dollar" measure of production within the boundaries of Canada, by either residents or non-residents. In contrast, Gross National Product can be measured in either constant or current dollars and includes any output attributable to a resident of Canada, whether that output originates inside or outside of Canada.

There are also several other sources of data. A sampling of some of the more relevant Statistics Canada publications is included in Table 4.

A possible problem is that Porat used current dollar terms while Real Domestic Product is in constant dollars. It would probably not be difficult to calculate current dollar estimates based on the RDP, although it might still be argued that constant-dollar estimates would be more appropriate. In any case, it makes little difference if the purpose is only to analyze changes in the composition of output.

As RDP estimates have been published since 1935, it is probable that an information sector time series back to at least that time, could be constructed. However, it appears that Porat did not change his allocation basis for the information component of each industry from year to

TABLE 4

Selected Statistics Canada Publications on the Information Sector

1977

<u>Topic</u>	<u>Publication Number</u>	<u>Latest Information Available</u> <sup>1</sup>	<u>Description</u>
<u>Appliances and Equipment</u>	43-004	April, 1977	Radio and television receiving sets
	43-205	1974	Manufacturers of household radio and television receivers
	43-206	1974	Communications equipment manufacturers
	63-222	1974	Computer service industry
<u>Communications</u>	56-001	June, 1977	Communications service bulletin
	56-002	April, 1977	Telephone statistics, revenue, expenditures, etc.
	56-201	1975	Telecommunications statistics
	56-202	1975	Telephone statistics: preliminary report on large telephone systems
	56-203	1975	Telephone statistics
	56-204	1974	Radio and television broadcasting

TABLE 4 (continued)

Selected Statistics Canada Publications on the Information Sector

1977

<u>Topic</u>	<u>Publication Number</u>	<u>Latest Information<sup>1</sup> Available</u>	<u>Description</u>
<u>Communications</u> (concluded)	56-205	1974	Cable television
<u>Education</u>	81-001	1974	Service bulletin: education, science and culture division
	81-208	1973-74	Financial statistics of education
	81-212	1974-75	University financial statistics
	81-220	1976-77	Advance statistics of education
<u>Libraries</u>	81-205	1973	Public libraries in Canada
	81-206	1972	University and college libraries in Canada
<u>Motion Pictures and Recording</u>	63-206	1975	Motion picture production
	63-207	1975	Motion picture theatres and film distributors
	47-004	April, 1977	Phonograph records and pre-recorded tapes

TABLE 4 (concluded)

Selected Statistics Canada Publications on the Information Sector

1977

<u>Topic</u>	<u>Publication Number</u>	<u>Latest Information<sup>1</sup> Available</u>	<u>Description</u>
<u>Religious Organizations</u>	61-211	1974-75	Selected financial statistics of religious organizations
<u>Research</u>	13-202	1975-77	Federal government activities in the natural sciences
	13-203	1974-76	Industrial research and development expenditures in Canada
	13-205	1975-77	Federal government activities in the human sciences
	13-209	1975	Expenditures of provincial non-profit industrial research institutes
	13-403	1963-73	Research and development expenditures in Canada
	13-404	1973	Expenditures on scientific activities by non-profit organizations
<u>Signs and Displays</u>	47-209	1974	Signs and displays industry

<sup>1</sup> Period for which latest information is available, as of July 20, 1977

year when constructing his time series. In view of the vast structural changes in most industries over this period, this would appear to be a serious weakness in his work. On the other hand, such allocation procedures would be very difficult for the 1930's and 1940's. It is suggested that a shorter time series over a more recent period might be more appropriate.

The estimates of the size and growth of the information sector based on the input/output matrices and the RDP indexes would probably be adequate for most purposes. However, to duplicate Porat's results for Canada would require the construction of an information sector in the income and expenditure accounts (i.e. the "GNP" accounts). As the expenditure data by industry of origin in the national accounts have not been developed in Canada to nearly the same degree as in the United States, this task would necessarily depend on highly arbitrary assumptions.

The various published categories of Real Domestic Product are shown in Table 5. A similar breakup is available for the input-output matrices. Those that could be put into a primary information sector are marked with a star. The remaining may have primary information components which must be allocated. It can be seen that many difficult allocations are required.

Census information provides the sort of disaggregation by occupation required for calculating the number of information workers. Estimates for non-census years could be based on employment by industry, which is published regularly. A similar technique could calculate employee compensation, and the result could be used to calculate the size of the secondary information sector. *View 9*

Input-output matrices could be calculated for both primary and secondary information sectors. However, policy experiments with such matrices would not likely be very relevant, as the most recent input-output data for Canada is for 1971. The structure of the information sector has changed markedly since then. It is suggested that efforts be concentrated first on studying the size and growth of the sector up to 1971, with a relatively complete set of data. Once the facts are understood as well as possible for 1971, efforts could be made to update the information for use in policy-making.

The conclusion is that the project is feasible, especially if recent observations are not required. However, because of data limitations, the results will depend on the arbitrary assumptions used. It should be remembered that Porat was working with more timely and more detailed U.S.

TABLE 5

Components of Real Domestic Product

REAL DOMESTIC PRODUCT - PRODUIT INTERIEUR REEL .....	Paper and allied industries - Industrie du papier et activités connexes .....
AGRICULTURE - AGRICULTURE .....	Pulp and paper mills - Usines de pâtes et papiers .....
FORESTRY - FORÊTS .....	* Printing, publishing and allied industries - Imprimerie, édition et activités connexes .....
FISHING AND TRAPPING - CHASSE ET PÊCHE .....	Primary metal industries - Première transformation des métaux .....
MINES (including milling), QUARRIES AND OIL WELLS - MINES (y compris broyage), CARRIÈRES ET Puits DE PÉTROLE .....	Iron and steel mills - Sidérurgie .....
Metal mines - Mines métalliques .....	Steel pipe and tube mills - Fabricques de tubes et tuyaux d'acier .....
Placer gold and gold quartz mines - Placers d'or et mines de quartz aurifère .....	Iron foundries - Fonderies de fer .....
Iron mines - Mines de fer .....	Smelting and refining - Fonte et affinage .....
Other metal mines - Autres mines métalliques .....	Metal fabricating industries (except machinery and transportation equipment industries) - Fabrication de produits en métal (sauf machines et équipement de transport) .....
Mineral fuels - Combustibles minéraux .....	Machinery industries (except electrical machinery) - Fabrication de machines (sauf électriques) .....
Coal mines - Mines de charbon .....	Transportation equipment industries - Fabrication d'équipement de transport .....
Crude petroleum and natural gas industry - Industrie du pétrole brut et du gaz naturel .....	Aircraft and aircraft parts manufacturers - Fabricants d'avions et de pièces .....
Non-metal mines (except coal mines) - Mines non métalliques (sauf mines de charbon) .....	Motor vehicle and truck body and trailer manufacturers - Fabricants de véhicules automobiles et de carrosseries de camions et remorques .....
Asbestos mines - Mines d'amiante .....	Motor vehicle parts and accessories manufacturers - Fabricants de pièces et accessoires d'automobiles .....
MANUFACTURING INDUSTRIES - INDUSTRIES MANUFACTURIÈRES .....	Railroad rolling stock industry - Fabricants de matériel ferroviaire roulant .....
Food and beverage industries - Industrie des aliments et boissons .....	Shipbuilding and repair - Construction et réparation de navires .....
Meat and poultry products industries - Industrie de la viande et de la volaille .....	Electrical products industries - Fabrication de produits électriques .....
Dairy products industry - Industrie laitière .....	Manufacturers of major appliances (electric and non-electric) - Fabricants de gros appareils (électriques ou non) .....
Flour and breakfast cereal products industry - Meunerie et fabrication de céréales de table .....	* Manufacturers of household radio and television receivers - Fabricants de radiorécepteurs et de téléviseurs ménagers .....
Feed industry - Fabrication d'aliments pour les animaux .....	* Communications equipment manufacturers - Fabricants d'équipement de télécommunication .....
Bakery products industries - Boulangerie et pâtisserie (fabrication) .....	Manufacturers of electrical industrial equipment - Fabricants d'équipement électrique industriel .....
Beverage industries - Industrie des boissons .....	Non-metallic mineral products industries - Fabrication de produits minéraux non métalliques .....
Distilleries - Distilleries .....	Cement manufacturers - Fabricants de ciment .....
Breweries - Brasseries .....	Concrete products manufacturers - Fabricants de produits en béton .....
Tobacco products industries - Industrie du tabac .....	Ready-mix concrete manufacturers - Fabricants de béton préparé .....
Rubber and plastics products industries - Industrie du caoutchouc et des produits en matière plastique .....	Petroleum and coal products industries - Fabrication de produits du pétrole et du charbon .....
Rubber products industries - Industrie des produits en caoutchouc .....	Chemical and chemical products industries - Industrie chimique .....
Leather industries - Industrie du cuir .....	
Textile industries - Industrie textile .....	
Knitting mills - Bonneterie .....	
Clothing industries - Industrie de l'habillement .....	
Wood industries - Industrie du bois .....	
Sawmills, planing mills and shingle mills - Scieries, ateliers de rabotage et usines de bardoux .....	
Veneer and plywood mills - Fabricques de placages et de contre-plaqué .....	
Furniture and fixture industries - Industrie du meuble et des articles d'ameublement .....	



TABLE 5 (cont'd)

Components of Real Domestic Product

Manufacturers of pharmaceuticals and medicines - Fabricants de produits pharmaceutiques et de médicaments .....	* Education and related services - Enseignement et services annexes .....
Paint and varnish manufacturers - Fabricants de peintures et vernis .....	Health and welfare services - Services médicaux et sociaux .....
Manufacturers of soap and cleaning compounds - Fabricants de savon et de produits de nettoyage .....	Amusement and recreation services - Divertissements et loisirs .....
Manufacturers of industrial chemicals - Fabricants de produits chimiques industriels .....	* Services to business management - Services fournis aux entreprises .....
Miscellaneous manufacturing industries - Industries manufacturières diverses .....	Personal services - Services personnels .....
<b>CONSTRUCTION INDUSTRY - BÂTIMENT ET TRAVAUX PUBLICS .....</b>	Accommodation and food services - Hébergement et restauration .....
<b>TRANSPORTATION, STORAGE AND COMMUNICATION - TRANSPORTS, ENTREPOSAGE ET COMMUNICATIONS .....</b>	<b>PUBLIC ADMINISTRATION AND DEFENCE - ADMINISTRATION PUBLIQUE ET DEFENSE ...</b>
Transportation - Transports .....	<b>SPECIAL INDUSTRY GROUPINGS - AGRÉGATS SPÉCIAUX:</b>
Air transport and services incidental to air transport - Transports aériens et services auxiliaires des transports aériens .....	Index of industrial production - Indice de la production industrielle .....
Railway transport - Transports ferroviaires .....	Real domestic product less agriculture - Produit intérieur réel sans l'agriculture .....
Bus transport, interurban and rural - Transports interurbains et ruraux par autocar .....	Goods-producing industries - Industries productrices de biens .....
Urban transit systems - Réseaux de transports urbains .....	Goods-producing industries less agriculture - Industries productrices de biens sans l'agriculture .....
Pipeline transport - Transports par pipeline .....	Service-producing industries - Industries productrices de services .....
Storage - Entreposage .....	Commercial industries - Industries commerciales .....
Grain elevators - Silos à grain .....	Commercial industries less agriculture - Industries commerciales sans l'agriculture .....
* Communication - Communications .....	Non-commercial industries - Industries non commerciales .....
<b>ELECTRIC POWER, GAS AND WATER UTILITIES - ÉNERGIE ÉLECTRIQUE, GAZ ET EAU .....</b>	Non-durable manufacturing industries - Industries manufacturières de biens non durables .....
Electric power - Énergie électrique .....	Durable manufacturing industries - Industries manufacturières de biens durables .....
Gas distribution - Distribution de gaz .....	
<b>TRADE - COMMERCE .....</b>	
<b>WHOLESALE TRADE - COMMERCE DE GROS .....</b>	
Wholesale merchants - Grossistes .....	
<b>RETAIL TRADE - COMMERCE DE DÉTAIL .....</b>	
Food stores - Magasins d'alimentation .....	
General merchandise stores - Magasins de marchandises diverses .....	
Department stores - Grands magasins .....	
Other general merchandise stores - Autres magasins de marchandises diverses .....	
Motor vehicle dealers - Détaillants en véhicules automobiles .....	
Clothing stores - Magasins de vêtements .....	
Hardware stores - quincailleries .....	
Furniture, television, radio and appliance stores - Magasins de meubles, de téléviseurs, de radios et d'appareils ménagers .....	
Drug stores - Pharmacies .....	
<b>FINANCE, INSURANCE AND REAL ESTATE - FINANCES, ASSURANCES ET AFFAIRES IMMOBILIÈRES .....</b>	
<b>COMMUNITY, BUSINESS AND PERSONAL SERVICE INDUSTRIES - SERVICES SOCIO-CULTURELS, COMMERCIAUX ET PERSONNELS .....</b>	

\*Can be allocated in total to information section.

Source: Statistics Canada, 61-005

data and that his results have not yet been subject to the testing required of most official government data. Even then it appears to have been a three-year project consuming several man-years. The main advantage for a Canadian project would be that the ground had been broken and that rough estimates for Canada could be made using Porat's allocations as crude proxy measures. In addition, similarities between the two economies might allow some of the inferences from Porat's work for the U.S. economy to also apply to Canada.

#### Other Approaches

There are certain parts of the Porat-approach which may be premature given the current availability of data. For example, it has already been noted that policy simulations with a 1971 input-output matrix may not be very relevant.

But the basic concern is the policy relevance of the entire exercise. There is little point performing such difficult calculations unless the result will in some way aid in the formulation of policy. There is no question that informational issues are extremely important, but does a national accounting framework for the information sector aid in the discovery of or solution to social problems?

The existing national accounting framework was first developed by Colin Clark and Simon Kuznets under the influence

of the ideas of Keynes. The division of output on the expenditure side into consumption, expenditure, investment expenditure, etc. was logical in that these different components had different functional determinants. A policy maker needed to know these different aggregates in order to manipulate the correct policy instruments. Even economists who disagree with the basic Keynesian ideas would probably agree that the existing disaggregation is useful for forecasting, as different components do behave differently. For example, rapid growth in GNP will not likely be sustained unless it is accompanied by similar growth in consumption, in particular the consumption of durables.

In contrast, there is no obvious way that estimates of the absolute size or the rate of growth of the information sector would be useful for policy purposes. What difference would it make if the estimate of the size of the information sector in Canada was 30 or 50 per cent or whether it was thought to be growing at a rate of three per cent or six per cent per year?

The reason is that the information sector (as defined by Porat) is a mixed bag. To quote his thesis, "Information is by nature a heterogeneous commodity. Education is unlike research and development; computer processing

differs from data communication; television is vastly different from books." [9, p. 51]. Because of the great differences between the separate components of the information sector, it is questionable whether the sector aggregate has any relevance to decision-making, given existing instruments of social and economic policy.

To give one example, Porat expended a great deal of effort allocating medical services into the information and non-information sectors. Such information may be important to the medical industry, but it is difficult to see its value once aggregated into the national accounts.

It might be argued that the importance of the exercise is to organize social priorities within the field. However, it can be doubted whether such "information accounts" are either necessary or appropriate for assigning social goals. For example, the banking sector contributes less than three per cent of national output in Canada. Does this properly reflect its importance?

Finally, there may be difficulties with the accuracy of the calculations. Besides the inevitable problems with allocations and definitions, there are also questions about the existing data on which such an exercise must be based. Two key problems are the inclusion of quality changes

and the valuation of services.

Quality changes have always been a great problem in the national accounts. If only the number of units produced or shipped are counted, then there is no allowance for quality change. But if the dollar value of production or shipments is studied, it is difficult to know whether an increase in price per unit is due to an improvement in quality or to inflation. Many information sectors are exceptionally difficult in this regard because of rapid technological change. To use the pocket calculator example, one can now purchase a far better unit at far lower price than one could five years ago. It is difficult to keep pace with such rapid changes.

There are two parts to the second problem. First, government, churches, charities, etc. do not sell their output on markets. The national accounts (in nominal terms) must assume that the value of these outputs is exactly reflected by the cost. Second, there is a great difficulty in calculating the real, constant-dollar value of the outputs of all service industries, whether or not their output is marketed. The customary solution is the "labour-input" method, in which real output is assumed to be in direct proportion to the number of man-hours used. There is therefore

no allowance for productivity.

Fortunately, the method has been refined so that productivity increases are imputed. The results are benchmarked every few years using the value-added estimates of the Census of Manufacturers. However, there are many areas (such as the government sector) where the value-added concept is not meaningful, so that the valuation problem of service industries remains.

An alternative to this macroeconomic approach for the entire information sector is a microeconomic approach directed at specific policy issues. This would likely involve the construction of new data series but there would be no need to make all the arbitrary allocations required for a Porat-type exercise. The Committee for Scientific and Technological Policy does suggest some microeconomic studies on such topics as banking (electronic fund transfer systems), retailing goods and services, health services, the employment of women in the information sector and the consumer use of information facilities.

In Canada, a first step toward microeconomic, policy-oriented studies would be the compilation of certain kinds of data. For example, Statistics Canada data on the advertising industry are only available to 1975 and the

coverage of the survey is limited. Also, as pointed out by the Computer/Communications Secretariat in The Growth of Computer/Communications in Canada [2], Statistics Canada estimates of the computer services industry are only available to 1974 (1975 figures will be released shortly). This is a significant time lag in such a fast growing area. In addition, there is little information on the nature of user costs.

This approach might also entail careful study of the quality changes in such industries as computers, calculators and telecommunications equipment. This would be a first step to the inclusion of such quality differentials in the national accounts.

To summarize this chapter, Porat-type calculations are feasible for Canada. However, the likely degree of arbitrariness in the assumptions that would be required calls into question the potential value of such an effort. Difficulties with valuations of quality changes and services may also detract from the value of the project. It is suggested such a macroeconomic approach might be premature, given the limitations of existing data.

An alternative microeconomic approach might be used to focus on specific issues within the information

economy. This would include improvements in the statistical base, an important first step to a national accounting approach as outlined by Porat.



#### IV. SUMMARY AND CONCLUSIONS

This report first looked at some of the contributions to the existing literature. All of the articles concluded that the information sector was very important, although there was no consensus as to whether competitive or co-operative economic systems were more appropriate to its operation. The contribution most closely studied was a thesis by Porat, in which an information sector was built into the national accounts of the United States.

The report then discussed the Porat approach as it would likely be applied in the Canadian context. An alternative microeconomic approach based on individual consideration of particular topics within the information sector was also advanced.

The conclusion of the report is that the identification, conceptualization and measurement of the information sector within the national economy in Canada is, at this time, a formidable task of uncertain dimensions and purpose. It is recommended that a research program directed toward the information economy first grapple with the basic conceptual issues and define overall goals and objectives. This approach could also lay the foundation for future macroeconomic work on the information sector, either within or outside a national accounting framework.

Selected Bibliography

- [1] Bell, Daniel, The Coming of Post Industrial Society, Basic Books, New York, 1973.
- [2] Computer/Communications Secretariat, The Growth of Computer/Communications in Canada, Draft for Discussion, 1976.
- [3] Drucker, Peter, The Age of Discontinuity, Harper and Row, New York, 1968.
- [4] Hayek, F.A., "The Uses of Knowledge in Society", American Economic Review, Vol. 35, No.4, September, 1945. pp.519-530.
- [5] Hirschleiffer, J. "Where Are We in the Theory of Information?" American Economic Review, Vol. 63, No.2, May 1973, pp.31-39.
- [6] Machlup, Fritz, The Production and Distribution of Knowledge in the United States, Princeton University Press, Princeton, New Jersey, 1962.
- [7] Organization for Economic Co-Operation and Development, Committee for Scientific and Technological Policy, Proposed Mandate of the Expert Group in Economic Analysis of Information Activities and the Role of Electronics, Telecommunications and Related Technologies, 1977.
- [8] Parker, E.B., "Social Implications of Computer/Telecoms Systems", Telecommunications Policy, December, 1976. pp.3-20.
- [9] Porat, Marc, The Information Economy, Institute for Communication Research, Stanford University, Report No.27, 1976.
- [10] Porat, Marc, Building a Primary and Secondary Information Sector" A National Income Accounts Manual, Submission by the United States Delegation to the Working Party on Information, Computers and Communications Policy, Organization of Economic Cooperation and Development, June 1976.
- [11] Stigler, George, "The Economics of Information", Journal of Political Economy, Vol.69, June 1961.

