THE INFORMATION REVOLUTION

SOME POLICY PERCEPTIONS

M.R. Prentis
Director-General Telecommunications Economics

Department of Communications
Government of Canada

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The technological revolution based on computer communications and microelectronics has already taken place. The economics of production in all of the industrialized world will, in a few years, be based as much on the use of information labor and information capital as on the traditional non-information inputs. In the United States, it has been estimated that information, in one form or another, already represents about 50 per cent of the Gross National Product, and Canada is not far behind.(1)

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(1) The concept of "information" as a major element in the production process is relatively recent. The value of the product of a highly skilled professional such as a doctor or an engineer is based almost exclusively on his knowledge. A blue-collar worker, on the other hand, embodies little "information" in his output; his product is a result of the use of "non-information" labor and the capital equipment he has used, such as construction machinery, a welding torch or a lathe. Computers and other electronic equipment are changing the nature of the production process. Such items already embody a great deal of "information", both in their complex design and in their use of software programs. The people who use the new technology contribute "information" rather than repetitious skills. These people are managers, technologists, software specialists, office machine operators, air traffic controllers and countless other types of information creators or users. Tomorrow, the microprocessor and the electronic chip will give further impetus to the replacement of non-information activities by information activities. This is the electronic revolution, the start of the new information society.

The effects of the revolution can be readily seen in point-of-sale terminals in department stores, in automated check-outs in supermarkets and gas stations, in automated cash dispensers in banks, in low-cost pocket calculators and in computerized billing. There are other aspects that are not yet perhaps as obvious to the Canadian observer: the fully-automated warehouse connected to the automated check-outs in supermarkets and other retail centres; computer-aided medical diagnosis designed by world-famous doctors; new ways of helping those with physical or learning handicaps; a range of new capabilities in "office automation" led by Xerox and IBM; and new services into the home, such as those provided by videotex systems in a few scattered locations in Europe and the United States.

These applications of the new technology, which make increasing use of microprocessors, are linked together, when necessary, not only by traditional communications systems such as terrestrial communications networks, but increasingly by use of satellites, fibre optics and lasers. Widespread use of low-cost earth stations will accelerate the rate at which use of the new technology will spread.

These advances have been produced by rapid developments in both computing and communications technologies. Successive order-of-magnitude reductions in costs and physical size of components have led to an ever-increasing range of applications and penetration of use throughout industry and society. This phenomenon is occurring in all industrialized nations and is spreading to developing countries.

The gains to be made from use of the technology are now recognized as extremely large. The economic advantages are believed to be of such magnitude as to justify use of the term "revolutionary", and the changes in production methods are also of such a nature as to be regarded as revolutionary. But revolutions characteristically have two phases. There is the initial phase, when the old concepts yield supremacy to the new, and there is the implementation phase, during which the social and economic order takes on a new configuration within which the revolutionary concepts can develop to the full. This pattern is true of political revolutions, and it was true of the industrial revolution of the 19th century. In the world of today the speed of communications has accelerated the rate of change, but the pattern is the same. The technology of the information economy is now universally accepted, conceptually, as the basis of the new economic order. Phase I of the information revolution has been achieved. In some countries, notably the United States and Japan, Phase II is already well under way. In Canada, the communications infrastructure is one of the best in the world, and is already being used, in some industrial sectors, to implement the technology.

But we are, relatively speaking, only at the start of the revolution. Altogether, the inevitable change in production methods and in economi and corporate organization will be every bit as fundamental as the changes associated with the earlier industrial revolution. The impacts of that revolution on political, social and economic structures were profound and lasting. World trade structures and the international centres of economic power were in large part determined for a century or more by the speed with

which nations adopted the new technology; the parliamentary systems of Western Europe were obliged to respond institutionally and broaden the democratic base of their communities. The emergence of the great empires of the 19th century was based on the concentration of economic power in the imperial capitals. Today's new electronic revolution could create economic and political pressures of a comparable strength. Here in Canada, we are today faced by a situation full of threats and opportunities as we enter into Phase II, the implementation phase, of our information revolution.

The cost advantages of the new technology are such that no country can afford to delay its use. Rather, there are compelling reasons for any country to encourage maximum possible use of the technology, in order to maintain its national economic and cultural identity and international competitiveness. Country after country within the recent past has adopted policies directed at fostering the growth of this use in all sectors in their respective economies. In the United Kingdom, political awareness has developed rapidly in recent months. In December of last year, the Prime Minister announced a range of new policy initiatives, including an increase of £100 million in aid to the development of the micro-chip industry, raising the total to £400 million, while funds available to the National Enterprise Board were increased from £1 billion to about £3 billion. The program includes support to manufacturing (particularly that related to silicon chips), increased emphasis on training and education (particularly of technicians, programmers and systems analysts), on government procurement and the launching of a major awareness campaign to promote the incorporation

of the new technologies into government and business activities. In addition, increased attention is being given to social impacts (particularly on employment) and the Central Policy Review Staff is considering ways of improving policy co-ordination.

In France, political awareness also escalated rapidly last year, sparked by the report "L'informatisation de la société". New initiatives were announced by the French President in December. The objective is to catch up and become a world leader in production for, and use of, the technologies. Some FF2¼ billion have been allocated to the program. Increased emphasis is being placed on use of the new technologies and a special agency has been established to promote applications development. The program also includes increased funding for training and education and increased emphasis on standards (which serves to promote development of domestic industry). In addition, the President established an interagency task force to advise on the issues raised by transborder data flow; its report is scheduled to be ready in about three months. The French are worried about the growing use of U.S.-located data banks and the threat this creates to national sovereignty.

In Japan, a co-ordinated push is continuing. Japan's policies have four major thrusts: promotion of the computer industry; promotion of the data processing industry; development of social systems; and the "establishment of a foundation for the information age".

In all industrialized nations, similar patterns emerge. There are growing commitments, on the one hand, to promote manufacturing and new uses of information technologies, and, on the other, to assess, and, where necessary, to counter potential negative impacts. The range of impacts

- economic, social, legal, cultural and political - characteristically experienced by countries in the midst of this revolution (other than the United States and Japan), have strong similarities. A significant element is the migration of management decision-making and computer programming activities which has, in the absence of measures to the contrary, tended to occur just as easily across national borders as within them. Such a transfer leads to a further loss of autonomy on the part of subsidiaries of the large multinationals, although it tends to affect national enterprises also in a comparable way as they become more closely integrated with foreign suppliers. Beyond the economic considerations are questions of national security, the potential for crime and sabotage, privacy and political sovereignty. The location of the bulk of a country's data storage and processing determines to a large extent the degree of national independence that a country can enjoy.

A second group of problems arising from the information revolution is associated with employment. Use of the technology means very large gains in labor productivity, but it brings with it the problem of the unemployment which might be directly caused by the increased productivity of the new production process. This problem is exacerbated by the restricted mobility of displaced workers. A second type of unemployment is the "disemployment" caused by a permanent change in the type of skills required by the system; the case of the Swiss watchmakers and the Swiss response is illustrative. New employment opportunities require skills which cannot be readily acquired by the disemployed. Labor unions, such as those representing typesetters and post office workers, have drawn attention to this problem in Canada. A third type

of job loss is regional displacement arising from migration of the data-processing function; this is particularly important when the migration crosses national borders.

Unfortunately, some of the social impacts of the information revolution could be undesirable in the absence of remedial policies. Those that have received most attention to date are related to personal privacy. The potential for widespread computer crime are enormous. Another aspect of social concern relates to the impact of computers on human relations. Many feel that computer systems are de-humanizing: they point to examples of dunning notices for the payment of incorrect bills, to the difficulties experienced in getting corrections made and to the inflexibilities built into the systems. They are concerned about alienation and the decreased opportunities available for social contact. Interactive television will likely accentuate this problem and stimulate changes in our sense of community.

The cultural impacts arising from use of today's communications technology are pervasive. Widespread distribution of domestic television signals through the use of cable is an important unifying force, but the extensive distribution of foreign programming by the same means may be perceived as a cultural threat. In Canada, use of satellites to beam Canadian programming from the urban south into remote communities in the north could be destructive of indigenous cultures in those areas. Use of the technology for educational purposes can be seen, on the one hand, as advantageous, but it too could be seen as a cultural threat, especially in a federal system, where education is constitutionally within provincial jurisdiction.

The advent of the direct broadcasting satellite, or DBS, widens the problem. In the United Nations, debate continues on the conflict between a country's right not to be "broadcast to" without its consent and the principle of the free flow of information. Moreover, the use of earth stations by companies seeking to access data banks abroad or to send messages back and forth across countries conflicts with the principle of the national postal monopoly. International theft of signals for resale undermines copyright laws, which become unenforceable, and rob the individual whose property rights are violated. These are matters of both national and international policy concern in the field of communications but they command little attention in Canada outside the small group of experts directly concerned.

The integrated policies adopted by other countries for success in the implementation phase appear to include measures to promote:

- a strong telecommunications and electronic equipment manufacturing industry (associated in many cases with a strong computer manufacturing industry);
- a strong development of a healthy micro-electronics industry;
- a strong domestic market for the products of these industries (national telecommunications, defence procurement, other public procurement, including Crown corporations and promotion of domestic purchases by other goods and service industries);

- firm national control over telecommunications networks and the use of standards, protocols tariffs and rate structures to advance national interests, consistent with multilateral trade agreements;
- effective education, training and retraining programs for the development of suitably skilled labor;
- an assessment of social impacts (including the privacy question) and the development of appropriate policies;
- an assessment of the economic impacts and the development of appropriate policies;
- an assessment of new legal requirements (for example, related to privacy, liability, computer crime, facilitation of trade documentation, etc);
- optimum location of industry;
- retention of domestic storage and processing of information;
- co-ordinated government/private sector, well financed programs to foster the repid introduction of new interactive TV services;
- financial and taxation measures to promote the use of the new technologies and to strengthen domestic suppliers of goods and services;
- measures to promote new applications in areas such as electronic mail, electronic funds transfer, the office of the future and in the provision of improved social systems;
- education and other measures to increase citizen awareness of the benefits to be derived from the new technology, in order to provide a basis for the "new information age."

Such various individual measures, taken together, create a policy package designed to maintain national economic strength in the highly competitive new world information economy and in the face of new and significant areas of competition, to preserve a viable balance of payments position, to preserve national sovereignty and to avoid potential negative impacts on society and on the individual.

The development of policy in Canada does not yet resemble that observed in other countries, while the technology continues to spread. Already there are fears, such as those recently expressed in the Clyne report, that our own Phase II will result in the implementation of a social and economic order imposed from without, rather than one which reflects the cultural, linguistic and political realities on which our country was founded. Because Canada does not yet have any firm plans or policies for strengthening its economic and social system to meet these challenges, the consequences for Canada of other countries' policy initiatives could be severe. Canada's economic, social and cultural framework is such that it is already vulnerable to foreign influences. The branch-plant structure of industry is pervasive in manufacturing. The essence of this system is that the power of economic decision-making resides abroad. The new information systems, through the working of economic pressures, reinforce the tendency to centralization of decision-making which could lead to a growing extension of the branch-plant structure to other sectors of the economy.

But Canada possesses areas of strength which can be built upon to meet the emerging challenges. Among these is a highly-competitive electronics manufacturing sector of world scale, developed by private enterprise in close association with a major telecommunications carrier - a relationship which in Europe and other parts of the world depends on government protection for security. The Canadian telecommunications carrier system, which is almost entirely Canadian-owned, is extremely efficient. This system is available not only as vital infrastructure for Canadian industry and to serve social and cultural ends, but also as a tool for use in the development of further electronics-based manufacturing and service industries. The use of standards, protocols and rate and tariff structures to promote the development of integrated systems is as available to Canadian policy-makers as it is to those in other countries where the system is state-owned. The cable television system which now covers some 80 per cent of urban Canada is also Canadian-owned, but its procurement activity does not yet create the assured markets which characterize the telephone industry. The Canadian banking system, with its networks of branches, can likewise be an important factor in the formulation of a comprehensive policy framework, as can the major transportation systems. Provincially controlled utilities could also be significant.

Recently, there has been an increase in the strength of some of Canada's data-processing, software and carrier operations; some individual enterprises have taken steps to develop their capacity to provide service by forming close operational or corporate links, and thus have built a capacity to provide integrated services based on the use of both computers

and telecommunications. Some Canadian computer service bureaus are competing successfully in international markets, and are fully competitive in the domestic market. These pioneering efforts are an important example of what Canadian industry is in fact capable of doing.

In summary, Canada at present enjoys:

- A telecommunications carrier utility industry largely under Canadian control as a gateway to our market;
- A vertically integrated and, to this point, relatively secure world scale manufacturing and R&D enterprise;
- A will to innovate and to risk capital in our record carrier, cable distribution and telephone industries;
- An under-exploited capability in our CATV, record carrier and Crown corporate enterprises to provide a market for Canadian producers;
- A major banking industry, already well advanced in the use of the new information technologies, with existing networks of branches;

- A growing information processing industry which is showing enterprise and willingness to undertake risk in exploiting the technology;
- A dynamic research activity and capability in the Department of Communications promoting industrial instruments to transform technology into products and services.

This base of strength is of crucial importance to the required integrated policy framework.

The government's Board of Economic Development Ministers recently took some major steps towards building an environment in which the Canadian electronics industry will be better able to contribute to Canada's national strength. It has been announced, first, that the government will make available $50 million in assistance to electronic firms over the next three years, in part to help electronics firms carry out large-scale projects which will increase production and R&D. Specifically, it will assist projects which will provide significant economic benefits to the country and which would not otherwise be undertaken in Canada.

The resources being made available will also be used to encourage the increased use and production of microelectronic devices (integrated circuits) in Canada. Microelectronics is the key technology which will determine the competitiveness of electronic industries around the world. The output of electronics firms in turn is becoming critical to improvements in productivity in all of industry.

The specifics of the microelectronics measures are expected to include:

- an education program to make potential users aware of the benefits of microelectronics;
- promotion of the use of microprocessors ("computers on a chip") and other microelectronic devices in existing and new products;
- funds for studies leading to the incorporation of custom-integrated circuits in production processes and products;
- incentives to encourage the establishment of independent design and custom-integrated circuit production houses in Canada;
- establishment of a federally funded pilot production facility for integrated circuits.

The second part of the policy is the promotion of a strong Canadian capability in the high-technology, rapid-growth area of satellites. In the past, satellites needed by Canada have had to be purchased from firms outside the country with only some of the sub-contract work done by Canadian companies. Telesat Canada, this country's domestic satellite communications carrier, is now in the process of purchasing two new satellites. The government has taken money from its Economic Development Budget to make an offer of about $20 million to Telesat Canada, to assist Telesat's Canadian supplier to "tool up" to a higher capacity. With this step, the government is assuring a market base from which a developing Canadian company can

pursue export sales in a rapidly expanding world market-place for satellites and related hardware.

The satellite effort is the latest in a series of recent measures by the government in the telecommunications field. Last October, the government commenced a three-year $20 million program of major expansion and upgrading of the Department of Communications (DOC) Space Research Centre near Ottawa. In January this year, the government turned over to the City of Vancouver a $2.5 million mobile police communications system developed on an experimental basis for DOC. In February, Minister of Communications Jeanne Sauvé signed a five-year $4.8 million agreement with the Canadian Telecommunication Carriers Association for a major field trial of fibre-optics technology (the carrying of cable TV, phone and other services through highly-efficient glass strands) in the town of Elie, Manitoba. Last month, the government committed $9 million over a four-year period for the development of Telidon. Telidon is a new technique that will eventually give anyone with a television set, with the help of a cheap add-on device not unlike a pocket calculator, a wide range of capabilities such as information retrieval, text editing, data processing, electronic mail, electronic funds transfer and computer-aided instruction.

A third part of the policy -- use of government purchasing to enhance the performance of the electronics industry in Canada -- will involve the government taking new factors into account in its purchasing; thus, as part of the national development policy for the electronics industry, the

government was proposing to use its buying power to promote Canadian industrial development. In implementing these measures, special consideration will be given to assist the electronics industry.

These steps, of major importance in themselves, should be regarded as an important beginning in developing an integrated approach to the immense problems posed by the information revolution. Beyond them, however, it may also be necessary to develop a further policies covering:

- measures for the protection of political and economic sovereignty, such as control over the location of data storage and processing;
- measures to retain Canadian control over the use of the technology in communications;
- measures to promote the provision of low cost innovative data communications services to Canadian business so as to enhance its international competitiveness and to be conducive to the development of a strong Canadian data processing industry;
- measures to develop the telecommunications infrastructure and provision of information services to homes, which in turn will provide opportunities for the development of related manufacturing industries;

- further initiatives to promote use of the technology in manufacturing, transportation, resource and service industries;
- measures to encourage development of software, data banks and new information processing services;
- measures to promote manufacture of selected electronic products;
- measures to promote manufacture of capital goods based on, and embodying, microprocessing;
- measures to offset the transfer of key decision-making and other functions associated with use of the technology;
- measures directed at ensuring that Canadians are equipped with the skills necessary for employment in the information society;
- measures to protect privacy, reduce vulnerability and protect cultural sovereignty;
- legal measures to cover, for example, protection of software and data banks, computer crime, liability in new systems such as electronic funds transfer, facilitation of trade documentation, etc.

Many of these matters bear upon areas of provincial responsibility, and there is, accordingly, a pressing need to ensure that the governments of the provinces are aware of the contribution they might make, by working within their own jurisdictions, to the safeguarding of Canada's economic, political and cultural sovereignty.

The world today is in the midst of a revolution which will bring about a new economic order and a new society. Governments everywhere are implementing policies designed to reinforce the pressures already apparent in attempts to gain international competitive advantage. If Canada fails to move in its own interest, there will be inferences, based on our past history, about our will to retain control over the course of the information revolution as it unfolds within our borders. Given our basic strengths, however, and building on the foundations already laid, we can by the right approach to policy demonstrate to the world that the information revolution represents one of the greatest opportunities this country has ever seen.