TELECOMMISSION

Study 2(i)

Study of Institutional Structure of Telephone Operating Industries

The Department of Communications

TELECOMMISSION

STUDY 2 (i)

STUDY OF INSTITUTIONAL STRUCTURE OF TELEPHONE OPERATING INDUSTRIES

SUBMITTED BY

CN/CP TELECOMMUNICATIONS

TRANS-CANADA TELEPHONE SYSTEM

THE TELEPHONE ASSOCIATION OF CANADA

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CN/CP TELECOMMUNICATIONS

TRANS-CANADA TELEPHONE SYSTEM

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TELECOMMISSION STUDY 2 (i)

PART I

INTRODUCTION

Canada's telecommunications needs are served by a comprehensive network of communications systems built by the country's two telecommunications carrier groups: the telephone companies and the telegraph companies.

This Paper documents the development of these systems, tracing briefly their history and organization, comparing the service they provide with that of other countries and describing their achievements and contributions to the growth of Canada.

It attempts to give some impression of the uniqueness of the problems faced by the builders of Canada's national network, and the magnitude of the job of co-ordinating the efforts of the close to 1700 systems whose facilities constitute the total network.

It describes the degree of co-operation achieved by CNT and CPT in constantly improving their ability to provide telegraph service to the nation at minimum total cost, and to expand their competitive strength in the total telecommunications field.

The builders and operators of Canada's telecommunications systems overcame many obstacles in their 124-year history, and although the competitive nature of the two major carrier groups is apparent, each has recognized a need to rely on the other in the interest of ensuring that this vast, thinly-populated country has one of the world's finest networks.

Today, although the problems are much more complex and occur far more frequently, the formula for resolution is still the same: to furnish whatever is required to ensure that Canadians have the best possible telecommunications services at the lowest possible cost.

PART II
SECTION 1

HISTORY

The present development of the telecommunications art in Canada is simply the latest stage in the continuing evolution of man's ability to transmit intelligence. It probably all began with sign language, progressed through spoken and written communication, employed drums, runners, flags and similar devices to bridge distances, finally arriving at the first use of telecommunications, the telegraph.

Probably no industry better illustrates the continuing urge of man to build better. Having arrived at a system that transmitted written words with the speed of light, he continually worked to improve it. Experimenting to develop a telegraph carrier and, as well, a means of helping the deaf, Alexander Graham Bell invented the telephone.

Even though man could speak or write to practically all corners of the world, he still continued to invent and innovate so that today, pictures of events can be broadcast instantly, and all forms of data transmitted at remarkable speeds.

Mankind is on the threshold of -- if not already deeply involved in -- a dramatic "information explosion", presenting him with an even greater challenge to expand his communications capability.

The history of the evolution of telecommunications in Canada stems from the development of the Telegraph and Telephone industries, a brief history of which is individually outlined in this section.

SECTION 2

HISTORY OF THE TELEGRAPH INDUSTRY

The word "telegraph" is composed of two Greek words, "tele", meaning "at a distance" and "grapho", which means "I write". This is indicative of the primary endeavour of CN/CP and its predecessors in the telecommunications field, namely the conveyance of information over distances.

On December 19, 1846, two years after the first public message was transmitted in the United States and approximately 30 years before the advent of the telephone, the first telegram in Canada was sent from Toronto City Hall by the Mayor of that city to his counterpart in Hamilton over the lines of Toronto-Hamilton-Niagara and St. Catharines Electrical Magnetic Telegraph Company. This initial Canadian line was 89 miles long, and at the outset carried an average of 10 to 12 messages a day.

The formation and incorporation of public telegraph companies took place rapidly in Canada following this historical event, and thus followed the pattern of many fledging industries. Companies were formed to serve small areas, and as districts began to overlap, amalgamations ensued.

The first large scale telegraph company, founded in 1847, was known as the Montreal Telegraph Company. In 1871, the Dominion Telegraph Company was incorporated and competed in most of eastern Canada with the Montreal Telegraph Company. By 1881, Western Union's Canadian subsidiary, the Great Northwestern Telegraph Company, secured long-term leases of the

Montreal and Dominion Telegraph Companies. From the beginning of telegraph service in Canada, Western Union, under its own name, served areas later to be known as British Columbia and the Maritime provinces.

To counter the American domination of the telegraph business, the Federal Government granted commercial telecommunications rights to the Canadian railways: Canadian Pacific Railway on February 16, 1881, Canadian Northern Railway in 1902 and Grand Trunk Pacific in 1906. In 1915, the Canadian Northern took control of the Great Northwestern Telegraph Company and its leases. In the latter part of 1920, the Canadian government took over the Canadian Northern and Grand Trunk Pacific Railways. Their respective telegraph companies were also amalgamated and on January 1, 1921, Canadian National Telegraphs was born and charged with the responsibility of providing all the necessary railway communications required by the newly-formed rail system as well as a public telegraph service. In 1924 and 1929, respectively, Western Union abandoned its operations in British Columbia and the Maritimes to the Canadian National Telegraphs Company which then provided rail and public telegraph service across the entire country.

At the end of World War II, the Department of Transport became heir to a major trunk line that connected the Alberta Government Telephones' network on the south with Alaska in the north. This was the famous 1,700 mile Northwest Communications System constructed by the United States Government in 1943 along the general route of the Alaska Highway as part of the defense system of North America. In 1946, the Department of Transport, on behalf of the Canadian Government, entrusted this system to Canadian National to maintain, operate and expand.

During the 1950's, the Canadian National also acquired the properties of the Yukon Telephone Company and in the 1960's the Yellowknife, Hay River and Fort Smith Telephone Companies which were the last privately owned companies in this area of the Northwest Territories.

In 1949, when Newfoundland became Canada's tenth province, the government entrusted the communications operation of the services previously provided by the Newfoundland Posts and Telegraphs to Canadian National. These included public telegraph service, local exchange and toll telephone service to part of the Island and communication services to several major U.S. military installations established during World War II. Prior to 1949, CPT interconnected via Commercial Cable Company with Newfoundland Posts and Telegraphs for the handling of telegrams to the rest of Canada.

Before World War II, CN and CP primarily provided public telegraph message service and acted as communications departments of the parent railways. The end of World War II marked the beginning of large industrial growth, creating a rapidly expanding need for private wire services. It was at this time that the scope of CN and CP operations in the telecommunications industry began to enlarge.

Because of the increasing competitive pressure from the telephone companies, Canadian Pacific and Canadian National pooled their operations in private wire services on August 1, 1947. The "pooling" arrangement was so successful that it has since been gradually expanded to include other service areas such as Telex and Broadband, and in the construction of a jointly-owned transcontinental microwave system.

Until 1968, the only "service" provided by CPT and CNT which was not on a "joint Basis" was the telegram. Competition in this area remained very keen. However, the constant increase in the costs associated with message handling made it mandatory that steps be taken to eliminate the duplication of effort and costs. Out of this decision evolved the Reciprocal Withdrawal Program in the message handling field. Since March 15, 1968, Canadian Pacific has withdrawn from 43 cities, and Canadian National from 34. This procedure, along with the complete interchange of traffic between the two systems, actually places the public telegraph service in the same position with respect to the two companies as if it were joint, but with each company retaining its traditional share of the business.

This process of merging of CN and CP Telecommunications has strengthened their competitive efforts within the telecommunications industry and will become more effective with further refinements. Individually, CN Telegraphs and CP Telecommunications have grown over the years with the Canadian economy, and collectively will play an increasingly important role in the development of the country. They have consistently demonstrated their initiative in the development of new services for communications, such as Telex in 1964 and Broadband Service in 1967, and welcome the challenges of the future to meet the needs of business and the public at large for more advanced and greatly expanded telecommunications services at fair and reasonable prices.

SECTION 3

HISTORY OF THE TELEPHONE INDUSTRY

With the invention of the telephone in 1874, the foundations of today's telephone companies were laid. One of the early significant uses of the telephone was for the collection and distribution of telegraph messages. Telegraph companies, recognizing this advantage to their business, operated telephone systems in Canada for a short time. Some of these were Western Union, Dominion Telegraph Company, and the Montreal Telegraph Company.

The first telephones to be placed in service in Canada were leased in pairs for use on private lines erected by the lessors. In fact, until 1878, when the first telephone exchange in Canada was opened at Hamilton, Ontario, this was the only means of providing telephone service to Canadians. Telephones were leased from Professor Melville Bell or his agents, and the first such instruments were leased by Mr. Bell to Prime Minister Alexander MacKenzie in 1877. The limitations of such a method soon led to the invention of the switchboard, leading to the development of the switched network, as we know it today.

The formation of the present major telephone companies in Canada began in 1880, with the establishment of The Bell Telephone Company of Canada. It set about to unify the provision of telephone service in Canada, presumably along the lines that had been followed in the U.S., although these had not assumed their final form until 1885 to 1890.

In 1880, Bell acquired the telephone licences and plant of:

- Dominion Telegraph Company of Canada
- Montreal Telegraph Co.
- The London Telegraph and Telephone Company
- The Hamilton Telephone Company
- The Canadian District Telegraph Company (Limited)
- Windsor, Ontario, telephone exchange
- Quebec telephone exchange

In acquiring the telephone operations of the telegraph companies, arrangements were made whereby telegrams could still be passed by telephone where telegraph facilities were not available. Some telephone companies still collect telegram charges, remitting to the telegraph companies.

In 1881, Bell acquired interests in all of the Canadian provinces as they exist at the present time, except Newfoundland. In British Columbia, the interest was by the exercise of licensing rights for the use of telephone rather than by the purchase of plant. An obstacle to expressing a deeper interest in British Columbia was the construction costs expected in the mountains.

A variety of circumstances resulted in Canada developing differently from the U.S. Vast distances, difficult to bridge economically, and initially impossible to bridge technically, caused the creation of many small "local" companies, sometimes in competition with The Bell Telephone Company.

In the Prairies, governments could see a real need for rural service but the costs could not be economically supported by private enterprise. As well, there was a strong sentiment among the new settlers for public or co-operative ownership of utilities and marketing services.

The result of these circumstances was that Bell sold its interests in all the provinces except Ontario and Quebec during the period 1885-1910. These interests were acquired by the provincial governments in the Prairie provinces and by investor-owned companies in the Maritimes.

It should not be assumed that the companies referred to here were the only companies existing. In most, and probably all provinces, many independent telephone companies were organized, and many still exist today. There are approximately 900 in Saskatchewan, close to 1700 in Canada. Competing telephone companies also kept appearing, and history provides much information illustrating the public need for regulated, monopolistic provision of public telephone service.

Thus, it evolved that major companies became responsible for the provision of total facilities in their areas, and these areas grew through mergers with and acquisitions of other companies. In this way, by connecting agreements with neighbouring companies, and finally through the connecting agreement of the Trans-Canada Telephone System (1931), the telephone companies met the need for wider service, culminating in complete national service with interconnections to practically all countries in the world.

The telephone utility was born in competition. The late 1880's and early 1900's saw telephone companies competing with each other. Subscriber service suffered, and it soon became obvious that the public could not be well and economically served by competing telephone companies. A statement of the time, "double bill or half service", illustrates the situation.

Competing companies could not survive. Inevitably one failed, to be bought up by the other. Competition was expressed through price cutting, which left neither company with the resources to expand and improve its service. Once one company became firmly entrenched, new competition was virtually impossible.

Thus, the public telephone business naturally became a monopoly, and public regulatory processes were developed to provide those controls that adequate protection of the public interest requires.

For somewhat similar reasons, the large telephone companies became larger. The degree of co-ordination and uniformity required to develop an efficient system led to mergers and acquisitions of non-competing companies. Small companies found it difficult to finance modernization and improvement. They were acquired by larger companies with the resources and the intent to provide modernization to meet the public need.

This process of evolution continues today because the skilled manpower combined with the financial strength of the telephone companies are necessary to meet the evolving telecommunications need of Canada.

A particular feature of the telecommunications business in Canada is the almost universal use of flat local service rates by the telephone companies. In other countries, local rates are substantially measured. Discussion of this feature of Canada telephony will be covered in Telecommission Study 7 (ab).

PART III

ORGANIZATION

CN/CP TELECOMMUNICATIONS

CN/CP Telecommunications provide throughout Canada a full range of telecommunications services, except public telephone service, in keeping with rights granted under the Canadian Pacific's charter and the Canadian National Railway Act. In this respect, the Canadian Pacific and Canadian National Railways' involvement in telecommunications differs from that of most railroads, whose primary concern is the provision of communications for railroad operations. CN/CP Telecommunications represents a joint undertaking by the telecommunications departments of the parent railroads as a telecommunications carrier.

In addition, CN Telecommunications has the exclusive responsibility for public telephone service in certain areas of Newfoundland, and of the Northwest Territories and Yukon.

As departments of Canadian Pacific and Canadian National Railways, CN/CP Telecommunications are responsible to the parent organizations for provision of telecommunications services to their customers and for the maintenance of a satisfactory level of earnings.

Within each company, the telecommunications departments are treated as separate entities. They do not carry out or arrange for their own financing for new capital, but compete with other departments within the corporate structure for capital allotments. The amount of capital made available is dependent on their earnings potential and availability of capital

from the corporate body. In practice, however, the only limiting factor is the maintenance of an adequate rate of return.

While the Canadian National and Canadian Pacific Telecommunications are integral parts of their respective rail organizations, charges for service provided to and obtained from other departments of the parent companies and company subsidiaries are assessed at commercial tariffs. Each has access to a number of corporate services for which they are billed according to use made. Such services which are available to all departments include personnel, stores, medical, accounting, finance, transportation, law, investigation and public relations.

SHARING REVENUES AND EXPENSES

Prior to 1947, Canadian National and Canadian Pacific Telecommunications operated as competing carriers. Since that time, competitive pressures from the telephone companies have caused Canadian Pacific and Canadian National to "pool" their resources and operate as a joint enterprise. "Pooling" was initially limited to private line services. The underlying principle established at that time was that there should be equal contributions in terms of capital investments and operating costs, in return for which all revenues would be shared equally. There was, and still is, no actual inter-company accounting of operating expenses for such services, it being left to individual initiative to maintain the lowest level possible. These principles have subsequently been extended by means of a program of plant amalgamation, so that by 1974 there will be no duplication of terminal plant except in Vancouver, Winnipeg, Toronto and Montreal. This is being accomplished by the assignment of responsibility by area, with the aforementioned cities being excluded, to enable

a balancing of effort and to protect service reliability, since installations in these four locations are primary regional distribution centres. The diversity of plant at these locations minimizes the possibility of large-scale interruptions to service.

Since services are equally shared, a comprehensive set of plant records are maintained for monitoring each company's plant contributions to the pooled effort. A basic assumption is made that if the plant contribution is equal, the maintenance offered by each company will also be approximately equal. Regular reviews are made of each company's contribution and construction plans are adjusted to minimize discrepancies.

Variations of these principles have been applied in other service areas in respect to major switching and transmission systems. Agreements have been reached which provide for joint ownership of Telex and Broadband switching equipment, and microwave and coaxial cable transmission systems. The maintenance and operation of switching equipment is included in the responsibility allocations. However, maintenance and operating expenses of jointly-owned transmission systems are shared equally, to avoid disparities in cost due to geographic locations.

Similarly, area responsibilities have been assigned for the provision of Public Telegraph Service. In each area, one company is responsible for all Public Telegraph Service and, in order to avoid accounting complexities, retains all revenue originating from that location. There is no sharing of operating and delivery expenses beyond the sharing of responsibility for interconnecting lines.

ORGANIZATION

Within the pooling arrangement each company operates as a separate entity, administratively, operationally and financially. Canadian Pacific is operated from a System headquarters at Montreal, with four regional offices located at Vancouver, Winnipeg, Toronto and Montreal. Canadian National headquarters are at Toronto, with two regional offices at Toronto and Edmonton. Regional operations are further subdivided into four operating districts, with headquarters at Vancouver, Edmonton, Dawson Creek, Winnipeg in the west, and Toronto, Montreal, Moncton and St. John's in the east. Each department reports through a General Manager to its respective rail organization at an executive level. Headquarters operations are responsible for such functions as marketing, engineering, planning, personnel, system accounting and for supervision of operations. Operations are the direct responsibility of the Regional Managers and their supporting staffs.

At this time Canadian National/Canadian Pacific Telecommunications employ approximately 6,600 people, of whom approximately 15 percent perform management and supervisory functions, 12 percent are non-scheduled clerical staff and 73 percent are employed in jobs of a technical nature. All of the latter are assigned to the regions, and are members of either the Canadian Telecommunications Union or Transportation Communication Employees Union.

This organization has been the result of continuing development brought about by technological advancements in the telecommunications industry to meet the demands of the Canadian economy for new and improved

telecommunications services. Significant has been the decrease in operating personnel associated with the Public Telegraph Service. The volume of telegraph service reached a peak in 1954, and has been declining ever since at an annual average of approximately six percent, due, in part, to the increased use of line switched services. The decrease in this class of personnel has, however, been more than offset by rapid increases in technical maintenance personnel, brought about by technological advances and the introduction of new and more complex services. In fact, the number of personnel in this category has increased over a 30 year period by 25 percent. This compares favourably with increases in gross revenues, over the same period, of approximately 900 percent in that it indicates growth in technical capabilities with good control in costs, by application of modern testing and maintenance techniques and the use of automation.

Maintenance of technical competence has and will continue to be a major consideration. This competence must, of course, be complemented by a familiarity with company organization, procedures and policies. To this end, it has been and will continue to be necessary to provide comprehensive training programs. CN/CP operate continuous schools for its technical personnel, and maintain a staff whose sole responsibility is to prepare and provide courses and training information on new technologies and equipments. This has particular significance in telecommunications where, because of changing technology, it is frequently necessary to retrain senior personnel in other types of work.

Similar to most industries, the selection and development of

management supervisory personnel has become more difficult, as the pace of business has accelerated and the needs for prompt decisions to seize market opportunities have intensified. CN/CP has recognized this need with the establishment of management development courses and greater use of university training programs and industrial seminars.

A major aim in the development of CN/CP Telecommunications has been the realization of efficiencies available by joint operations. To this end, it has been necessary to eliminate duplication wherever possible, coincident with retention of management and financial identity. Wherever joint interests are best served by a common staff, joint offices have been established to administer segments of our business. Sales staffs have been amalgamated, and administration of jointly-owned switching systems is handled by one authority.

PLANNING

On the other hand, the planning for new developments and expansion programs and the financial management of operations continues to be an individual responsibility. Planning has benefited from this arrangement in realizing the best ideas generated by two independent authorities, and the ability to test the soundness of programs on a vitally interested partner. Duplication in development has been avoided by the assignment of specific programs.

In the planning area, be it in the long range or current plan stage, there are four basic facts which are given careful attention:

(a) Market Planning

A future demand for an existing service or for a potential new service must be identified by study of many factors which include historical information, various indices of industry growth, gross national product of the country, pricing strategy, life cycle analysis and demand for the service.

(b) Technological Planning

All current plans (5 years) are based on known or proven technology. Considerable time and effort is spent on a long range determination of the state of the art, to be absolutely certain that adequate technology is being used in planning for current and future installations. Work done in long range plans is much more difficult, as the state of the art is changing so rapidly that what may be a "way out" idea today may be the "in thing" 10 years hence. In fact, the long range plans are mainly guide lines for specific planning within a five year term (current).

(c) Financial Planning

Every project is examined from an economic standpoint to ensure that it will continue to produce (if expansion to an existing service) or will produce (in the case of a new service) a service at a rate which will be attractive to the user, and at the same time provide a return in both CN and CP investments which will attract the capital to carry it out.

(d) Human Resources Planning

Staff, both in relationship to quantity and training, required to carry out future plans is a very real factor to be reckoned with, before embarking on an expanded or new endeavour.

Monthly meetings are held at CN and CP senior management level at which time current and long range proposed plans are evaluated within the above four outlined categories, to determine their soundness and if they are meeting overall management objectives.

Once a program is embarked upon, regular reviews of its progress are made at management level with extensive use of C.P.M. charts (critical path method) to identify and rectify trouble areas.

CN/CP SERVICES

The present day expertise in telecommunications of Canada's two national railways, CN/CP, has been the outgrowth of the railway's basic need for communications. As the Canadian Pacific Railway's ribbon of steel first crept across Canada in the 1880's, a telegraph line followed, at first with a single conductor and then expanding to many pairs. From this small beginning of providing for railway operations, the telecommunications capabilities of both of Canada's major railroads have grown in step with Canada and have pioneered many of the telecommunications services which we have come to accept as a way of life. CN/CP Telecommunications has played important roles in Canadian economic development. Since 1911, they have been in the foreground of the wired news service (Canadian Press and later Broadcast News) - stock exchange ticker operations - commercial radio broadcasting coast to coast - air traffic controller voice network - weather map facsimile distribution network. Until the commissioning of the telephone companies' Trans-Canada Microwave System in 1958, all long distance telephone service to western Canada via a Canadian route was served over railway telegraph lines between Sudbury and Winnipeg. The first circuit in this area was

established on August 6, 1928.

In 1956, CN/CP introduced to Canadian business a world-wide Telex network, which has experienced an annual growth in Canada of 18 percent per annum. In later years, CN/CP provided some TV network facilities for the CBC. Again in 1967, CN/CP introduced an important communication service to Canadian business - Broadband service, specifically designed to handle high speed data (initially up to 50 kilo-bauds). CN/CP have also provided an integral part of the very extensive defence circuitry of the Canadian Forces. From a small beginning in 1881, with only one customer, CN/CP has grown with Canada until now, 89 years later, it is an important entity in Canada's telecommunications industry.

PART IV

ORGANIZATION

TELEPHONE INDUSTRY

There are more than 1700 telephone companies in Canada today. A customer of any one of these can be quickly connected to a telephone in either his local or any other company, both within and outside Canada.

The complex problem of interconnecting these companies to provide Canada with a system which ranks high among those of the world, could not have been solved without the highest degree of co-ordination and standardization in all phases of planning and design down through the years.

This co-operation between companies led to the establishment of formal associations of operating companies, the first of which, The Telephone Association of Canada, appeared in 1921. Its membership today includes the eight members of the Trans-Canada Telephone System listed on Page 32, in addition to the following:

edmonton telephones (City of Edmonton)
The Island Telephone Company, Ltd. (P.E.I.)
Northern Telephone Ltd. (Quebec and Ontario)
Ontario Northland Communications (Ontario)
Québec-Téléphone (Quebec)

The purpose of this organization is to facilitate a sharing of experience between companies, and the exchange of technical and operating information. An advantageous degree of uniformity among the members' practices resulting from this participation in TAC affairs contributes

greatly to their effectiveness. This is achieved through the activities of the various functional committees, composed of senior management personnel from each of the companies. TAC also sponsors Canadian representation on international telecommunications associations.

There are many smaller companies which are not members of TAC. They, too, have similar associations, with aims very similar to those of TAC. These associations include the Canadian Independent Telephone Association, Quebec Independent Telephone Association, Ontario Telephone Association and the Saskatchewan Association of Rural Telephone Companies. Liaison between these associations and TAC is maintained through contact between their member companies, and the member companies of TAC.

Of great significance to the development of telecommunications in Canada was the formation, in 1931, of the Trans-Canada Telephone System, organized to design, build and operate a Canadian continent-wide network.

Prior to its formation, Canada relied on transmission through the U.S. for most of its Trans-Canada requirements. With the advent of TCTS and the provision of completely Canadian facilities, Canada gained full control of its telecommunications network.

The Trans-Canada Telephone System's membership consists of the major telephone company in each province, representing the greatest resources and investment in toll facilities. Membership is thus related fundamentally to provincial boundaries, and hence has a definite, well-understood and permanent basis.

The members of the Trans-Canada Telephone System are:

Alberta Government Telephones

Bell Canada

British Columbia Telephone Company

Manitoba Telephone System

Maritime Telegraph and Telephone Co., Ltd.

The New Brunswick Telephone Company, Ltd.

Newfoundland Telephone Company Limited

Saskatchewan Telecommunications

- Canadian Overseas Telecommunication Corporation is an associate member of TCTS.
- Maritime Telegraph and Telephone Co., Ltd. represents the interests of The Island Telephone Company, Limited.

The Trans-Canada Telephone System is not a corporation, but an association or voluntary partnership of eight telecommunications organizations working together to provide the necessary co-ordination and integration of Canada's telecommunications services on a national basis. As partners in this nation-wide business, they provide a complete network capable of carrying a diversity of communications -- television and radio programs, data and defence communications as well as regular traffic from coast to coast.

The System is directed by a Board of Management composed of Directors representing all member companies. The Board of Management meets frequently and all decisions are based on unanimous agreement. Experience

has shown that this is the best way to determine ways and means of meeting objectives of all provinces, and with this the objectives of the nation. The requirement for unanimity makes it impossible for a majority to impose its will.

The Board is supported by inter-member operational and administrative committees that plan and co-ordinate the carrying out of the various programs of the System in its national telecommunications activities.

All members have a dual role: to provide good quality service within the territories they serve and to work together to provide nation-wide facilities and services.

Achievement of this objective requires the establishment of design standards and common operating procedures. This calls for co-operation and planning of high order.

TCTS is a unique organization in that it combines in its membership, companies of different types of ownership, whose activities are affected by several different regulatory agencies. The three Prairie companies are provincially-owned Crown corporations, while the rest are investor-owned. In other countries, ownership is vested primarily with the central government or, as in the U.S., with investor-owned enterprises which have developed the telephone industry to its present level of efficiency.

One important factor in the development of communications has been the close association between Canada and the U.S. This association

was of great advantage in the early development of the Canadian system -- and continues to be.

Because of the size of the American operations, research and development results far beyond the scale that Canada itself could afford to produce are made available through special service agreements.

Service agreements have contributed greatly to the development of the Canadian system. Principal among them are the agreements of the members of TCTS, (except British Columbia Telephone Company), with Bell Canada; between Bell Canada and A.T. & T.; and between B.C. Tel. and General Telephone and Electronics.

The agreements permit the flow into Canada of technical and operating information produced by the vast resources of A.T. & T. and General Telephone, supplementing our own capability. Through member relations with independents, the entire Canadian industry benefits.

Joint courses, conferences and seminars are conducted, which enhance the capabilities of telephone people in all aspects of the business.

The individual members of TCTS accept the responsibility to co-ordinate with all telephone companies in the provinces in which the members operate, with the objective of ensuring that the total public need for service is met to the maximum degree possible. Member companies work closely with these companies, providing training courses, technical assistance, and System information as required. Each member, therefore, recognizes a dual responsibility, both to these connecting telephone companies as well as to the other members of TCTS.

CONSTRUCTION PROGRAM

Probable no single effort better illustrates the high degree of coordination and cooperation that characterizes the TCTS operation than the annual construction programs. The TCTS program is really the sum of parts of each member's construction program, although it can be said, with equal strength, that each member's program includes his contribution to the TCTS network.

As each member prepares his construction program he considers many factors and conditions. The single objective is to provide, improve and expand the service offerings in his operating territory in both intra-company and Trans-Canada services, so that his system will continue to fill its role as a vital part of the total national system.

During the past ten to fifteen years particularly, there have been tremendous increase in the demand for basic telephone and other telecommunications services. This has been coupled with a trememdous surge in the volume of traffic handled, resulting in a significant increase in the size and cost of construction programs of all the Trans-Canada companies; all in an era of rapidly rising costs.

For the member companies of TCTS alone it is estimated that in the next five years, essential construction will entail expenditure of around $4 billion, about as much as has been spent in the last ten years.

Because of the nature of their business, the telephone companies have much less choice in the size and timing of their expansion program than

most industries enjoy. A continuous program of construction must be undertaken to ensure the availability of facilities -- to the extent possible, considering economic and financial constraints -- to meet consumer needs.

As an essential preliminary to the determination of expenditures required to provide facilities for growth, a forecast of the probable demand for services must be made.

A great deal of attention is given to forecasting demands for telephone and other telecommunications services. The changing environment in each section of each telephone exchange area is continually analyzed, to provide forecasts of future requirements.

PLANNING

Planning for the network is structured in two phases. First, planning is carried out within the framework of fundamental plans which are broad, long-range 15 to 25 year views of the future in terms of growth, environment and technology. These are intended to be guides rather than specific courses of action, to help prepare for the future in an economic and orderly fashion, and to visualize where innovation or new technology may be used to advantage.

The second phase concerns current plans where the focus is on the next five to seven years, and are considerably more detailed. This stage of planning is based on known technology.

Planning influences financial and manpower programs, and research and development recommendations, and it is important to communications equipment manufacturers in forecasting future production loads.

The nature of the communications business dictates that all additions to the network be compatible with existing plant. Furthermore, these additions must incorporate the latest technical advances to ensure meeting service requirements which are becoming more critical as to quality, and are increasing in variety. Additions are planned in the most economical manner, having due regard for both initial and continuing costs.

The effective implementation of construction programs requires continuous review and revision of estimates of dollar and material requirements. At regular intervals each year, construction programs are reviewed and analyzed. Analysis identifies projects which must proceed so that growth in service requirements will be met as forecast, and progress toward essential modernization objectives maintained.

In implementing the program, due consideration is given to service, financial return and manufacturers' production, as well as to financial and manpower resources. The engineering of each project includes an economic comparison of possible plans to select the optimum course.

The total construction expenditures are affected by four major factors:

1. Replacement and movement of plant in service;

2. Growth in demand for present service offerings;
3. Innovation and modernization of services and equipment;
4. Resources.

1. Replacement and Movement of Plant in Service

Expenditures in this category are required because of customer movement, public improvement projects, and for replacement of plant either damaged by storms or not economically maintainable.

The expenditures do not increase revenues, but are essential to maintaining service.

2. Growth in Demand for Present Service Offerings

The growth in the number of telephones in service in Canada has been dramatic during the last ten years; from 1959 to 1969 it was over 70 percent.

At the same time, the calling rate has likewise increased, to the point where Canadians are among the most talkative people in the world, with an average of nearly 700 telephone calls per person per year. This growth in the calling rate has required great additional capacity in both switching equipment and transmission network facilities.

Also included in the growth category are expenditures required to promote continuity of service and survivability of plant. This reliability is expected by Canadian telephone customers and must be maintained.

3. Innovation and Modernization

Telephone companies must ensure that planning done today will meet the needs of the future as public expectations rise, and technology advances. Inability of telecommunications services to cope with the traffic volumes expected in the future would have a serious impact on the Canadian economy. It is therefore essential that the network be able, through continuing modernization, to meet future demands.

This important portion of the construction program makes provision for all forms of innovation and modernization in switching, transmission, and terminal apparatus to meet emerging requirements being generated by such developments as computerized information banks, computer to computer transfer of information, visual services, in addition to the continuing modernization of public telephone service.

The importance of organizational structure is promoting innovation in the telecommunications industry is discussed in Appendix 1 to this Telecommission Study.

4. Resources

The ability to carry out construction programs depends on the availability of all necessary resources: materials, manpower and money. Capital resources are particularly vital, and the lack of sufficient capital would seriously impair the program through inadequate provision of facilities and possible deferment of new construction designed provide facilities required for the needs of the future.

The availability and cost of all three categories of resources are significant controlling factors in construction programs, particularly in the current era of inflationary trends.

REVENUE SETTLEMENT

Because of the variety of services provided jointly by the many telephone companies in Canada and the importance of the revenue derived, revenue settlement is a significant facet of the total operation. Together with the technical factors of co-ordination, integration and compatibility, revenue settlement is vital to the task of welding the close to 1700 Canadian telephone companies into one efficient system.

The Trans-Canada Telephone System divides all System revenues among its members. In turn, the members of TCTS arrange settlements with most Canadian independent telephone companies. The purpose of these settlements is to ensure that the independent companies as well as the members receive a fair share of the revenues to enable them to participate in the provision of complete national service. These settlement arrangements are arrived at through discussion and what is, in fact, a bargaining process.

Revenues collected by one company for service provided in conjunction with one or more other companies are naturally subject to settlement.

There are five categories of toll message settlements:

Independent Company Settlement: covering all toll traffic exchanged between an independent company and a connecting TCTS member company,

including all calls which originate or terminate outside that member's operating territory.

Adjacent Member Settlement: covering all toll traffic exchanged between adjacent TCTS members, including that originating and terminating in their independents' territories.

Trans-Canada Settlement: covering all traffic involving the territories of three or more TCTS members, including independents, the Canadian portion of Canada-U.S. and domestic carrier portion of overseas toll traffic.

Canada-U.S. Settlement: covering Canada-U.S. toll traffic. Its purpose is to determine the Canadian and U.S. revenue shares, the Canadian part being settled among Canadian participants through the Trans-Canada and independent company settlements.

Overseas Settlement: covering the domestic carriers' portion of Canadian toll traffic with overseas points. Like the Canada-U.S. settlement, it determines the share to be distributed through Trans-Canada and independent settlements.

Settlement categories for private line services are very similar to those for message toll. The main difference is that any Canada-U.S. private line service involving only one Canadian company is settled directly by that company with the U.S. company concerned. All Trans-Canada private line revenues are combined with message toll revenues in the Trans-Canada settlement category.

Thus, the total Trans-Canada revenue settlement includes the revenues from all defined Trans-Canada categories including Canada - U.S. plus the Trans-Canada portion of Overseas revenues.

An important objective of a settlement plan is to produce mutually acceptable results to the participating companies. It is more important that the type of settlement achieve this objective than that it conform to any standard pattern. Thus, the various members of the industry have chosen the type that best meets the needs of a particular relationship.

There are a variety of plans to distribute revenues. By far the greatest sum of money is settled under what is known as the Full Division Plan of Settlement. This type of plan is used by TCTS members for Trans-Canada and most of their Adjacent Member settlements.

A large number of settlements are made on a Commission and Prorate basis. Many variations are used for settlements between TCTS members and their independents. There are also a few settlements related to rate schedules.

Differing environmental situations have resulted in modifications so that many specific settlements vary from one another in minor ways to achieve the desired acceptability.

Because of the significance of the Full Division Plan type settlement it is considered that a general description would be of value.

While the basic principles of Full Division Plans of Settlement are always the same the procedures permit a wide variety of weighting factors

and arbitrary assignments to be used, in order that bargaining parties may arrive at mutually acceptable solutions. Very few, if any, Full Division Settlement Plans are identical.

Under the Full Division Plan, the revenues to be settled are pooled. Basically each member receives from the pool an amount equal to the expenses it assigned to provide the revenue generating services. The balance of the pooled revenues is distributed to each participant on the basis of his proportinate participation in the provision of the service. The participant's contribution is normally measured in terms of his assigned plant investment.

Each participant therefore determines:

a. Originated revenues for distribution after settlement with independents
b. Assigned expenses
c. Assigned Plant Investment

The amounts of "assigned expenses" and "assigned plant investment" are determined by application of detailed, uniform procedures, agreed to by the participants.

In the mechanics of the process, the participant's total plant investment is separated into theoretical categories - (exchange) and (inter-exchange.) A portion of each category is assigned to each settlement by use factors. The portion assigned is determined by agreed methods to measure proportinate participation in that settlement by agreed measurement units.

Similarly, "expense" participation is determined for each settlement by analysis and correlation of accounting and use data. This measurement also assists in recognizing the impact of variations in labour rates, geographic factors, etc.

The pooled revenues are then distributed in accordance with the principles described above.

"Assigned investment" and "assigned expense" allocations as carried out by TCTS for revenue settlement purposes do not determine rates of return when related to revenue. They are only used as a measure of the proportionate participation of the members. They are not a measure of actual investment and expenses in a given service.

Because of the fact that average use factors and ratios are applied to assign broad categories of exchange and interexchange book costs and expenses to the various settlements, any similarity between assigned investment and expense dollars and actual investment and expense dollars is destroyed.

The procedures of the Full Division Plan of settlement are complex. There is a high degree of uniformity required in the total involvement. It is essential that there be uniform accounting, uniform settlement study procedures and reasonable uniform characteristics, such as scope of service offering and rates.

In summary, this overall chain of settlements has been a vital part -- just as modernization, innovation and response to public need have been -- in developing the Canadian telecommunications network.

PART V

TELECOMMUNICATIONS: CANADA AND OTHER COUNTRIES

Comparisons of national telecommunications systems are extremely difficult, as the variables and combinations of them, which affect the development of a system are almost unlimited.

The following table indicates the degree of penetration of the market in telephone and record message business, as of January 1, 1969.

Country	Telephones Per 10,000 pop.	TWX-Telex Customers Per 10,000 pop.
Switzerland	4,342	15.46
West Germany	1,865	11.99
Austria	1,688	11.40
Norway	2,702	7.74
Sweden	5,176	N/A
U.K.	2,326	5.15
France	1,498	3.15
U.S.	5,402	4.15
Canada	4,212	10.40

Canadians travelling abroad tend to measure the standard of service in other countries by the standard they are accustomed to at home. This is natural, but hardly valid. The standard of service provided in any nation should be measured by that nation's need, its ability to pay and many other factors. Service that Canadians would not consider good may well be adequate for another country.

Comparing service requires consideration of many factors and, in fact, pure conclusions are next to impossible to draw. It is equally difficult to compare rates, but no comparison is really valid unless it relates to the unmeasurable -- the service for which payment is made.

One measurement, for example, is that it takes two hours of work for a Canadian telephone customer with average income to earn the cost of a month's individual line residence service. In the United States, the figure is 2 hrs. 10 mins.; in London, England, 4½ hrs. (double the amount), and in Paris, France, 16 hrs. or 8 times the cost in Canada.

However, the proportion of the gross national product of these nations which is represented by the value of telecommunications services, is not readily available and would require considerable research to develop.

The way of life has an effect on telecommunications needs. Where a population moves on foot or on bicycles, they are less likely to demand telephone service like that of Canada and the U.S., and do not appear to need the standard offered on this continent.

National policy is a factor, particularly where postal service and telecommunications are provided by the same department of government. This is fairly common in European countries. It then becomes a question of which method of communication national policy emphasizes: postal, telegraph, telephone, Telex-TWX.

Pricing policy is a large factor. European telephone systems use measured rates, the U.S. is heavily "measured rate", Canada is flat rate. It is generally accepted that measured rates depress demand for service, particularly in nations of lower standards of living. Hence, measured service reduces use of telecommunications more in European nations than it does in the U.S.

Financing is a major consideration. In Canada and the U.S., telecommunications companies rely on the external financial market to a substantial degree for their capital requirements. In Sweden, most of the Telecommunications Administration's financing is from its own internal sources, with some government financing involved. In other European countries, the telecommunications capital budgets are subject to the availability of government financing and, presumably, are considered in light of priorities with other government projects in the allocation of funds.

Integration of manufacturing, research and development functions with the operating companies seems to be a major factor in the total national development. Whether it is a cause or effect is not important because it is an essential, regardless. In the United States, this integration is achieved by General Telephone and Electronics Corporation for their group of companies and by A.T. & T. with Bell System operating companies, Western Electric and Bell Labs. In Canada, the G.T. & E. has Lenkurt Electric Company of Canada Limited and Automatic Electric (Canada) as manufacturing and R&D subsidiaries of G.T. & E. Bell Canada has the manufacturing and R&D facilities of Northern Electric.

The topic of innovation and corporate integration in Canadian telecommunications is discussed more fully in Appendix I to this report.

Thus, it can be said that the two countries having what is considered to be the best telecommunications service also have the highest degree of integration of manufacturing, R&D and operations.

In Sweden, the Telecommunications Administration carries on operations, manufacturing and R&D within its own organization. In recent years, it has joined forces with the L.M. Ericsson Company of Sweden to pool the resources of both in the development of electronic switching equipment.

The Administration usually manufactures all customer equipment, switching equipment and private branch exchange equipment from its own designs, but it co-operates with outside manufacturers of transmission equipment to supply a large part of its requirements.

Britain has recently re-organized its Post Office to form a Post Office Corporation with a Board largely drawn from outside the public service. A very strong executive team has been assembled to revitalize the General Post Office. Within the Post Office Corporation, there are major divisions for telecommunications and postal service.

Under the old system, equipment was manufactured for the Post Office by selected manufacturers under bulk supply agreements. This system was cumbersome, as every little specification was tied down to the most minute detail by the Post Office, leaving no room for innovation on the part of the manufacturers. The Post Office, however, has its own R&D facilities, and under the new system, joint planning by the Post Office Corporation and industry will take place through an advisory group on telecommunications systems definitions. The Post Office Corporation will then purchase equipment through competitive bidding using specifications developed by the advisory group. Specifications will be more detailed for interfaces than they are currently. Very ambitious plans for improvement have been outlined in a government white paper, published in 1969.

In France, a single ministry administers the closely linked activities of post, telecommunications and banking. The telecommunications organization is completely dependent on outside suppliers for all its supplies.

Existing facilities are overloaded and there is a long waiting period for new services. The ministry is facing a serious situation in its efforts to overcome the problems.

By all appraisal standards, it is generally agreed that the Canadian systems with their well integrated R&D, manufacturing and operating functions provide excellent service. In Great Britain and France, there is a much lesser degree of integration and these systems are not considered comparable to those in Canada, the United States and Sweden.

The factors of service, consumer needs and market penetration are related. They are, in themselves, a combined factor determining the degree of public acceptance of telecommunications service. If the service does not meet the public's need, the public does not buy it and does not use it. An example can be found in France, where there is a recorded backlog of 350,000 applicants for telephone service, but it is estimated that the actual backlog is really about 2.5 million, because many potential customers do not apply due to the delay in obtaining service.

As France improves the technical standard of existing service and expands its network to meet identified needs, a new flood of demand will appear which in turn will create further congestion. Until these demands are met, the quality of service will not substantially improve.

There is an old adage in the telecommunications business, "service sells service" and, until the service "sold" is provided on demand and is technically good, the public need is not being adequately met.

There are four ways by which people communicate information to one another: face to face, mail, telegraph and telephone. The last three are really monopolies, but it is only in Canada and the U.S., of the countries looked at, that they are provided by different organizations.

In Canada, neither postal nor telegraph revenues are considered when planning telecommunications and designing long distance message rates; in Great Britain they could well be a major factor.

A distinct advantage contributing to the high standard of service between Canada and the U.S., is that Canadian carriers are completely integrated in a total system design with their U.S. counterparts. The resulting high degree of uniformity of service facilitates the ease by which the public can use the service.

It has already been pointed out that service in other countries should not be measured by Canadian and U.S. standards but by the needs of the countries concerned. Canadians must judge their own service by how well it meets their needs, and their own carriers by how well they perform in anticipating and serving the total public need. Canada needs constantly improving service, regardless of what kind the rest of the world has, and its carriers intend to provide this.

PART VI

CANADIAN TELECOMMUNICATIONS INDUSTRY: GROWING WITH CANADA

The development to date of the Canadian telecommunications industry has been achieved, for the most part, through the efforts of the communications carriers. In the industry's opinion, the public need for service has been met and will continue to be met in the future.

The Canadian telecommunications industry has approximately seven billion dollars invested in facilities which, in recent years, have been increasing at about 10 per cent per annum. Demand has been adequately forecast and met, as evidenced by the short lead time required to provide a service once the order has been expressed. This is particularly noteworthy, in view of the long lead times required to produce backbone networks.

During the last fifteen years:

- 29,000 route miles of microwave systems have been built;
- 5.3 million telephones have been added;
- 23,500 Telex-TWX installations have been made;
- Direct Distance Dialing has been provided.

To meet these tremendous growth requirements, the Canadian telecommunications industry has been a leader in innovation in Canada. The industry continually carries out research to determine what the user wants.

The public telecommunications systems have been growing ever since the early beginning of the industry. While the systems are constantly being improved and expanded, it is always necessary to ensure that new facilities will be able to work with the existing facilities and be compatible with existing network parameters. It is thus no accident that the "total system concept" in technological planning originated with the telecommunications industry.

The "total system concept" requires the study of many factors involved in the decision to incorporate new facilities in the system. These include technical and operating characteristics, market and economic considerations, compatibility requirements, optimum time schedule and appraisal of alternate possibilities.

Frequently a considerable amount of R&D and engineering information is required to permit proper appraisal of all the factors and to satisfy demands.

Further planning is required on the part of the operating companies and the manufacturers to co-ordinate the various activities such as production, installation, training of personnel, financial planning, establishment of maintenance facilities and market introduction.

As will be evident from the above, innovation in the telecommunication industry is a rather complex process which involves close integration of efforts between the various disciplines in the operating companies' and the manufacturers' organizations. Quite often, new industry projects also need to be planned on a national basis requiring system co-ordination.

The vital role of management in the operating companies, as instigators of innovation, needs to be emphasized. Planning of new facilities and the introduction of new services must necessarily be done well in advance of current market requirements. While comprehensive and thorough planning enables management to make decisions with a greater degree of certainty, there is no such thing as an infallible way of judging market conditions, technological trends, and the many other factors influencing the economic outlook for the telecommunications industry. Therefore, a fairly high degree of risk is associated with many of these management decisions.

In recent years the Canadian R&D capability has been greatly strengthened by close co-operation among telecommunications operating companies, manufacturers and R&D organizations, and also by federal government assistance programs. As a result, Canadian technological capability in the telecommunication field has been much improved and this progress is continuing. More than any other Canadian industry, the Canadian telecommunications industry has been conscious of the need to innovate in order to keep abreast of new service demands, and to continue to provide Canada with one of the world's best telecommunications systems.

It is of tremendous importance to the industry to possess a high level of technical competence, and this level has been raised through the establishment of strong Canadian R&D laboratories. This indigenous R&D effort is vital to support Canadian manufacturers of telecommunications equipment, and the Canadian public telecommunications carriers are justly proud of the fact that nearly all the equipment used in their networks is of Canadian manufacture.

Innovation is discussed in Appendix I to this study and in Telecommission Study 4(a) on the Future of Technology. Major new projects will make tremendous demands on the industry in the coming years but, on the basis of the past performance and the well trained and experienced personnel, there is every reason to feel confident that the Canadian telecommunications operating industry, R&D, and the manufacturing industry will be able to cope with the new requirements, expanded demands for service, and new sophisticated technology.

The great growth of the last two decades has witnessed significant innovations in telecommunications technology. Some highlights of the industry's development in this period are the introduction of:

- Telex, by CN/CP Telecommunications
- the Trans-Canada Telephone System coast-to-coast microwave system
- network television service throughout the nation
- TWX, by T.C.T.S.
- Direct Distance Dialing
- the CN/CP Transcontinental microwave system
- Touch-Tone service
- a computer based store and forward service by CN/CP Telecommunications
- electronic switching
- Broadband Exchange Service, by CN/CP Telecommunications
- Message Switching Data Service, by T.C.T.S.
- MULTICOM Service, by T.C.T.S.

These achievements have made available to Canadians, at just and reasonable rates, the complete spectrum of telecommunications services. Included among them are the following, more common services:

- Public Telephone Service The telephone customers of Canada are served by an extremely efficient system. The operations of almost 1700 companies are integrated so that all customers of all companies can achieve fast connection with each other and customers in other countries. As an illustration, Canadians placed over 432 million long distance calls in 1969, up 11.1% over 1968.

Over 98% of telephones have automatic dial or Touch-Tone service. Direct Distance Dialing was introduced in Canada in 1956, as a result of extensive studies begun in 1953. These were actually joint studies involving Canada and the United States since it was obvious that the DDD networks of both nations should be integrated.

The conversion to DDD required the close examination of practically every part of the telephone industry's operation, from billing to transmission. Each customer in North America was assigned a unique 10-digit telephone number, toll routes were re-arranged, computer type switching units were installed, additional toll circuits were built, all according to plan and co-ordinated among the companies involved.

Today, well over 90 per cent of Canada's telephones can dial directly to almost 120,000,000 telephones in Canada and the U.S.

These achievements have come about while the rate structure is one of the lowest in the world. Indeed, the Canadian industry has

reduced long distance rates over the years. A three minute station night call, Halifax to Vancouver, cost $2.80 in 1960 and $1.95 today; $1.00 if placed after midnight.

- Public Telegraph Service The telegraph service, which was the most important provided by CN/CP, grew steadily, reaching a peak during the year 1954. Since then, there has been a reduction in the number of telegrams handled, resulting probably from the many more sophisticated services that are available to the public today. At the present time, this business represents about 15 percent of the CN/CP's overall business.

The problem of picking up and delivering the telegram continues to remain the most difficult to solve. We can cross the continent with a message in a few seconds, but delivery to the customer takes the bulk of the time. Improvement has been made in this area, and such media as the telephone, facsimile and Telex have largely replaced the messenger boy.

- Switched Teletype Service

Telex - Data Telex

Telex is a relatively new communications service, inaugurated in Canada during the year 1956. It is basically an automatic system for the interconnection of teletypes by dialing. Today there are more than 20,000 customers using Telex in Canada and about 350,000 throughout the world. Telex operates at a speed of 66 words per minute in the five-level teletype code and Data Telex operates in the eight-level code at 100 words per minute. Two hundred and seventy-five customers are now using Data Telex.

TWX

TWX service was introduced to Canada in 1962. It operates in

the eight-level code, at a speed of 100 words per minute, providing switched record service and some types of data transmission. Access to the network is available at virtually every point in Canada reached by the telephone companies' network.

TWX is interconnected for international service to the European Telex network and the TWX network in the U.S. There are approximately 3,400 TWX customers in Canada.

- Private Line Service These services are provided in three types:

Voice - such as commercial voice, CBC radio network service and service to private broadcasters, both AM and high quality 15 KHz FM service.

Video - including the CBC English and French and CTV networks with colour capacity.

Digital - Many telecommunications customers have requirements of such proportions that their need can best be met by a digital service, custom built to their particular needs. These include stock brokers, computer customers, facsimile users and many other varied requirements.

- Private Switched Networks These networks meet the needs of many customers for special services. Included among them are:

  - the collection and dissemination of news in both record and voice forms.
  - facsimile transmission in the news field and in the law enforcement field.

- the transmission of stock quotations among members of broker associations.
- the particular telecommunications needs of the Canadian Forces.

Several other Telecommission Studies on the Future of Technology, The Wired City, and on Computers discuss the tremendous scope for future innovation.

This is an era of constant change -- in our institutions, in man's attitudes towards his environment, in governments, in social and economic systems and in man himself. There are no hard and fast rules for charting new communications frontiers to meet the needs of the coming society, and it is imperative that we consider all the questions objectively. We are going to be faced with a challenge such as we have not experienced in our history, and we are prepared for it.

CN/CP Telecommunications
Trans-Canada Telephone System
The Telephone Association of Canada

July 1970

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THE NEED FOR INNOVATION IN TECHNOLOGY

APPENDIX 1

THE IMPORTANCE OF ORGANIZATIONAL STRUCTURE IN PROMOTING INNOVATION IN THE TELECOMMUNICATIONS INDUSTRY

THE NEED FOR INNOVATION IN TECHNOLOGY

GENERAL

The need for innovation in the Canadian telecommunications carrier industry must be seen against the background of the central role of this industry in our society, its future role, and the economic and social environment of the industry. The broad term "innovation" is used here to signify the whole process of introducing new technology. It includes research and development, engineering of manufacture, market introduction and other essential steps.

The Canadian telecommunications carrier industry provides the vital information highways linking the various parts of our far-flung country together, enabling people to communicate with people, machines with machines, and broadcasters to interconnect their program studios, broadcasting stations, and other facilities to reach a national audience.

The public telephone network which forms the largest and most highly developed part of the Canadian telecommunications network is distinctly Canadian, yet it is fully integrated with the North-American Direct Distance Dialling (DDD) Network allowing Canadian telephone subscribers to dial upwards of 100 million other subscribers without operator assistance. By any comparative standard the Trans-Canada Telephone System provides service of high quality at reasonable rates. The present network facilities are flexible, providing a wide range of services from the conveyance of television signals to wide and narrow band data services, yet it is obvious that the rapidly rising requirement for data communications, pending service offerings such as videophones, and a host

of other service requirements, many of which have hardly been thought of today, will impose heavy demands on the industry and lead to a more rapid rate of innovation and increased demands for sophisticated technology.

The Canadian telecommunication carrier industry, besides having a very high degree of Canadian ownership, has also traditionally obtained most of its technical facilities from domestic manufacturers. It is a very capital-intensive industry making heavy demands on the Canadian financial resources but has also contributed very substantially to the growth of Canadian manufacturing industry and other industries supplying the telecommunications carriers. For many years most of the telecommunication equipment manufactured in Canada was of foreign design but increasingly Canadian manufacturers of telecommunications equipment have developed their own designs and are rapidly increasing their R&D capability to support their own manufacturing operations.

The market for Canadian telecommunication equipment is largely dependent on the spending on technical equipment and supplies by the telecommunications carriers, although export sales are becoming increasingly important in some sectors.

In a modern technological industry it is not feasible to plan the various steps in an innovative cycle in isolation. Thus the planning of the telecommunications carriers will largely determine the size of the accessible market, the type of equipment required, and the various technical requirements to be met. The expected sales of new types of equipment will in turn determine how much R&D it is possible to justify on economic grounds on particular classes of technology and equipment. Futhermore, advance

knowledge of the plans of the telcommunications carriers for the introduction of new equipment is necessary to allow sufficient lead time for industry to develop the kind of hardware needed at the time it is needed. Current experience appears to be that R&D expenditure in the order of 8 to 10 percent of total product sales is required to keep pace with the rapid advances in technology and in the resultant requirements of the public as identified by the telecommunication common carriers.

During 1970's the Canadian telecommunication carriers will spend about 700 million dollars on new construction and also very considerable sums on maintenance and supplies. The construction budgets of the various telecommunication carriers are at the present time very restrained due to the rigid economic climate and should probably have been considerably high to achieve an optimum rate of growth and modernization.

Future projections are always uncertain but it is expected that the total value of telecommunication plant of the TCTS companies will rise from $6.5 billion in 1970 to $17 billion by 1980 and $42 billion by 1990.* This will call for a tremendous amount of new equipment and it is of paramount importance to the telecommunications manufacturing industry that the bulk of this investment in new plant be spent on equipment of Canadian design and manufacture. Very directly therefore the amount of sales of equipment to the Canadian telecommunication carriers will determine in very large measure the financial health of the manufacturing industry and the

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* This estimate was developed by the TCTS companies and is quoted from Telecommission Study 4(a) - The Future of Technology.

amounts this industry can afford to spend on R&D. Conversely, unless a very much enlarged R&D effort is undertaken by Canadian manufacturers of equipment for the telecommunication carrier companies, it will be necessary to rely much too heavily on imported designs and this may indeed make it impossible to satisfy the need for technically sophisticated equipment from Canadian manufacturing sources.

In considering the need for R&D in the telecommunication field it should also be emphasized that a host of new input/output devices, business machines, computer terminals, etc. will increasingly be connected with the telecommunication carrier network. Most of these devices will probably be owned by telephone customers, and this class of equipment will probably call for a very considerable R&D effort if Canadian manufacturing industry is to compete in this sector of the market.

The very central importance of electronic technology to any industrialized nation is now becoming generally recognized. In particular it may be said that Servan-Schreiber's book, "The American Challenge", in which he probes the reasons for American technological superiority and American takeover of many European industries, has proved important in focussing attention on these problems. Servan-Schreiber points out that U.S. investment in Europe is concentrated in the high-technology growth industries and that 90% of this investment is financed from European sources. After enumerating the inroads made by U.S. industry in European sophisticated electronic fields such as computers and microcircuits, he goes on to say:

> "These figures are important to keep in mind, for electronics is not an ordinary industry: it is the base upon which the next stage in industrial - and cultural - development depends. In the nineteenth century the first industrial revolution replaced manual labor by machines. We are now living in the second industrial revolution, and every year we are replacing the labor of human brains by a new kind of machine - computers.
>
> A country which has to buy most of its electronic equipment abroad will be in a condition of inferiority similar to that of nations in the last century which were incapable of industrializing. Despite their brilliant past, these nations remained outside of the mainstream of civilization. If Europe continues to lag behind in electronics, she could cease to be included among the advanced areas of civilization within a single generation."

A second quote from "The American Challenge" would appear of interest:

> "During the past ten years, from the end of the cold war and the launching of the first Sputnik, American power has made an unprecendented leap forward. It has undergone a violent and productive internal revolution. Technological innovation has now become the basic objective of economic policy. In America today the government official, the industrial manager, the economics professor, the engineer, and the scientist have joined forces to develop coordinated techniques for integrating factors of production. These techniques have stimulated what amounts to a permanent industrial revolution."

The above quotes are felt to be equally applicable to our Canadian situation and much of the thrust in our efforts to enhance the level of technological knowledge and skill in Canadian industry should be aimed at the electronic field.

The Science Council of Canada has come out strongly in favour of putting most of the emphasis on "mission oriented R&D", in other words R&D performed in support of a particular program of innovation. This view is strongly shared by the telecommunication carriers. It should be remembered

that the "total systems concept" originated in the telecommunication industry as a method for dealing with many complex factors in the planning and engineering of telecommunications systems. Under this concept the problems of technology requiring solution as part of the development of any particular system may be defined and specifically directed R&D may be concentrated on main areas. This subject will be dealth with more fully in a later section of this report.

SPECIAL CANADIAN REQUIREMENTS

The importance of the Canadian telecommunication network is such that the very functioning of our national institutions, business, news media, and cultural activities are highly dependent on the reliable availability of these services. In a world of changing military commitments, uncertain peace, and internal upheavals in many countries it would be dangerous for the Canadian telecommunication carriers to be too highly dependent on foreign suppliers. This is particularly true of our basic telecommunication services both locally and as regards toll facilities. On the other hand Canada will never be entirely selfsufficient - nor will any other developed nation, nor is it desirable to be so. This need for reliable sources of supply goes further than a mere need to assure a continued supply of equipment and parts used in the network. Today there is a growing need for knowledgeable technical back-up from industry to the service industries as equipment is becoming steadily more sophisticated. It is often not sufficient that such back-up be provided by the manufacturing plant as it is frequently necessary to know the design intent of a particular piece of equipment - knowledge which can normally only be supplied by the development laboratories responsible for the original design.

So much has been written lately on the subject of innovation that it would appear largely superfluous to repeat these arguments here. A wealth of material on this subject has been presented to the Senate Committee on Science Policy during their current hearings. In the Fifth Annual Review of The Economic Council of Canada which dealt with "Science, Technology and the Economy", a useful definition of the relationship between R&D and innovation was given:

> "While R&D is concerned essentially with invention - with the conception of an idea, and the initial development of the idea - innovation is concerned with the crucial role of entrepreneurial decision-making and risk-taking in the "follow-through" process, which involves the coupling of the initial idea of the results of R&D with engineering, design, financing, tooling-up, production and marketing. Thus, R&D by itself may add nothing to economic growth. It is the innovation process - beginning when management decides to move from R&D into engineering, design and all of the succeeding stages - which brings new products, processes and services into use, and which contributes to growth. A recent U.S. study sets out some "rule of thumb" figures for the distribution of costs in the successful development of certain products in that country:
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> | | |
> |---|---|
> | Research - Advanced Development - Basic Invention | 5-10 per cent |
> | Engineering and Designing the Product | 10-20 per cent |
> | Tooling - Manufacturing Engineering (Getting ready for manufacture) | 40-60 per cent |
> | Manufacturing Start-Up Expenses | 5-15 per cent |
> | Marketing Start-Up Expenses | 10-25 per cent |
>
> If innovative activity is to be stimulated and encouraged, both public and private efforts must be directed over a much broader range of effort than R&D. There is danger that policy-makers will concentrate on support of R&D, leaving the rest of the process to take care of itself."

The Canadian telecommunications carriers carry out very extensive planning activities, combining studies of technology, traffic growth, changing population patterns, ecology, industrial and business

development, etc. in order to anticipate the requirement for new services, changes to existing services, network extension and modernization, expansion of services, introduction of new concepts of service and operation and so forth. Out of this mass of planning data emerge short term and long term plans for expansion of services, construction of new plant, and a time table for these various steps. The details of this planning process may differ somewhat within the industry but the basic steps are the same. A very important part of this planning is the technical specification of new equipment, and the overall planning of new systems. Due to the rapid advance of new technology such plans are best developed in cooperation with the manufacturing companies, particularly with the System Engineering Department of the R&D arm of the manufacturer. If any new system is to be developed in Canada, it is essential that the manufacturing companies know 5 to 2 years in advance of the requirements of the carrier companies and that extensive cooperation takes place to develop specifications, cost estimates, delivery schedules, plans for field testing and system implementation. In the case of major systems, such as e.g. the introduction of an electronic stored program switching machine, the cost of the R&D itself is extremely high and a tremendous amount of planning must be undertaken to ensure the smooth change-over to the new facility. While the risk element is correspondingly less for other products requiring less R&D or less investment in manufacturing plant it is nevertheless extremely hazardous for a manufacturer to develop new equipment without close contact with the carrier industry.

In Canada climatic and geographical conditions sometimes impose special demands on equipment performance. Thus it is important that

amplifiers and repeaters which are often exposed to extreme cold, be especially designed to provide proper temperature compensation at all times. A special requirement exists in Canada for small and economical switching machines for use in our smaller communities. Another example is the need for an economical satellite ground station for the reception of TV only, yet sturdy enough to withstand the very high wind velocities and heavy ice loading sometimes encountered in the Canadian North. The industry requirements are not always this unique to Canada as most of our equipment is built to international or North-American standards, but here it is important to assess those areas where the Canadian market plus export potential is of sufficient size to justify an indigenous design effort and those features which would make the equipment particularly suitable for Canadian conditions.

CANADIAN INDUSTRY ORGANIZATION FOR ENCOURAGING INNOVATION

In a world of rapidly advancing technological knowledge the competitive pressure on all industries is mounting. In advanced fields of technology such as in electronics technological excellence is indeed a very saleable product and very often more important than low price in securing sales. It is becoming very important for electronic manufacturing companies to produce the right product at the right time and this normally implies that to keep up with the demands of a sophisticated market a successful company must have the capability within its own organization to perform market analysis and R&D or must have direct and complete access to such knowledge from a closely associated organization. There is normally very little to be gained by launching a new product two years after the competitors made their product available unless very substantial improvements can be offered. Notable

examples of how advanced technology rather than price can give a particular company supremacy in a certain market are these: IBM in the computer field, Hewlett-Packard in electronic test instruments, Varian in the supply of klystron tubes. Some Canadian examples would be CAE's strong position in the supply of aircraft simulators, the success of deHavilland in the design of STOL aircraft (Cariboo, Otter, Beaver). Lately Northern Electric's Contempra telephone is a highly successful product showing great export potential.

In any field where products need to be produced and distributed in any sizeable quantities, economies of scale become very important. In such fields the value of total sales is usually quite high and this in turn determines the financial ability of a manufacturer to make further investments in R&D.

For any Canadian-owned manufacturer in the telecommunications field the ability to generate new product designs has become a matter of sheer survival. To some extent there will always be a need to do a certain amount of manufacturing in Canada under licenses from foreign firms, but there is a time lag involved in obtaining such purchased R&D information, normally some strings are attached restricting the licensee to certain markets and furthermore it is increasingly becoming necessary for a manufacturing firm to possess a very advanced level of skill in order to even be able to put into use technical information purchased from others. Such skill levels are usually only possessed by organizations which do some R&D on their own, so the paradoxical situation arises that in order to make use of R&D information purchased from others you have to be able to carry out R&D on your own.

A somewhat different situation exists for Canadian branch plants of foreign firms. In this case the close ties with the parent firm will usually facilitate the transfer of design information and less time lag will be involved in coordination of manufacturing know-how etc. There is no fixed pattern governing such situations as in some cases Canadian subsidiaries of foreign firms carry out a particular function for the entire corporation and do independent R&D in Canada.

VERTICAL AND HORIZONTAL INTEGRATION OF THE CANADIAN TELECOMMUNICATION INDUSTRY.

The existing organizational structure of the Canadian telecommunication industry has a major impact on the performance of this industry, particularly in encouraging manufacture of electronic equipment in Canada and in creating a strong R&D base for the industry.

The major organization in this field is the Bell Canada - Northern Electric complex which combines telecommunications operations, manufacturing and R&D within a single corporate structure. Another important integrated structure is the relationship between The British Columbia Telephone Company, Quebec Telephone, Lenkurt Electric (Canada) and Automatic Electric (Canada) which all belong to the same parent organization, The General Telephone & Electronics Corp. of New York, either as direct subsidiaries or through the holding company, The Anglo Canadian Telephone Company.

These organizations manufacture a wide range of telecommunication equipment for the Canadian market and for export, supplying all of the Canadian common carriers and not just their affiliated operating companies. To illustrate this point it may be useful to look at the distribution of the sales of the Northern Electric Company for the year 1969. In that year

the Company had total sales of $482.5 million, of which sales to Bell Canada accounted for $248.5, domestic non-Bell $183.4, and export $50.6.

Nor is there any rigid rule within any of these integrated corporations that they will necessarily be self sufficient in all areas. Thus Bell Canada will make purchases of technical equipment from companies other than Northern Electric if a more appropriate product is available. Similarly, the B.C. Telephone Company will obtain certain types of equipment from companies other than Lenkurt or Automatic Electric, e.g. certain types of switching equipment.

By far the greater portion of Canadian R&D in the telecommunication field is performed by these integrated corporations. Thus in 1969 Bell-Northern had gross R&D expenses of $52.9 million, not counting R&D in the social sciences or on business information systems. This included both R&D performed in Canada and the value of purchased R&D. Northern Electric in 1969 performed $41.3 million R&D in its own laboratores and purchased technical information for $2.9 million, while Bell Canada performed R&D worth $2.6 million and purchased R&D for $5.9 million (from A.T.&T. Co.). In addition Northern Electric had capital expenditures of $6.2 million for R&D and Bell had capital expenditures of $.5 million.

Similarly, Automatic Electric (Canada) Ltd. is currently spending approx. $1 million annually on R&D in Canada and about $1 million annually for purchased R&D information. Lenkurt of Canada is currently spending $1.4 million on R&D in Canada and $.2 million on purchased R&D.

An annual rate of increase of 10% is expected in R&D expenditures. These figures are quoted here merely as a quide to the magnitude of the

current R&D activities in the integrated telecommunication organizations. It should be noted that such data are never directly comparable because of the many different transfer arrangements for technical information in effect throughout the industry, thus sometimes a parent organization will charge its subsidiaries in full for license information, technical knowhow etc. while in other cases such information is transferred freely without any special charges being made.

The Total Systems Concept

The basic philosophy underlying the integration in one corporation of telephone operations, manufacturing and research and development activities is the total systems concept. This simply implies that for best results all of the various factors influencing the development of the telecommunication carrier network must be taken into account in a total planning concept to ensure best results. This concept was first developed by the American Telephone and Telegraph Company but it is today a fact that most countries with highly developed public telecommunication system do have complete or partial integration of operations, manufacturing and R&D in this field. An interesting comment on this facet of A.T.&T. organization is given by the eminent economist John Kenneth Galbraith in his book, "The New Industrial State":

> From pages 364-365:
> "The railroads, under a different system of regulation, followed their own rather special pattern of development.[1]

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[1]Most American railroads have had a pattern of development different from that of the firms of similar size in the industrial system. There is no similarly developed technostructure; for most of their history there has been no similar technical dynamic; there has been no similar capacity for taking control of prices, demand for the services, labor and capital supply and the other

requisites for successful planning. Regulations, prohibitions on mergers and diversification of activities and a tradition of routine, highly ritualized management of low technical aspiration and competence have all been factors. In Japan, France, Canada and other countries where there has been one national system or one or two dominant systems, the industry has had greater control over the requisites of its planning and its comparative performance value have been better. Each part provided a fraction of the total services of moving people locally and regionally; none, in consequence, could plan the entire service. None had appreciable authority over prices, use of service, capital supply or labor supply. None had a developed technostructure. In an industry which required planning, none of the requisites of planned performance were available. It is not surprising that the results have been singularly bad.

Although no parallels are exact, it is interesting to contemplate the different development of telephone service. This makes use of an old form of electronic communication. As in the case of the railroads and urban transit, alternative technology has been massively subsidized by the Federal government for military purposes. But in the telephone industry one giant corporation had planning authority coordinate with the whole task. It embraced both local and long-distance service. It had resources for competitive technical development and also for seeking government underwriting of such development where, as is usually the case, this could be justified by military application. The scale of A.T.&T. accorded it substantial authority over rates; it could enter actively on the management of the demand for its services; it had control over its capital supply; size combined with technological advance have enabled it to plan its labor requirements, keep them within the prospective supply and maintain authority over its labor force.

Had local telephone service been provided by one or more companies in each city, town and hamlet; had all these rates been subject to local regulation and influence; had long-distance service been supplied by numerous separate companies, only loosely coordinated with the local service; had there been little or no research or technical development anywhere in the system; had the local units been strongly dependent on external authority - municipal government or local banks - for capital; and had there been no planned provision for labor supply or substitute technology, it seems unlikely that telephonic communications could have survived in any very useful form.[2] That they flourished, none can doubt, is owing not to a mindless response to a free market but to the subordination of the market at all points to comprehensive planning."

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[2]As a partial demonstration of the point, it has been suggested that, in the absence of automatic transmission of calls, it would require approximately the entire female working force of the country to handle current traffic.

The Canadian situation differs in degree from that of the U.S. but there can be no doubt that the application of the total planning concept has played a major role in giving us a telecommunication system of high quality. Due to special arrangements such as the service agreements existing between Bell Canada and other telephone companies, much of the basic planning information used by or originating in Bell Canada is made available to other Canadian telecommunication carriers, and similarly the R&D arm of the two integrated corporations Bell-Northern and B.C. Tel. - Lenkurt (Canada) - Automatic Electric (Canada) are very much interested in maintaining close liaison with all of the telecommunication carriers. These agreements will be discussed in more detail later.

The telecommunications network is in a very real sense growing organically as a living mechanism. Whenever new systems or equipment are incorporated into this network they must be compatible with the existing equipment but at the same time make use of the most modern technology and accommodate new and more sophisticated service needs. Because of the billions of interacting parts in the public telecommunication network extremely high reliability is required. Thus an electronic switching machine is designed and built to give reliability several orders of magnitude greater than commercial computers. The very marked increase in productivity which has taken place within the telecommunication carrier industry within the last decade, is largely due to improved technology and improved equipment reliability making it possible to provide installation and maintenance of a rapidly growing plant without a corresponding increase in maintenance and installation personnel.

Some of the advantages accruing to a telecommunication carrier from an integrated organization involving operations, manufacturing and R&D are these:

- Cordinated planning whereby the operating requirements of the telecommunication carrier, the state of the art in technology, the expertise in the systems engineering field of the R&D organization can all be brought to bear on a problem for optimum results.
- Decisions with respect to innovation can be taken for the long term, thus permitting innovative items to be introduced earlier than would be possible under a non-integrated method of operation which tends to insist on financial pay-off for the short term.
- Compatibility is stressed as the R&D and manufacturing organizations will possess an intimate knowledge of the existing network, the operating standards of that network and of any special technical problems existing as regards network operations.
- Maintainability of equipment is stressed. The telecommunication carrier has a special interest that equipment be designed which can be maintained at low cost by few people employing as much as possible regular maintenance personnel and standard test equipment. The preparation and availability of good maintenance and installation practices is important in this connection.

- Saving in engineering staff and effort. If the telecommunication carrier is able and willing to rely on the expertise and reliability of its associated manufacturer and the insight of R&D staff, a very considerable duplication in planning efforts may be avoided. In this case the relationship is essentially one of mutual trust. While the telecommunication carrier will always assume the role of the customer - and sometimes a customer who is very hard to please - little time is wasted in doing the same job twice.
- Exploratory R&D performed by the R&D laboratory on behalf of the telecommunication carrier and system engineering studies performed in advance of decisions on development of new systems play a key role in strengthening the technical decision-making capability of the operating company and ensuring that the most up-to-date technological knowledge is brought to bear on the solution of planning problems.
- The assurance that the right kind of equipment, built to the right standards, will be available when it is needed, and that maintenance parts, installation services, and technical assistance as required will be readily available.
- An organized maintenance and installation service will be available from one main source thus greatly simplifying the management of these services.
- Saving and simplification of supply services because the telecommunication carrier is able to keep a lower level of spare parts inventory without endangering the safety

of his equipment and may also rely on the manufacturer to keep the main spare parts inventory, while further savings are available because of simplified supply routes and administration.

- Generally lower prices because the manufacturing plant is able to plan for optimum production runs, runs little risk of wasting R&D and engineering effort on products for which there is no market, and is able to realize considerable savings in marketing, distribution and inventory stock. Obviously, these advantages only partially apply to a company supplying both an associated telecommunication carrier and the general equipment market but then on the other hand sales to the general market and for export help to lower production costs because of greater economies of scale.
- Exchange of personnel between R&D laboratories, manufacturing plant and the telecommunication carrier company entails considerable advantage for all parties. Thus it is essential for the Systems Engineering Department of an R&D laboratory to possess an intimate knowledge of the problems of telecommunications operations, and for this reason many of the systems engineers have many years of experience with operating companies. Similarly, a telecommunication carrier will often require personnel with a predominant R&D or manufacturing background for specialized tasks or simply to provide an infusion of new blood in the organization.

It should be noted that many of these advantages of an integrated type of organization can to a large degree be shared by independent telecommunication carrier companies which choose to avail themselves of the products and the assistance of the integrated corporations. On the other side the large independent portion of the market in many ways acts to stimulate and encourage a competitive attitude within the integrated R&D, manufacturing, and operating structure.

Some of the advantages accruing to the manufacturer and the associated R&D organization from an integrated type of corporate structure are these:

- Planning for new product development under a total systems concept in close cooperation with the telecommunication carrier provides the R&D systems engineers with a much better background of information on the requirements of the telecommunication carrier, a wealth of planning data, critical coordination of equipment specifications and design goals in advance of actual development work, and also provides the R&D organization and the manufacturing organization an opportunity to influence the planning activities of the carrier company.
- Knowledge of the requirements of the telecommunication carrier, the framework of costs agreed to, and the timing envisaged for development and manufacture, enables the R&D and the manufacturing organizations to do a better planning job subject to less uncertainty. In particular such knowledge aids in establishing a reasonable balance between commitment of funds to R&D and to engineering of manufacture.

- Consultation between the carrier, the R&D laboratory and the manufacturing plant during the development, manufacturing and installation phases proves helpful in eliminating "bugs" in equipment at an early stage. A particularly important aspect of new product development is field testing of the equipment, and this is usually undertaken in cooperation with the carrier.
- Close and continuous association with the telecommunication carrier on all phases of network technology strengthens the capability of the R&D and manufacturing organizations and also enables the manufacturer to offer similar assistance to customers outside of his own integrated corporation.
- The basic relationship of trust existing between the various arms of such an integrated organization enables the planners and the R&D staff to concentrate on problem solving without serving double duty as salesmen.
- Greater market stability and strong financial backing provides the manufacturer and his R&D organization with the ability to plan ahead and strive for a more efficient utilization of resources in plant and manpower than if such a partly stabilized market did not exist.
- In most areas of modern telecommunication technology size is important and is becoming more so in a market increasingly dominated by giant-sized international corporations. Participation in an integrated corporation helps to establish a reasonable base of manufacturing operations which may be

enlarged through further expansion into the uncommitted markets.

. Constant feedback of information from the telecommunication carrier on the need for improvement in existing equipment helps the manufacturer to undertake product improvements which in turn help to prolong the useful lifespan of a product. A certain percentage of R&D effort will always need to be devoted to such product improvement.

. Exchange of manpower with the telecommunication carrier is very important for an R&D organization, particularly in the field of systems engineering.

The above enumeration of the advantages of industry integration should not be taken as an argument against the need for viable, smaller manufacturers in the telecommunication field. It is becoming increasingly evident that even the very largest manufacturing firms can not hope to provide all the needs of the telecommunications industry. The larger firms are not selfsufficient, thus the Northern Electric Company makes use of the services of approx. 5000 subcontractors in Canada and has contributed much assistance to many of these subcontractors to help them provide Canadian replacements for products which were previously imported. Also, there is a great scope for the smaller firm and the entrepreneur in mushrooming new fields such as CATV, business machines for use over the telecommunication system, data processing equipment, instrumentation, telemetering, and a long, long list of other specialties. There is thus no danger that the major corporations will preempt the field, on the contrary there is plenty of scope for everybody and there is no end in sight for the need to do expanded R&D in electronics.

Northern El 5000 subcontrs

Some advantages of integration of the telecommunication industry from a national point of view are these:

- Industry integration has been instrumental in developing a strong Canadian telecommunication manufacturing industry making a major contribution to the Canadian economy.
- The integrated telecommunication industry has led the way in technological innovation and contributed to giving Canada a public telecommunication service of high quality, providing service at reasonable rates by international standards.
- The major portion of Canadian R&D in the electronics field is performed by such integrated corporations. This effort is strongly supported by the operating companies which have done much to encourage industrial R&D in telecommunications in Canada.
- In times of emergency the Canadian telecommunication system is more secure because most of the technical equipment in this network is of Canadian manufacture - and increasingly also of Canadian design.
- The telecommunication carrier companies will in future years be investing billions of dollars in network expansion and modernization. This will represent a significant part of our total national investment. By substantially plowing these funds back into the Canadian industry through purchase of Canadian equipment and performance of indigenous R&D we help to strengthen

a particularly significant sector of the Canadian economy, which provides livelihood to 100,000 Canadians (in 1970).

- The growing strength of the Canadian telecommunication manufacturing industry is evident in the strengthened position of the industry in the export markets. This is a very encouraging sign.
- The telecommunications R&D laboratories are creating a need for highly competent technologists and scientists in Canada and will be a strong factor in stopping the "brain drain" to the U.S.
- From a national defence point of view the strong R&D establishments of the integrated corporations are a very real asset in peace or in war.
- If we are to accept the viewpoint of Servan-Schreiber, quoted earlier in this chapter, that "electronics is not an ordinary industry: it is the base upon which the next stage of industrial - and cultural - development depends" then it becomes doubly important to do everything in our power to build up a strong electronics industry in Canada, and there can be little doubt that the degree of integration existing in Canada between telecommunication operations, manufacturing and R&D has contributed much to our present strength in this field of technology.

Subsidiaries of international companies performing R&D or manufacturing in Canada are important in the industry. This really represents a different form of industry integration in that these companies draw part of their strength both in R&D and in marketing from the parent company.

Some of these companies do a substantial amount of R&D in Canada, such as RCA (Canada) which develops satellite communications ground stations and microwave relays on behalf of the RCA corporation, and otherwise engages in defence contracts and space work, mostly under contracts to the Federal Government. It is of interest to note that in the placement of defence contracts the Federal Government has in no way discriminated against subsidiaries of foreign companies as long as these companies performed R&D and manufacturing in Canada.

BELL CANADA - NORTHERN ELECTRIC

Because of the large size of this organization and its central position in the R&D field it would appear appropriate to describe the main features of this corporate structure.

Bell Canada is almost entirely Canadian-owned in the 95% of the equity capital and 98% of the shareholders are Canadian. Its main operating subsidiaries are: The Newfoundland Telephone Company, New Brunswick Telephone Company and Northern Telephone Limited. Bell Canada also has majority ownership in the Maritime Telephone and Telegraph Company Limited but is restricted to voting 1000 shares only under Nova Scotia legislation. Northern Electric Company Limited is the main manufacturing subsidiary and is 100% owned by Bell Canada. The Northern Electric Company holds controlling interest in a new corporation, Microsystems International Limited, which has been established for the purpose of developing and manufacturing microcircuits for an international market and for use in domestic Canadian equipment. Up to the present time the R&D effort has been conducted by the Northern Electric Research and Development Laboratories with main laboratories

in Ottawa and branch laboratories in Montreal, Lachine, Belleville, Kanata, London, and Toronto. These are the largest industrial laboratories in Canada, employing more than 2000 persons, and performing R&D covering most of the telecommunications field. The establishment of these laboratories as a separate company has been announced with effect from 1 Jan. 1971. Formally the laboratories will be called the Bell Canada - Northern Electric Research Laboratories but the shorter name "Bell Northern Research" will be commonly used. This reorganization will give the Laboratories a stronger voice vis-a-vis Bell and Northern, and it might also be an advantage for non-Bell telecommunication carriers to be able to contract directly with the Laboratories for R&D in support of their operations and planning.

Northern Electric was reorganized in 1969 essentially along product lines. Thus both marketing and manufacturing of Switching Equipment were combined in one Company division, while similarly structured divisions were established for Transmission, Wire and cable, and Apparatus, respectively. The product line organization is somewhat modified by the establishment of a separate division for International Operations and another for Distribution Sales which will provide special marketing assistance and services for the product line divisions. Under this organizational concept each product line division will work with the R&D Laboratories and with Bell Canada in determining R&D programs for each product line and will provide funding in support of such R&D. Such program determination is mainly performed by Product Planning Committees, one for each product line, with the Systems Engineering Department of the Laboratories providing strong support through the preparation of a Prospectus for each project, coordination of

market forecasts, technological data etc. The principal involvement of Bell Canada is through the Planning and Research Department of Bell Canada HQ. Microsystems International Limited will also undertake a very agressive R&D program, part of which will be performed by the R&D Laboratories and part by MIL directly.

As previously mentioned, Bell Canada is particularly interested in exploratory development work which is performed by the Laboratories in advance of actual development work to provide insights and data for use in planning future development projects. Bell Canada funds (70%) of such exploratory R&D with Northern Electric paying the other (30%). Development costs are in general recovered by Northern Electric through sales of equipment.

Prior to 1957 the Western Electric Company of the U.S. held a 43.6% interest in Northern Electric, the remaining stock being owned by Bell Canada. Partly as a result of the Consent Decree entered into in 1956 between the U.S. Department of Justice and the A.T.&T. Company, Western Electric sold its investment in Northern Electric to Bell Canada. Bell Canada acquired 89.97% ownership of Northern Electric in 1957, increased to 99.99% in 1962, and 100% in 1964.

Up to 1959 the Northern Electric Company had operated mainly as a manufacturing plant using design information originating with Western Electric Company and Bell Labs. It was felt this was not a desirable permanent situation, and in 1955 a study was made by Dr. C.J. Mackenzie, former President of the National Research Council, on the establishment of a centralized research and development laboratory. The R&D Laboratories were formally established in the summer of 1958.

Under a Service Agreement entered into in 1923 with the A.T.&T. Company on Services, Licenses and Privileges, and succeeded by a Service Agreement of 1949 which is still in force, Bell Canada has access to results of Bell Laboratory research and advice and assistance from the A.T.&T. Company on a wide range of matters, including general engineering, plant, traffic, operating, commercial, accounting and other matters and has the right to furnish such information to other operating companies in Canada. The agreement also gives Bell Canada the right to use of Bell Lab. and Western Electric patents and licenses and it may extend this right to its subsidiaries. Under agreements between Bell Canada and other Canadian telephone companies these companies also receive such information (excluding patents and licenses) but all companies do not contract for the same amount of information. It should be noted that the information received under the Service Agreement is not design information. It serves a very useful purpose in facilitating coordination of North-American telephone services and keeps us abreast of developments within the Bell System but does not contain the detailed manufacturing information nor design calculations and manufacturing knowhow.

Bell & ATT

Northern Electric has for many years had a Patent License Agreement and a Technical Information Agreement with Western Electric. Prior to 1959 Northern Electric under the terms of the Technical Information Agreement had rather free access to Western Electric design information and manufacturing knowhow. When the T.I.A. was renewed in 1959 for a further five years, and again in 1964, the amount of information obtained by Northern Electric under the T.I.A. was greatly reduced, and the economic terms became much less favourable. Essentially, Northern Electric is now in the same position

vis-a-vis Western Electric as any other manufacturing company, as any manufacturer may obtain patents and technical information from Western Electric on equal terms under the Consent Decree of 1956. The flow of information under the T.I.A. entered into in 1969 between Northern Electric and Western Electric has dwindled to a trickle and mainly comprises certain types of information on electronic switching. No manufacturing knowhow is included under the T.I.A.

The Technical Information Agreement may be considered a straight commercial agreement of decreasing significance to Northern Electric as most of Northern Electric's new designs are based on independent Canadian R&D. It will, however, be of some importance for some time to come because so many of Northern Electric's current products are based on original Western Electric designs or make use of W.E. patents.

The main significance of the A.T.&T. Company - Bell Canada Service Agreement to Northern Electric is that under the terms of this agreement Northern Electric makes use of W.E. patents without paying royalties on sales to Bell Canada or its operating subsidiaries but has to make a charge to cover royalty payments on sales to other companies if any W.E. patents are used in equipment sold.

It will be evident from the above that the special relationship which once existed between Western Electric and Northern Electric has undergone a drastic change in the past ten years and that today nothing more than a straight commercial relationship remains. Fortunately, the R&D capability of Northern Electric has now expanded very significantly but even then it is beyond the resources of that organization to generate

designs covering all the requirements of the operating industry. The most important thing is to concentrate efforts on those projects which are really important. A major concern in preparing an R&D program is therefore to make the right Make or Buy decisions.

In 1969 Northern Electric's performed R&D amounted to approx. $41.3 million while the value of information purchased from Western Electric was $2.9 million. The corresponding figures for Bell Canada were: Performed R&D $2.6 million, purchased R&D (From A.T.&T. $5.9 million). The R&D budget of Northern Electric has been increasing at a rate of $5 million annually for some years now and should continue to do so over the next five-year period unless the current shortage of funds continues and forces a stop to this expansion.

Nor should it be forgotten in discussion of R&D being performed by the R&D Laboratories that some very worthwhile R&D is also being undertaken directly by Bell Canada. Such telecommunication carrier R&D is normally concerned with special assembly work to engineer a system to suit a specific function but some larger efforts such as the SWAP system development, which is a radio paging system for wide area use, have been undertaken by Bell engineering staff. A considerable amount of development work is also being done in the operating industry in the area of improved technology for burying cables, improved maintenance practices, etc. Bell Canada is also actively engaged in research in the demographic and social science field, in cooperation with the University of Toronto and Université de Montréal.

SWAP

INNOVATION IN THE OPERATING INDUSTRY

The telecommunication carriers are engaged in a continuing process of innovation to keep abreast of the growing demands for new and more sophisticated demands for telecommunication services, to expand the existing network facilities as part of a natural growth process, and to modernize or replace existing plant which no longer is able to meet the exacting demands of the network. A major aim of this process of innovation is to increase productivity, and this industry has been highly successful in absorbing greatly increased equipment costs and an increased tax burden, as well as greatly increased salary expenses, through increases in efficiency. Only very recently - in the last three years - has the inflationary trend in our economy been so pronounced as to outstrip the industry's ability to compensate for spiralling costs through productivity increases alone. Undoubtedly the strong technological position of the telecommunication carriers, combined with the efforts of the manufacturing industry and R&D organizations in support of the carriers, has been a decisive factor in promoting this flow of innovation in the carrier industry. It must be observed that innovation encompasses something far more than the introduction of modern equipment and complex communications systems. It is a way of life - it is a constant striving to do things better - to provide better service through better facilities, using improved methods and procedures, improved management of the network, and to employ resources-people, technology and capital-to best advantage.

The various problems and opportunities for R&D and innovation in the field of telecommunication technology have been well described in Telecommission study 4(a) on the Future of Technology and will not be

repeated here. Let it just be mentioned that such technological problems very often arise from a need in the operating field. An example of this was the introduction of Direct Distance Dialling (DDD). By the end of the forties it was becoming clear that the telephone companies were experiencing serious difficulty in engaging enough long-distance operators to cope with a burgeoning demand for long distance calls. The logical answer was the introduction of DDD which was undertaken on a North-American basis, starting in 1958 in Canada. Today a problem is experienced in coping with the relatively small proportion of calls which still require operator assistance, and the answer to this problem is expected to be the development of a New Traffic Service Position System based on the SP-1 stored program switching machine. This system will not replace telephone operators but will help to streamline their work functions and the attendants' equipment so as to make it possible for one operator to serve more customers.

DDD 1958

The computerization of billing, accounting, and supply services has proceeded systematically at a rapid pace, and the telecommunication carriers are leading the way in the adaptation of computers to industrial uses.

Another major innovation program is the increased use of buried plant by all TCTS companies. This has advantages from a maintenance as well as from an esthetic point of view, and Alberta Government Telephones in particular have come very far under their program to place most rural cables underground.

The next major steps in innovation will probably be increased use of Pulse Code Modulation (PCM) transmission and switching systems because such systems will be particularly well suited to the transmission and switching

of data traffic at low error rates and also have advantages for voice communication over very long distances. The introduction of PCM technology first became feasible with the invention of the transistor but it took the development of integrated circuits, so-called micro-circuits, to put the development of major PCM systems within economic reach. The extensive application of modular microcircuits on a plug-in basis, self-checking error circuits, and a high degree of redundancy in elements of such micro-circuits will in turn be the answer to an operational need on the part of the telecommunication carriers for equipment of still higher reliability to minimize the maintenance requirements and simplify repairs.

Incidentally, the establishment of Micro-systems International Limited in 1969 is a prime example of joint Government-Industry action to solve a major problem in industrial development. In this instance the Advanced Devices Centre of the Northern Electric Company had been actively developing semiconductors and microcircuits for some years but it was not possible within the existing economic framework to undertake this project on a really major scale. The Department of Industry, Trade and Commerce recognized the need for a really major Canadian effort in the field of micro-circuits and provided very extensive economic backing (about $48 million) in the form of conditional grants and loans which made it feasible to establish Micro-systems International Limited as major contender for a good slice of the international market for micro-circuits for telecommunication systems. The potential rewards are large in this field but a substantial element of risk is involved for Northern Electric and Bell Canada in this venture. MIL alone intends to invest $42 million in R&D on micro-circuits over the first five-year period of its life. This project

is probably more significant than any other specific R&D project, because if the venture is successful a basis will have been established for another Canadian quantum leap in electronic technology.

Generation of R&D - Product Cycle

The subject of defining the precise relationship between technological growth, innovation and R&D has not been extensively researched to date. From what literature is available on this subject it would appear that no simple relationship between spending on R&D and technological growth can be established. This would appear reasonable as many other factors such as the general level of education of a country, popular expectations, social environment, managerial competence, and many other factors have a bearing on how fruitful an R&D program will be as a stimulant of industrial growth. What is certain, however, is that without R&D and an attendant high level of technological competence no company, nor any nation, can hope to achieve preeminence in science-based industries.

Certain other factors also deserve attention such as the fact that high growth companies in the electronic field not only possess technological skills but are characterized by earning an above-average return on investment. Thus Servan-Schreiber in "The American Challenge" (page 79) quotes economists maintaining that net profits should be 12-13 percent of equity capital in order to maintain growth in areas of advanced technology. Canadian industry has consistently fallen short of this target which may be deserving of more attention not only on the part of industry but even more so by governments.

Various attempts have been made to predict the requirements for

R&D in terms of "product cycles" and growth rates, and such considerations undoubtedly add to our understanding of the overall problem; but as sometimes changes in technology occur by fairly sudden leaps rather than by a smoothly continuous process, long term prediction is not an easy task. It is generally true that the life-expectancy of new electronic equipment is declining in spite of increased equipment reliability because the equipment is likely to become obsolescent before it is worn out. Such obsolescence may occur either because of functional improvements in newer equipment or because of style changes in the case of customer equipment.

In the case of equipment on telecommunication carrier premises obsolescence is more likely to be functional, e.g. older equipment can not perform additional functions without extensive modification or newer equipment is more compact and easier to maintain. In either case the useful life expectancy equipment is generally becoming shorter, and to stay on top a manufacturer of telecommunication equipment constantly has to update his equipment and replace older products with completely new designs at more frequent intervals. With one blow the transistor made most of the older vacuum tube technology obsolete, and integrated semiconductor circuits promise to make designs using discrete components obsolete for many, if not for all, applications. This means that a telecommunication carrier in addition to the requirement for new equipment for network extension and the provision of new types of services must also on an average count on having to replace all existing plant after a certain number of years. So-called "planned obsolescence" has never been encouraged by the telecommunication carrier industry - as on the contrary equipment is generally built to last a lifetime, but nevertheless the effects of a shortened

product cycle is being felt at both the operating and manufacturing level and is a prime reason why a strong R&D capability is a necessity for survival as far as any manufacturing concern in the telecommunication field is concerned.

To support such a strong R&D capability in a broad field large size is required and moreover many products for the telecommunication carrier industry can only be manufactured economically in very large quantities. Increasingly the large international corporations will become even larger and use their tremendous technological capacity and large scale economy of production to offer much stiffer competition in the world's markets - and on our doorstep. Even Northern Electric Company is only a medium-sized company by international standards and it is therefore essential that Canadian industrial policy should encourage larger size and continued expansion and diversification of Canadian industry. At the same time it should be recognized that in many special fields size is of less importance, and every effort should therefore also be made to encourage the smaller firms and the entrepreneurial enterprise.

APPENDIX 2

Statistical Data - Trans-Canada Telephone System.

DATA FROM ANNUAL REPORTS

MEMBERS OF THE TRANS-CANADA TELEPHONE SYSTEM

TOTAL TELEPHONES

	31 Dec 69	31 Dec 68	Increase	Incr 69/68	Avg Annual Incr 10 yrs
				%	%
Newfoundland Telephone Company Limited	88,247	82,645	5,602	6.8	6.8
Maritime Telegraph and Telephone Company, Limited	269,211	256,388	12,823	5.0	5.4
The New Brunswick Telephone Company, Limited . .	214,820	206,507	8,313	3.9	5.9
Bell Canada	5,752,820	5,450,782	302,038	5.5	5.6
Manitoba Telephone System*	402,967	385,892	17,075	4.4	4.8
Saskatchewan Telecommunications	306,883	297,009	9,874	3.3	5.9
Alberta Government Telephones	468,371	431,075	37,296	8.7	8.9
British Columbia Telephone Company*	974,823	914,304	60,519	6.6	6.8
TRANS-CANADA TELEPHONE SYSTEM	8,478,142	8,024,602	453,540	5.7	5.9

* NOTES

Manitoba Telephone System: year ending 31 March.
British Columbia Telephone Company: 1967-1969 includes Okanagan Telephone Company.

DATA FROM ANNUAL REPORTS

MEMBERS OF THE TRANS-CANADA TELEPHONE SYSTEM

TOTAL OPERATING REVENUES

	1969	1968	Increase	Incr 69/68	Avg Annual Incr 10 yrs
	$	$	$	%	%
Newfoundland Telephone Company Limited	13,261,627	11,675,793	1,585,834	13.6	18.0
Maritime Telegraph and Telephone Company, Limited	38,390,039	35,207,617	3,182,422	9.0	10.0
The New Brunswick Telephone Company, Limited . .	35,332,002	31,965,092	3,366,910	10.5	9.8
Bell Canada	842,090,131	758,477,957	83,612,174	11.0	8.4
Manitoba Telephone System*	48,478,143	43,333,199	5,144,944	11.9	9.7
Saskatchewan Telecommunications	47,094,799	43,265,574	3,829,225	8.9	9.6
Alberta Government Telephones	98,847,686	86,755,471	12,092,215	13.9	15.4
British Columbia Telephone Company*	158,044,000	139,389,349	18,654,651	13.4	11.2
TRANS-CANADA TELEPHONE SYSTEM	1,281,538,427	1,150,070,052	131,468,375	11.4	9.3

* See notes on page 1.

DATA FROM ANNUAL REPORTS

MEMBERS OF THE TRANS-CANADA TELEPHONE SYSTEM

LOCAL SERVICE REVENUES

	1969	1968	Increase	Incr 69/68	Avg Annual Incr 10 yrs
	$	$	$	%	%
Newfoundland Telephone Company Limited	6,765,830	6,135,505	630,325	10.3	15.6
Maritime Telegraph and Telephone Company, Limited	19,574,955	18,239,743	1,335,212	7.3	8.3
The New Brunswick Telephone Company, Limited . .	14,740,601	13,665,927	1,074,674	7.9	7.3
Bell Canada	472,827,086	437,553,742	35,273,344	8.1	7.3
Manitoba Telephone System*	21,498,292	20,199,594	1,298,698	6.4	6.1
Saskatchewan Telecommunications	17,427,915	16,416,314	1,011,601	6.2	8.6
Alberta Government Telephones	32,149,350	28,857,905	3,291,445	11.4	13.2
British Columbia Telephone Company*	78,363,000	72,640,898	5,722,102	7.9	8.3
TRANS-CANADA TELEPHONE SYSTEM	663,347,029	613,709,628	49,637,401	8.1	7.7

* See notes on page 1.

DATA FROM ANNUAL REPORTS

MEMBERS OF THE TRANS-CANADA TELEPHONE SYSTEM

TOLL SERVICE REVENUES

	1969	1968	Increase	Incr 69/68	Avg Annual Incr 10 yrs
	$	$	$	%	%
Newfoundland Telephone Company Limited	6,384,357	5,414,898	969,459	17.9	22.8
Maritime Telegraph and Telephone Company, Limited	17,948,927	16,121,997	1,826,930	11.3	12.0
The New Brunswick Telephone Company, Limited . .	19,572,207	17,369,566	2,202,641	12.7	12.0
Bell Canada	329,209,338	284,713,476	44,495,862	15.6	10.5
Manitoba Telephone System*	25,390,408	21,685,060	3,705,348	17.1	14.3
Saskatchewan Telecommunications	28,249,646	25,542,822	2,706,824	10.6	10.2
Alberta Government Telephones	62,865,148	54,176,491	8,688,657	16.0	16.7
British Columbia Telephone Company*	74,969,000	63,391,164	11,577,836	18.3	15.8
TRANS-CANADA TELEPHONE SYSTEM	564,589,031	488,415,474	76,173,557	15.6	12.0

* See notes on page 1.

DATA FROM ANNUAL REPORTS

MEMBERS OF THE TRANS-CANADA TELEPHONE SYSTEM

TOTAL OPERATING EXPENSES#

	1969	1968	Increase	Incr 69/68	Avg Annual Incr 10 yrs
	$	$	$	%	%
Newfoundland Telephone Company Limited	9,594,006	8,033,525	1,560,481	19.4	20.8
Maritime Telegraph and Telephone Company, Limited	24,037,755	21,380,720	2,657,035	12.4	9.6
The New Brunswick Telephone Company, Limited . .	22,929,514	20,357,565	2,571,949	12.6	10.2
Bell Canada	530,200,446	463,986,847	66,213,599	14.3	7.5
Manitoba Telephone System*	36,765,099	33,011,332	3,753,767	11.4	8.8
Saskatchewan Telecommunications	30,332,587	28,586,623	1,745,964	6.1	7.4
Alberta Government Telephones	73,505,234	66,389,913	7,115,321	10.7	15.0
British Columbia Telephone Company*	100,856,000	87,878,499	12,977,501	14.8	10.8
TRANS-CANADA TELEPHONE SYSTEM	828,220,641	729,625,024	98,595,617	13.5	8.7

* See notes on page 1.
\# Includes Depreciation, excludes Taxes and Interest Charges.

DATA FROM ANNUAL REPORTS

MEMBERS OF THE TRANS-CANADA TELEPHONE SYSTEM

TOLL MESSAGES

	1969	1968	Increase	Incr 69/68	Avg Annual Incr 10 yrs
				%	%
Newfoundland Telephone Company Limited	4,967,900	4,606,400	361,500	7.8	11.7
Maritime Telegraph and Telephone Company, Limited	13,900,562	13,112,092	788,470	6.0	7.2
The New Brunswick Telephone Company, Limited . .	9,793,718	9,012,863	780,855	8.7	9.1
Bell Canada	271,762,924	243,080,492	28,682,432	11.8	7.0
Manitoba Telephone System*	14,300,000	12,900,000	1,400,000	10.9	6.5
Saskatchewan Telecommunications	18,272,000	17,351,000	921,000	5.3	6.5
Alberta Government Telephones	38,558,467	34,786,774	3,771,693	10.8	10.8
British Columbia Telephone Company*	38,333,479	33,094,626	5,238,853	15.8	8.1
TRANS-CANADA TELEPHONE SYSTEM	409,889,050	367,944,247	41,944,803	11.4	7.5

* See notes on page 1.

DATA FROM ANNUAL REPORTS

MEMBERS OF THE TRANS-CANADA TELEPHONE SYSTEM

TOTAL TELEPHONE PLANT

	31 Dec 69	31 Dec 68	Increase	Incr 69/68	Avg Annual Incr 10 yrs
	$	$	$	%	%
Newfoundland Telephone Company Limited	55,379,535	50,393,805	4,985,730	9.9	12.5
Maritime Telegraph and Telephone Company, Limited	172,101,198	159,475,188	12,626,010	7.9	10.1
The New Brunswick Telephone Company, Limited . .	159,076,755	146,461,480	12,615,275	8.6	9.7
Bell Canada	3,593,443,180	3,279,224,000	314,219,180	9.6	8.9
Manitoba Telephone System*	263,764,855	239,054,762	24,710,093	10.3	8.2
Saskatchewan Telecommunications	217,707,821	202,533,233	15,174,588	7.5	8.3
Alberta Government Telephones	476,382,011	420,508,342	55,873,669	13.3	13.4
British Columbia Telephone Company*	678,715,000	616,604,753	62,110,247	10.1	10.8
TRANS-CANADA TELEPHONE SYSTEM	5,616,570,355	5,114,255,563	502,314,792	9.8	9.4

* See notes on page 1.

DATA FROM ANNUAL REPORTS

MEMBERS OF THE TRANS-CANADA TELEPHONE SYSTEM

CONSTRUCTION EXPENDITURES

	1969	1968	Increase	Incr 69/68	Avg Annual Incr 10 yrs
	$	$	$	%	%
Newfoundland Telephone Company Limited	6,514,027	6,708,206	(194,179)	(2.9)	11.4
Maritime Telegraph and Telephone Company, Limited	17,747,526	19,165,684	(1,418,158)	(7.4)	8.6
The New Brunswick Telephone Company, Limited	17,176,351	14,572,454	2,603,897	17.9	11.2
Bell Canada	389,326,223	338,628,855	50,697,368	15.0	7.1
Manitoba Telephone System*	32,000,000	28,600,000	3,400,000	11.9	10.6
Saskatchewan Telecommunications	22,866,417	22,590,454	275,963	1.2	10.5
Alberta Government Telephones	69,700,000	57,721,000	11,979,000	20.8	8.9
British Columbia Telephone Company*	74,000,000	70,802,771	3,197,229	4.5	6.1
TRANS-CANADA TELEPHONE SYSTEM	629,330,544	558,789,424	70,541,120	12.6	7.6

* See notes on page 1.

DATA FROM ANNUAL REPORTS

MEMBERS OF THE TRANS-CANADA TELEPHONE SYSTEM

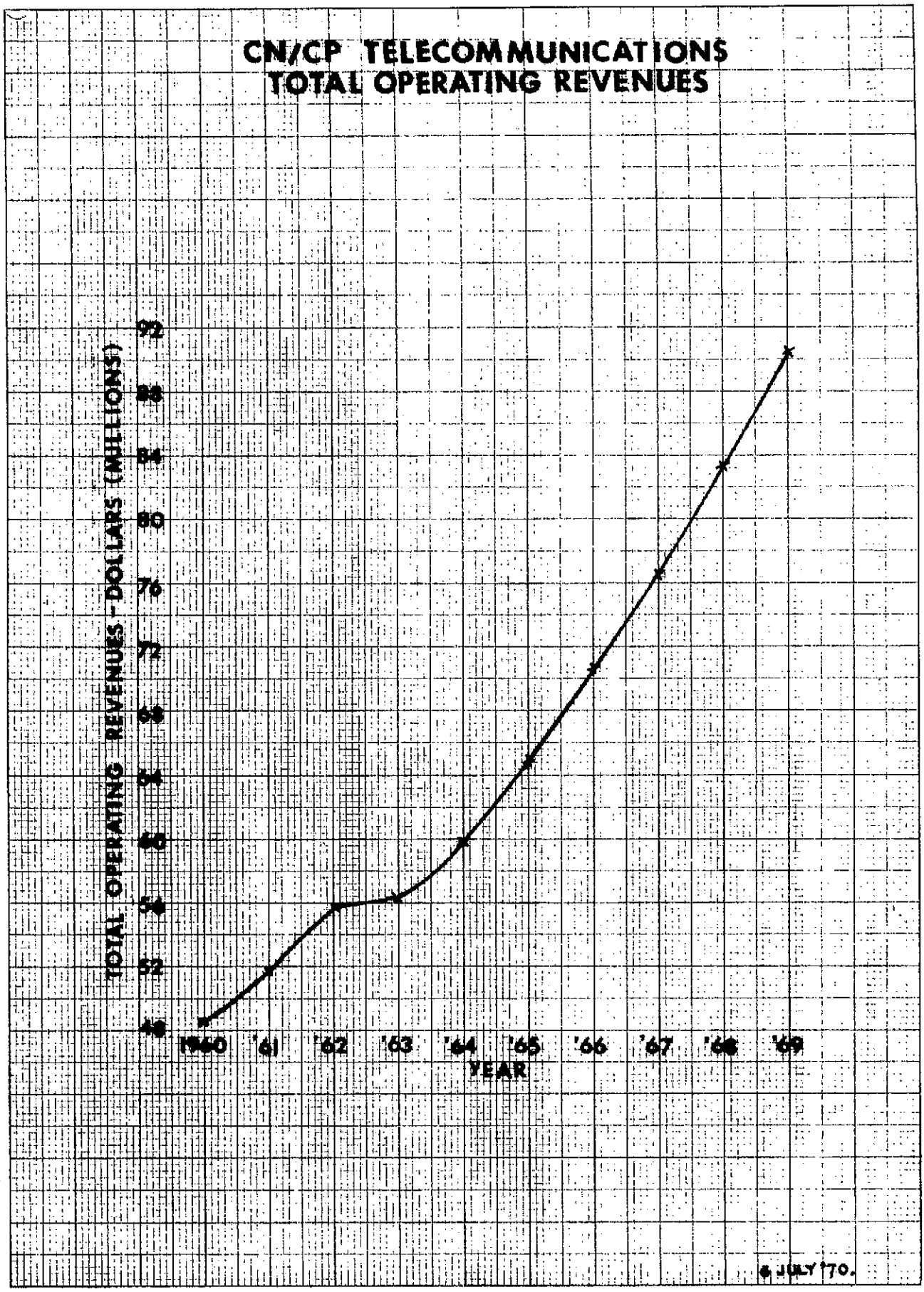
NUMBER OF EMPLOYEES

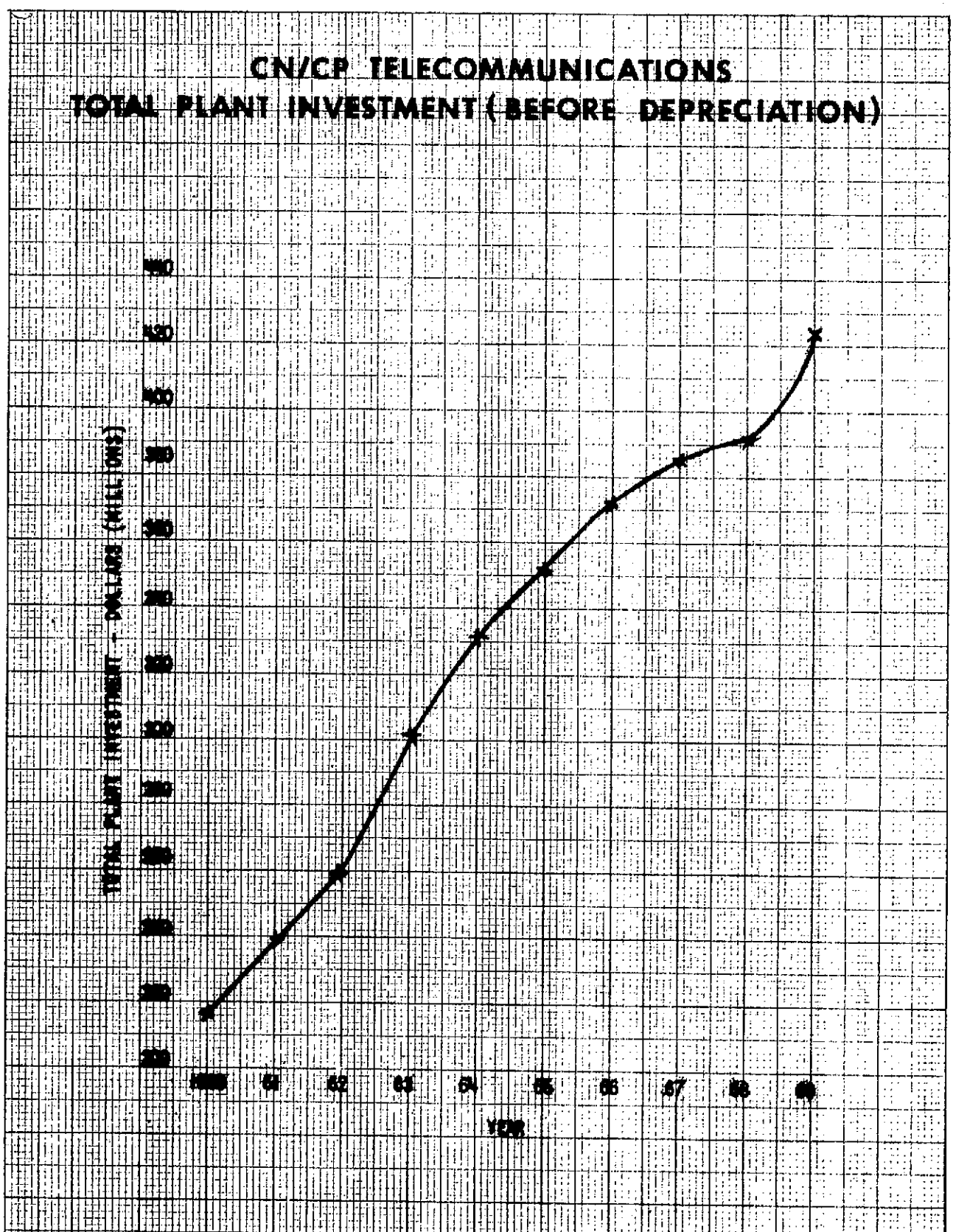
	31 Dec 69	31 Dec 68	Increase	Incr 69/68	Avg Annual Incr 10 yrs
				%	%
Newfoundland Telephone Company Limited	849	835	14	1.7	4.6
Maritime Telegraph and Telephone Company, Limited	2,469	2,474	(5)	(0.2)	3.0
The New Brunswick Telephone Company, Limited . .	2,069	1,992	77	3.9	2.7
Bell Canada	38,686	37,489	1,197	3.2	0.4
Manitoba Telephone System*	4,159	4,257	(98)	(2.3)	2.3
Saskatchewan Telecommunications	2,435	2,447	(12)	(0.5)	2.0
Alberta Government Telephones	6,791	6,360	431	6.8	6.5
British Columbia Telephone Company*	8,889	7,991	898	11.2	3.7
TRANS-CANADA TELEPHONE SYSTEM	66,347	63,845	2,502	3.9	1.7

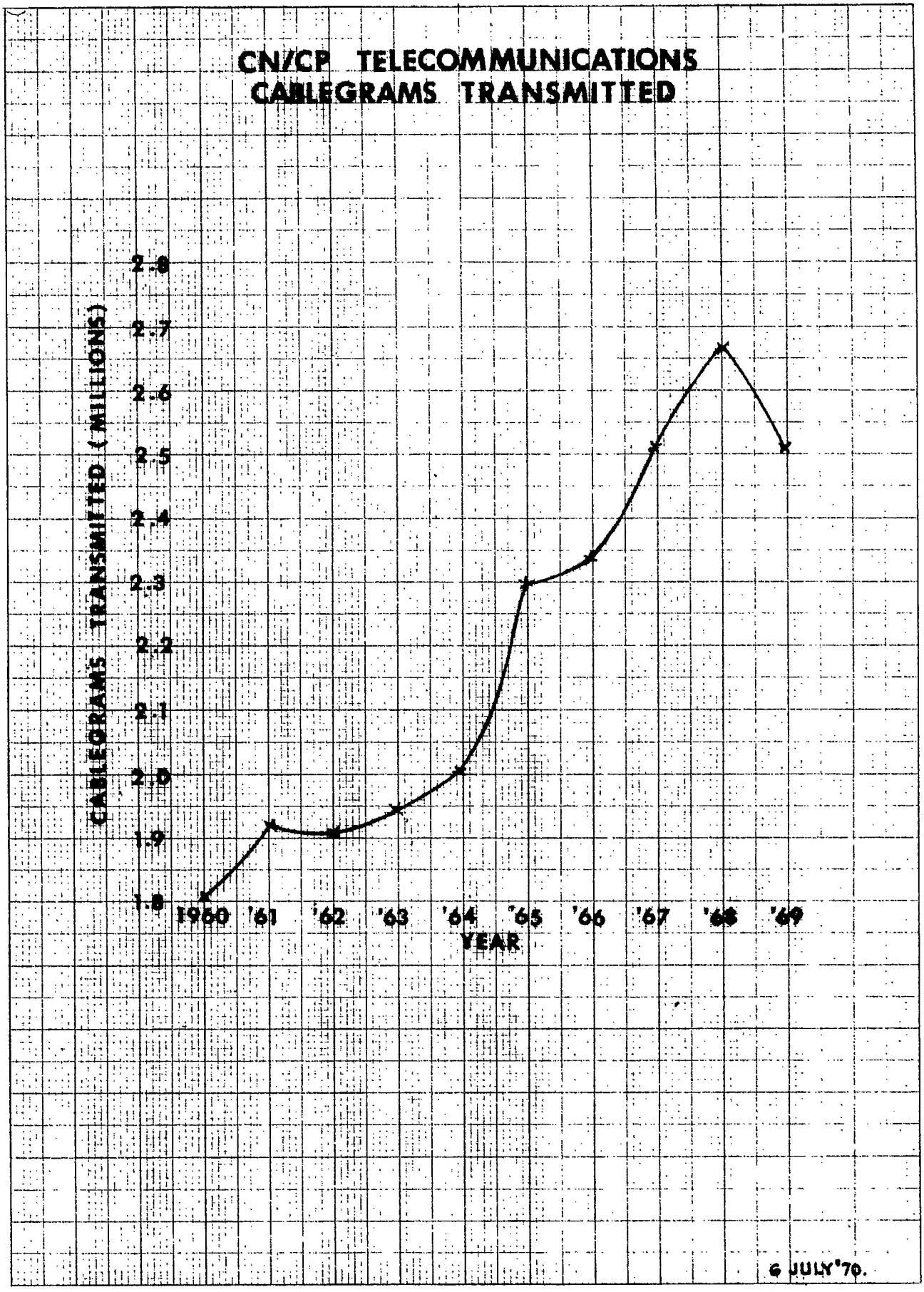
* See notes on page 1.

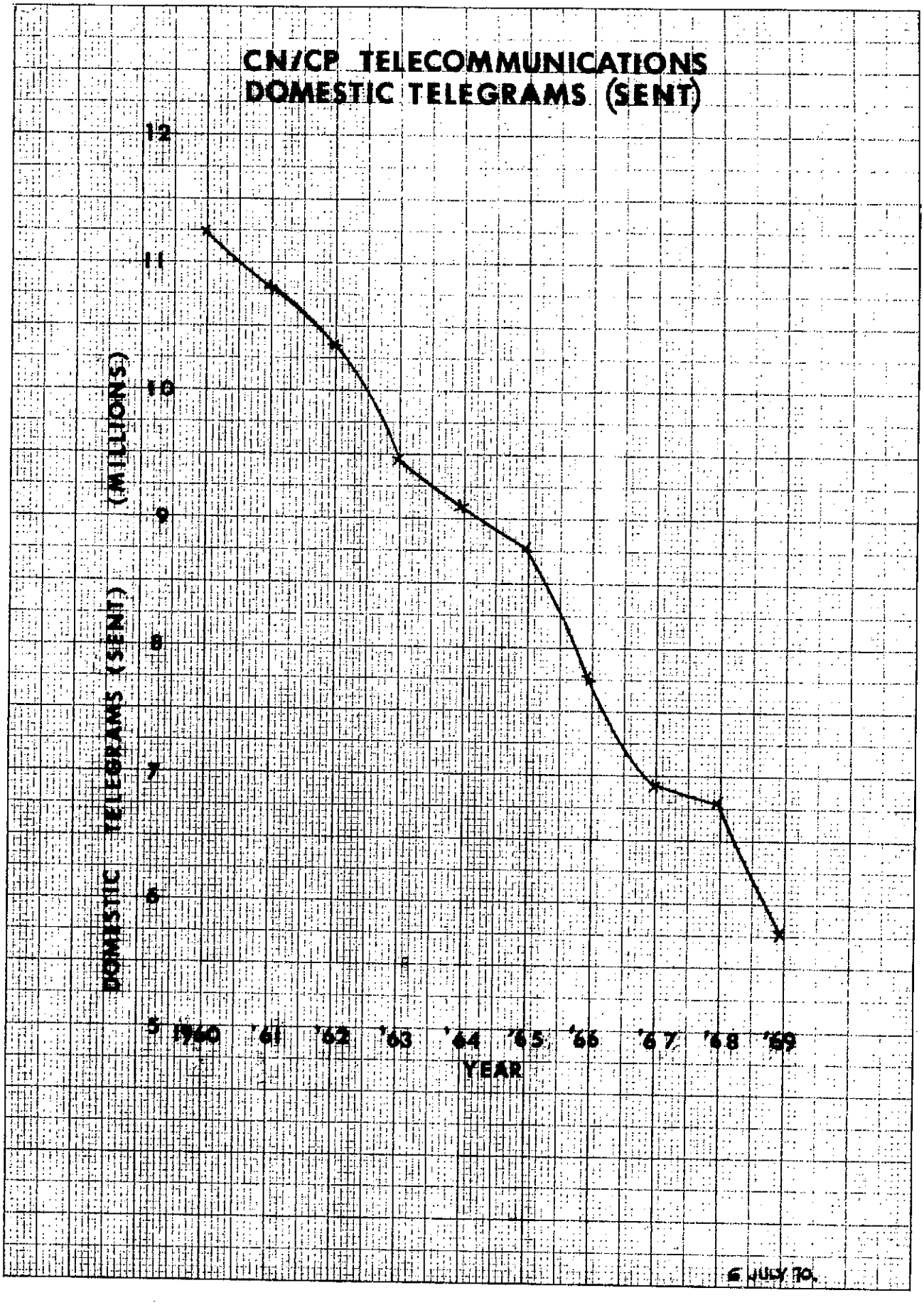
APPENDIX 3

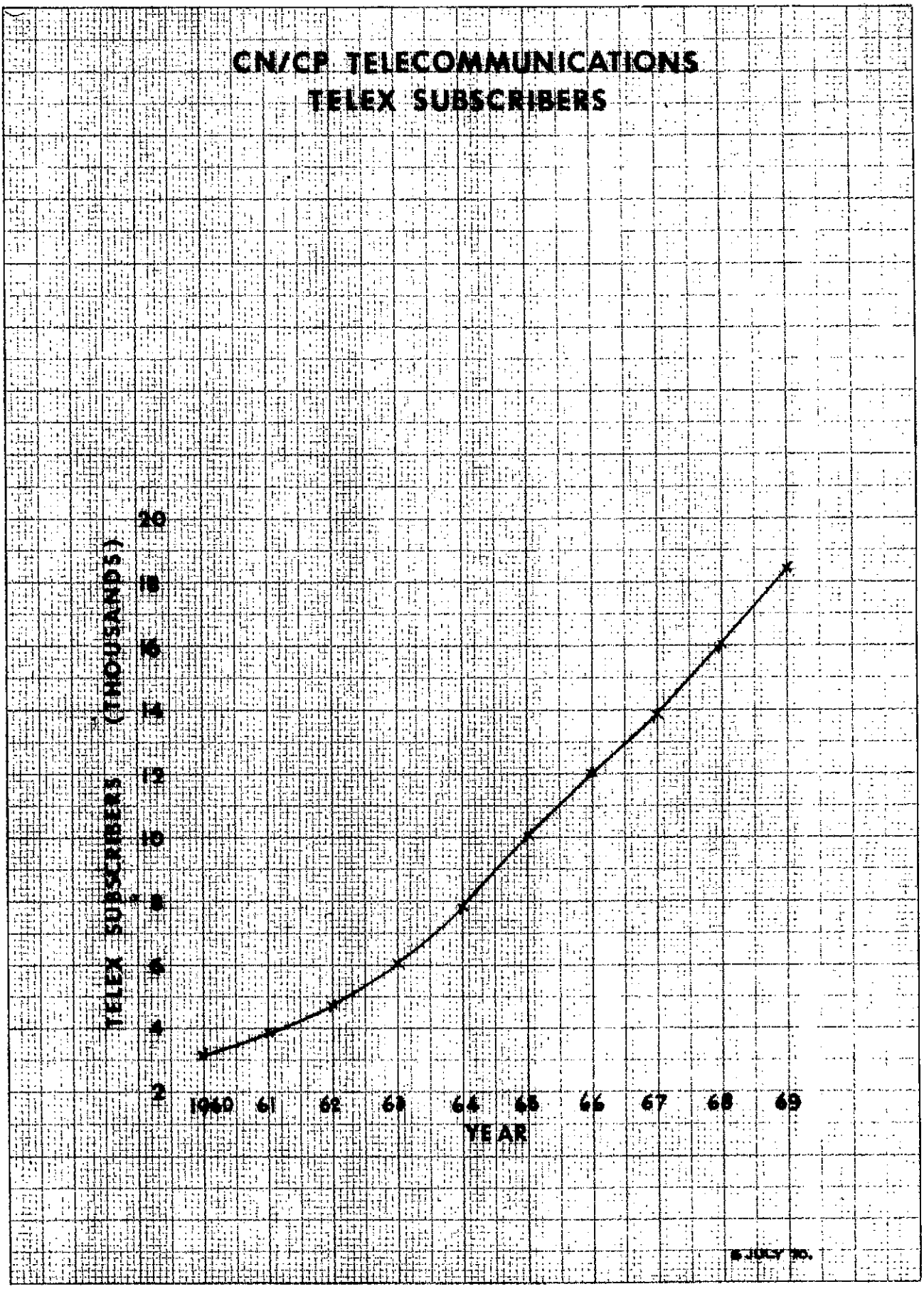
Statistical Data - CN/CP Telecommunications.


CN/CP TELECOMMUNICATIONS
TOTAL OPERATING REVENUES
TOTAL OPERATING REVENUES - DOLLARS (MILLIONS)
92
88
84
80
76
72
68
64
60
56
52
48
1960
'61
'62
'63
'64
'65
'66
'67
'68
'69
YEAR
6 JULY '70.


CN/CP TELECOMMUNICATIONS
TOTAL PLANT INVESTMENT (BEFORE DEPRECIATION)
TOTAL PLANT INVESTMENT - DOLLARS (MILLIONS)
YEAR
© JULY 70.


CN/CP TELECOMMUNICATIONS
CABLEGRAMS TRANSMITTED
CABLEGRAMS TRANSMITTED (MILLIONS)
2.8
2.7
2.6
2.5
2.4
2.3
2.2
2.1
2.0
1.9
1.8
1960
'61
'62
'63
'64
'65
'66
'67
'68
'69
YEAR
6 JULY'70.


CN/CP TELECOMMUNICATIONS
DOMESTIC TELEGRAMS (SENT)
DOMESTIC TELEGRAMS (SENT) (MILLIONS)
12
11
10
9
8
7
6
5
1960
'61
'62
'63
'64
'65
'66
'67
'68
'69
YEAR
6 JULY 70.


CN/CP TELECOMMUNICATIONS
TELEX SUBSCRIBERS
TELEX SUBSCRIBERS (THOUSANDS)
20
18
16
14
12
10
8
6
4
2
1960
61
62
63
64
65
66
67
68
69
YEAR
JULY 30.

APPENDIX 4

Extracts from "The World's Telephones" published January 1969 - AT&T.

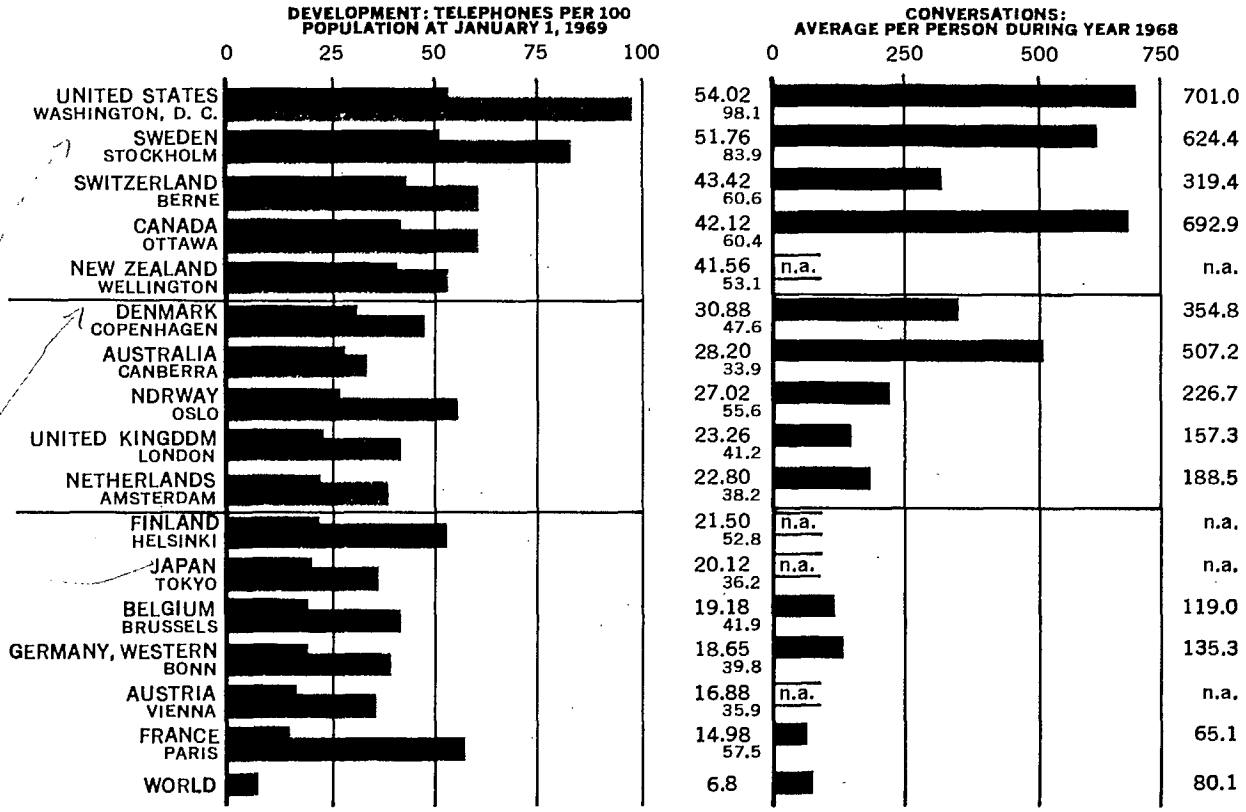
Telephones by continental area

Data are at January 1

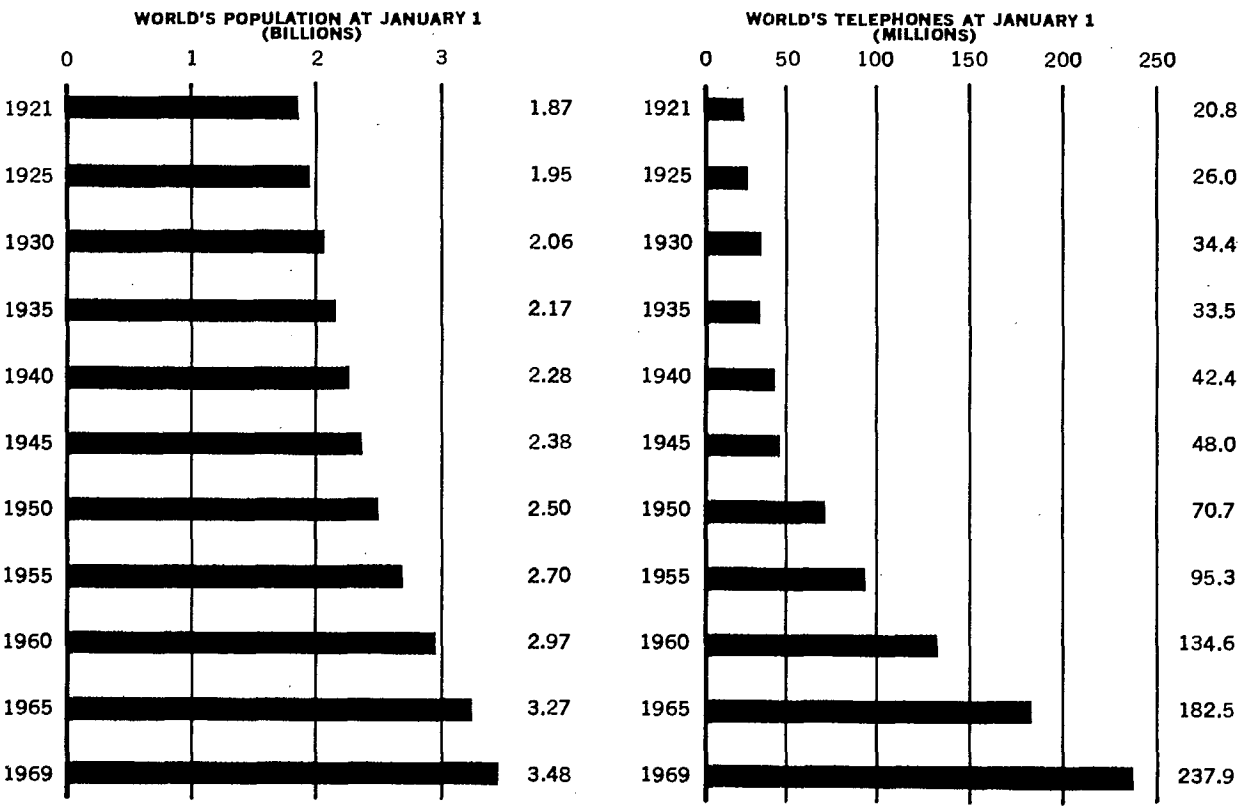
CONTINENT	TOTAL IN SERVICE			PRIVATELY OPERATED[1]		AUTOMATIC		CONNECTING WITH BELL SYSTEM	
	NUMBER 1969	PER CENT OF WORLD	PER 100 POPULATION	NUMBER 1969	PER CENT OF TOTAL	NUMBER 1969	PER CENT OF TOTAL	NUMBER 1969	PER CENT OF TOTAL
NORTH AMERICA	117,686,000	49.5	52.7	116,134,000	98.7	117,427,000	99.8	117,684,000	100.0
MIDDLE AMERICA	2,224,000	0.9	2.5	1,689,000	75.9	2,084,000	93.7	2,220,000	99.8
SOUTH AMERICA	4,924,000	2.1	2.7	2,334,000	47.4	4,423,000	89.8	4,801,200	97.5
EUROPE	77,359,000	32.5	12.0	13,502,000	17.5	70,986,000	91.8	74,063,000	95.7
AFRICA	2,961,000	1.2	0.9	25,000	0.8	2,345,000	79.1	2,779,000	93.9
ASIA	27,628,000	11.6	1.4	19,834,000	72.2	22,532,000	81.7	22,523,000	81.7
OCEANIA	5,118,000	2.2	26.5	399,000	7.8	4,504,000	88.0	5,110,000	99.8
WORLD	237,900,000	100.0	6.8	153,917,000	64.7	224,301,000	94.3	229,180,000	96.4

CONTINENT	TOTAL NUMBER OF TELEPHONES IN SERVICE					
	1968	1967	1966	1965	1964	1959
NORTH AMERICA	111,773,000	106,341,000	100,779,000	95,509,000	90,824,000	71,799,000
MIDDLE AMERICA	2,004,000	1,810,000	1,641,000	1,500,000	1,389,000	911,000
SOUTH AMERICA	4,635,000	4,469,000	4,242,000	4,072,000	3,873,000	3,000,000
EUROPE	71,866,000	66,976,000	62,432,000	58,138,000	54,112,000	37,598,000
AFRICA	2,766,000	2,618,000	2,474,000	2,360,000	2,242,000	1,769,000
ASIA	24,531,000	21,746,000	19,261,000	16,875,000	14,748,000	7,555,000
OCEANIA	4,825,000	4,540,000	4,271,000	4,046,000	3,812,000	2,868,000
WORLD	222,400,000	208,500,000	195,100,000	182,500,000	171,000,000	125,500,000

Countries with 1,000,000 or more telephones and 15 per 100 population



Growth of population and telephones



Telephone conversations during the year 1968

Number in Thousands

AREA	LOCAL	LONG DISTANCE	TOTAL	AVG. PER PERSON
Algeria	122,772	212,774	335,546	25.9
Angola	26,656	927	27,583	5.1
Argentina	3,912,160	64,565	3,976,725	168.4
Australia	2,295,000	152,040	2,447,040	205.8
Bahama Islands	74,595	475	75,070	507.2
Belgium	899,989	244,910	1,144,899	119.0
Bermuda	20,774	178	20,952	410.8
Brazil	9,364,206	187,346	9,551,552	108.3
Burma	77,106	2,182	79,288	3.0
Cambodia	6,601	863	7,464	1.1
Canada	14,003,930	389,720	14,393,650	692.9
Ceylon	63,887	7,937	71,824	6.0
Chad	3,941	40	3,981	1.2
Channel Islands	28,150	2,256	30,406	271.5
Chile	776,636	26,716	803,352	85.9
China, Taiwan	969,347	21,454	990,801	73.6
Congo, Brazzaville	7,577	604	8,181	9.4
Congo, Democratic Rep.	148,975	326	149,301	8.9
Costa Rica	94,598	6,090	100,688	61.4
Cyprus	36,489	3,689	40,178	64.6
Czechoslovakia	1,139,703	138,826	1,278,529	89.0
Denmark	1,299,358	428,505	1,727,863	354.8
Ethiopia	53,767	2,590	56,357	2.3
Fiji Islands	29,900	734	30,634	60.7
France	2,139,125	1,108,450	3,247,575	65.1
French Guiana	1,638	60	1,698	42.5
Germany, Eastern	881,894	319,549	1,201,443	70.3
Germany, Western	5,554,320	2,586,605	8,140,925	135.3
Ghana	32,578	8,166	40,744	4.9
Gibraltar	8,068	82	8,150	326.0
Greece	1,335,617	65,813	1,401,430	159.2
Guadeloupe	5,594	568	6,162	19.4
Guyana	15,134	2,175	17,309	24.4
Hungary	583,636	34,249	617,885	60.3
Iceland	119,800	7,231	127,031	632.0
India	1,504,000	103,234	1,607,234	3.1
Indonesia	166,221	7,746	173,967	1.5
Iraq	195,595	1,056	196,651	22.8
Ireland	261,000	31,634	292,634	100.6
Italy	8,070,305	1,054,433	9,124,738	173.0
Ivory Coast	25,500	769	26,269	6.4
Jamaica, West Indies	106,000	1,721	107,721	56.3
Kenya	4,004	2,590	6,594	6.5
Korea, Rep. of	1,322,568	55,972	1,378,540	45.2
Lebanon	359,000	49,500	408,500	158.4
Liechtenstein	2,681	3,191	5,872	279.6
Madagascar	20,519	828	21,347	3.3
Martinique	7,937	68	8,005	24.7
México	2,450,190	47,889	2,498,079	52.9
Monaco	3,867	5,148	9,015	392.0
Mozambique	33,121	2,605	35,726	4.9
Netherlands	1,484,073	917,444	2,401,517	188.5
Netherlands Antilles	41,770	147	41,917	195.9
New Caledonia	3,823	349	4,172	43.5
Niger	3,062	96	3,158	0.8
Nigeria	75,286	2,152	77,438	1.2
Norway	771,118	94,692	865,810	226.7
Papua and New Guinea	11,110	436	11,546	5.0
Peru	583,385	11,066	594,451	46.5
Philippines	5,584,796	2,033	5,586,829	155.7
Polynesia, French	2,764	180	2,944	29.4
Portugal	656,736	54,079	710,815	75.1
Puerto Rico	410,822	12,090	422,912	155.3
Réunion	5,564	543	6,107	14.2
Ryukyu Islands	146,313	2,973	149,286	153.1
Sarawak, East Malaysia	23,639	1,529	25,168	27.1
Sénégal	16,806	1,704	18,510	5.0
Singapore	423,793	1,477	425,270	213.9
South Africa	1,913,444	103,176	2,016,620	106.4
South West Africa	18,737	6,948	25,685	42.5
Swaziland	966	185	1,151	29.1
Sweden	4,242,000	714,000	4,956,000	624.0
Switzerland	926,370	1,037,139	1,963,509	319.4
Tanzania	3,289	1,376	4,665	3.7
Thailand	182,006	2,225	184,231	5.5
Trinidad and Tobago, W. I.	121,525	19,006	140,531	137.6
Turkey	490,468	29,815	520,283	15.5
United Kingdom	7,483,000	1,211,000	8,694,000	157.3
United States	134,766,000	6,189,000	140,955,000	701.0
Viet-Nam, Republic of	44,475	449	44,924	2.6

Countries which have 500,000 or more telephones

Data are at January 1

COUNTRY	TOTAL TELEPHONES IN SERVICE — NUMBER 1969	1968	1959	Per Cent Increase from 1968	Per Cent Increase from 1959	Per 100 Population	AUTOMATIC — Number	Per Cent of Total
Argentina	1,599,861	1,553,281	1,223,509	3.0	30.8	6.72	1,464,862	91.6
Australia	3,392,436	3,178,278	2,056,000	6.7	65.0	28.20	2,985,633	88.0
Austria	1,242,785	1,163,194	615,328	6.8	102.0	16.88	1,225,480	98.6
Belgium	1,847,363	1,753,698	1,036,305	5.3	78.3	19.18	1,825,020	98.8
Brazil	1,560,701	1,472,677	949,306	6.0	64.4	1.74	1,326,596	85.0
Canada	8,820,770	8,385,476	5,118,293	5.2	72.3	42.12	8,641,465	98.0
Colombia	574,700 (Est.)	524,824	243,986	9.5	135.5	2.85	556,310	96.8
Czechoslovakia	1,789,373	1,678,717	889,684	6.6	101.1	12.44	1,642,320	91.8
Denmark	1,516,802	1,469,195	976,667	3.2	55.3	30.88	1,293,860	85.3
Finland	1,009,336	949,976	545,338	6.2	85.1	21.50	910,807	90.2
France	7,503,491	6,999,621	3,703,578	7.2	102.6	14.98	5,859,733	78.1
Germany, Eastern	1,896,151	1,780,319	1,175,131	6.5	61.4	11.10	1,896,151	100.0
Germany, Western	11,248,979	10,321,281	5,090,102	9.0	121.0	18.65	11,248,979	100.0
Greece	761,550	660,129	168,993	15.4	350.6	8.63	740,032	97.2
Hungary	684,389	634,527	400,972	7.9	70.7	6.66	530,435	77.5
India	1,057,193	993,590	378,496	6.4	179.3	0.20	782,727	74.0
Italy	7,752,042	7,057,187	3,182,455	9.8	143.6	14.37	7,751,745	100.0
Japan	20,525,211	18,216,767	5,096,296	12.7	302.7	20.12	16,981,770	82.7
México	1,174,943	1,044,415	447,984	12.5	162.3	2.44	1,081,411	92.0
Netherlands	2,917,384	2,715,635	1,402,155	7.4	108.1	22.80	2,917,384	100.0
New Zealand	1,155,465	1,119,422	641,342	3.2	80.2	41.56	974,635	84.4
Norway	1,036,027	987,292	683,075	4.9	51.7	27.02	841,984	81.3
Poland	1,650,896	1,530,479	732,682	7.9	125.3	5.08	1,418,396	85.9
Portugal	653,407	615,965	332,309	6.1	96.6	6.87	533,788	81.7
Rumania	596,000 (Est.)	551,820	261,700	8.0	127.7	2.99	476,800	80.0
South Africa	1,397,725	1,322,101	887,601	5.7	57.5	7.29	1,069,476	76.5
Spain	3,723,239	3,378,865	1,490,151	10.2	149.9	11.44	3,019,959	81.1
Sweden	4,110,579	3,934,694	2,526,424	4.5	62.7	51.76	4,090,185	99.5
Switzerland	2,685,800	2,533,684	1,475,003	6.0	82.1	43.42	2,685,800	100.0
United Kingdom	12,901,000	12,099,000	7,525,000	6.6	71.4	23.26	12,657,000	98.1
U.S.S.R.	9,900,000 (Est.)	9,100,000	3,810,000	8.8	159.8	4.14	7,326,000	74.0
United States	109,256,000	103,752,000	66,645,000	5.3	63.9	54.02	109,178,000	99.9
Yugoslavia	549,019	506,039	217,542	8.5	152.4	2.70	525,219	95.7

COUNTRY	MAIN — Number	Per Cent of Total	EXT. & P.B.X. — Number	Per Cent of Total	BUSINESS — Number	Per Cent of Total	RESIDENCE — Number	Per Cent of Total	Extension as % of Main
Argentina	1,255,683	78.5	344,178	21.5	662,512	41.4	937,349	58.6	10.0
Australia	2,386,595	70.4	1,005,841	29.6	n.a.	—	n.a.	—	—
Austria	831,032	66.9	411,753	33.1	n.a.	—	n.a.	—	—
Belgium	n.a.	—	n.a.	—	n.a.	—	n.a.	—	—
Brazil	n.a.	—	n.a.	—	n.a.	—	n.a.	—	—
Canada	6,097,930	69.1	2,722,840	30.9	2,557,150	29.0	6,263,620	71.0	19.5
Colombia	n.a.	—	n.a.	—	n.a.	—	n.a.	—	n.a.
Czechoslovakia	875,287	48.9	914,086	51.1	1,314,480	73.5	474,893	26.5	n.a.
Denmark	1,130,705	74.5	386,097	25.5	n.a.	—	n.a.	—	n.a.
Finland	679,772	67.3	329,564	32.7	n.a.	—	n.a.	—	n.a.
France	3,683,908	49.1	3,819,583	50.9	n.a.	—	n.a.	—	n.a.
Germany, Eastern	859,790	45.3	1,036,363	54.7	n.a.	—	n.a.	—	n.a.
Germany, Western	6,757,254	60.1	4,491,725	39.9	n.a.	—	n.a.	—	—
Greece	646,845	84.9	114,705	15.1	n.a.	—	n.a.	—	—
Hungary	354,965	51.9	329,424	48.1	472,121	69.0	212,268	31.0	—
India	773,117	73.1	284,076	26.9	n.a.	—	n.a.	—	—
Italy	5,587,494	72.1	2,164,548	27.9	3,236,457	41.7	4,515,585	58.2	12.7
Japan	15,176,715	73.9	5,348,496	26.1	13,408,545	65.3	7,116,656	34.7	3.4
México	643,358	54.8	531,585	45.2	641,347	54.6	533,596	45.4	43.5
Netherlands	1,863,591	63.9	1,053,793	36.1	n.a.	—	n.a.	—	—
New Zealand	783,030	67.8	372,435	32.2	423,844	36.7	731,621	63.3	13.5
Norway	642,536	62.0	393,491	38.0	455,851	44.0	580,176	56.0	n.a.
Poland	901,388	55.2	749,508	45.4	1,144,399	69.3	506,557	30.7	n.a.
Portugal	475,491	72.8	177,916	27.2	n.a.	—	n.a.	—	n.a.
Rumania	n.a.	—	n.a.	—	n.a.	—	n.a.	—	n.a.
South Africa	901,015	64.5	496,710	35.5	773,863	55.4	623,862	44.6	n.a.
Spain	2,323,725	62.4	1,399,514	37.6	2,419,171	65.0	1,304,068	35.0	13.2
Sweden	3,112,927	75.7	997,652	24.3	1,204,579	29.3	2,906,000	70.7	2.9
Switzerland	1,736,398	64.7	949,402	35.3	1,396,616	52.0	1,289,184	48.0	n.a.
United Kingdom	7,297,000	56.6	6,604,000	51.2	6,759,000	52.4	6,142,000	47.6	14.5
U.S.S.R.	n.a.	—	n.a.	—	n.a.	—	n.a.	—	n.a.
United States	64,406,000	58.9	44,850,000	41.1	30,407,000	27.8	78,849,000	72.2	43.6
Yugoslavia	n.a.	—	n.a.	—	n.a.	—	n.a.	—	—