DATA PROCESSING REQUIREMENTS STUDY FOR THE TELECOMMUNICATIONS ECONOMICS BRANCH OF THE DEPARTMENT OF COMMUNICATIONS

PHASE I REPORT

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1. OVERVIEW

1.1 Introduction

The Telecommunications Economics Branch of the Department of Communications is responsible for the analysis of the economic and financial aspects of telecommunications policy in the Department, and for providing advice on the economic aspects of telecommunications policy. In the execution of these responsibilities, it has become apparent that the expansion of major policy activities requires extensive computer system support. The Director General of the Branch therefore asked Systemhouse Ltd. to examine the current and future functions and activities within the three Divisions comprising the Branch (Statistical Information Services, Economic Analysis, and Financial and Regulatory Affairs), and develop recommendations on adapting and/or acquiring particular data, software and other resources (e.g. hardware, personnel) to best serve the needs of the Branch. This report is a response to that request and represents the end of PHASE I of a two phase study. The varied present and future requirements of each of the Divisions within the Branch have been identified in the areas of economic, engineering, and financial data, manipulative software, and other resources.

Upon approval of this report, PHASE II of the study will commence, culminating in a report which will make pragmatic recommendations which should be implemented to improve the effectiveness of the statistical, econometric, and financial operations of the Branch.

1.2 Approach

The Systemhouse team conducted an extensive series of interviews with virtually the entire staff of the Statistical Information Services, Economic Analysis, and Financial and Regulatory Affairs Divisions. Interviews were also conducted with key personnel in the National Telecommunications Branch, Social Policy and Programs Branch, and the Computer Science Directorate of the Personnel and Administration Branch, and in addition, external consulting services such as Canadian Economic Services Limited (CANECS), Sorès Incorporated, Market Mix Incorporated, and the Institute of Applied Economic Research (IAER). The list of persons contacted is shown in Appendix I.

The purpose of these interviews was to collect information on present and future activities and to identify requirements in the areas of data resources, models, software, and other resources that are/will be necessary to support the emerging analytical requirements of the Branch. The information collected during these interviews is presented in the next Chapter of this report.

The understanding of Branch activities and resulting requirements, gained in PHASE I of the study, will form the basis for an in-depth analysis and synthesis resulting in recommendations for Branch consideration.

1.3 Summary

The data processing requirements of the Branch can be divided into five groups relating to data, software, hardware, expertise, and education.

Both general and specific data requirements have been identified. The general data requirements fall into three categories: data availability, data characteristics, and data administration; the specific requirements relate directly to present and future applications.

Other than the National Policy and Planning Simulation Model and ALADIN, a data base management system, there is relatively little software currently being directly employed by the Branch in support of the activities discussed in this report. As a result, the software requirements identified cover virtually every type and stage of analysis carried out within the Branch. They relate to data preparation and entry, data maintenance, data massaging and manipulation, statistical analysis and econometric modelling, financial analysis and simulation, information display, and special purpose computing, including cross-referencing, cataloguing, and text processing.

In order to support the nature and level of computer usage indicated by the current and planned activities, requirements exist for both low speed and high speed terminal equipment, as well as keypunch/keyedit equipment and access to plotting facilities.

General considerations, plus the data, software and hardware requirements indicate a strong requirement for expertise in the area of data co-ordination and methods co-ordination, as well as specific training in data processing methods and tools. These special functions and requirements for education are addressed in further detail in subsequent Chapters of this report.

2. FUNCTIONS AND ACTIVITIES

2.1 Background

As frequent reference is made throughout the report to the various Branches of the Department and other government agencies, a short description of the formation of these groups follows.

The Department of Communications was derived from the Ministry of Transport and the Defence Research Board during the last ten years. Since then, the Department has developed into an organization comprised of four major areas, each under the direction of an Assistant Deputy Minister: Research, Services, Policy, and Space Program. The Telecommunciations Economics Branch is situated in the Policy area along with the International Telecommunications, National Telecommunications, Social Policy and Programs, and Federal/Provincial Relations Branches; each is headed by a Director General.

The Canadian Radio-Television and Telecommunications Commission (C.R.T.C.), formed in April of 1976, is responsible for the regulation of the tele-communications, broadcasting, and Cable television industries. The C.R.T.C. and the Department report to the Minister of Communications; her responsibilities with respect to the C.R.T.C. are defined under the National Transportation Act. The Department has additional responsibilities such as Research and Development in Communications and the implementation of specific space projects.

2.2 Branch Organization and Responsibilities

The overall objective of this Chapter is to outline the current and anticipated activities being performed by the Statistical Information Services, Economic Analysis, and Financial and Regulatory Affairs Divisions in support of the functional responsibilities of the Telecommunications Economics Branch. These responsibilities are twofold: to provide support for Departmental activities concerning the economic and financial aspects of telecommunications policy; and, to analyze regulatory proceedings, orders, and decisions relating to the telecommunications carriers, in support of the responsibilities of the Minister.

In order to discharge these responsibilities, the Branch engages in activities that can be generally characterized as follows:

- maintenance of data appropriate to the economic and financial investigation of the broadcasting, Cable television, and telecommunications industries

- performance of analyses of an economic and financial nature

- interaction with other Branches, Departments, and Agencies in support of their activities in regard to telecommunications policy.

The analytical and statistical activities are viewed both as tools for providing support to other groups and for providing an in-house generative research capability.

Following is a brief description of the major functional responsibilities of the Divisions and the current high-level activities in support of these. Specific activities are described in subsequent sections. Planned activities are also discussed; these may reflect augmented or modified functional responsibilities.

2.3 Functional Responsibilities and High-Level Activities

2.3.1 Statistical Information Services Division

The functional responsibilities of this Division can be stated as follows:

1. To support the activities of the Economic Analysis and Financial and Regulatory Affairs Divisions and other Branches through the development and maintenance of databanks of an economic, socio-economic, financial, and technical nature.

2. To develop and provide statistical publications for Departmental use and distribution, on data relating to the four components of the telecommunications sector, i.e. telegraph and cable, telephone, radio and television broadcasting, and Cable television.

3. To provide statistical analysis support to the Economic Analysis and Financial and Regulatory Affairs Divisions and other Branches.

4. To act as Departmental representative to other Departments, governments, agencies, industries, universities, and the general public in matters affecting telecommunications statistics.

A general priority exists to preferentially support activities within the Branch.

Support for these functional responsibilities is derived from the following high-level activities:

- advising on databanks to be developed
- acquiring appropriate data
- responding to requests for and producing appropriate statistics
- providing assistance in the design of questionnaires and surveys
- maintaining liaison with various groups concerning telecommunications statistics and data.

2.3.2 Economic Analysis Division

The major functional responsibilities of the Economic Analysis Division are:

1. To conduct economic and econometric studies of the telecommunications sector in Canada and in other countries.

2. To provide advice and guidance to senior Departmental management on the economic aspects of telecommunications policy proposals and their implementation.

3. To provide forecasts of economic variables relating to the telecommunications, broadcasting, and Cable television industries, and other matters within the field of Departmental responsibility.

These functions are viewed primarily as supportive of activities related to telecommunications policy formulation and implementation.

High-level activities in support of these functional responsibilities include:

- initiating, developing, and directing a comprehensive program of economic and econometric studies of the telecommunications sector in Canada and in other countries

- developing and executing economic and econometric analyses relating to the establishment of policy in the area of communications services and facilities

- responding, as requested, on the economic aspects of telecomminications policy through the development and preparation of comprehensive reports

- preparing forecasts of major economic variables relating to the activities of the telecommunications, broadcasting, and Cable television industries.

2.3.3 Financial and Regulatory Affairs Division

This Division has as its major functional responsibilities:

1. To monitor and analyze regulatory proceedings, submissions, orders, and decisions relating to the telecommunications carriers.

2. To respond to the Minister of the Department, as requested, in support of her responsibilities under the National Transportation Act, i.e. consideration of appeals of decisions taken by the C.R.T.C.

3. To perform analyses of corporate, financial, and regulatory matters in the area of Canadian telecommunications with a view to assessing the financial viability of the industry and producing input into policy development.

4. To develop costing, accounting, and regulatory principles for the identification and measurement of cross-subsidization in the telecommunication industries.

5. To perform complex modelling and analytical work, in qualitative terms, and to assess the implications of various policy options concerning the institutional, operational, financial, and economic structure of the telecommunications industry.

These functions are viewed primarily as supportive of activities related to telecommunications regulatory policy.

High-level activities in support of these functional responsibilities include:

- executing analyses of a financial nature
- maintaining, operating, and developing the National Policy and Planning Simulation Model (N.P.P.S.)
- providing analyses and evaluation of hearings and procedures before the C.R.T.C. relating to the telecommunications carriers
- maintaining technical liaison on financial and accounting matters with other groups, particularly C.R.T.C.
- selecting and using appropriate tools for general corporate, and financial analyses
- performing analytical work and formulating recommendations for policy development.

2.4 Specific Activities

2.4.1 Databank Development

Considerable effort has been expended by the Statistical Information Services Division in the area of data acquisition and its organization into both computerized and non-computerized databanks. To date a number of databanks have been developed for use within the Division, within the Branch, and within the Department.

As a result of a co-operative arrangement between the Department and Statistics Canada, the Statistical Information Services Division receives annually from Statistics Canada a copy of the Radio/Television and Cable Television annual returns. Each Broadcasting Transmitting/Receiving Licensee is required under the Broadcasting Act to submit to Statistics Canada an annual return for the year ending August 31st. In addition, the Division receives from Statistics Canada the Telephone Statistics Annual Report which is required to be submitted annually to Statistics Canada by each telephone company for the year ending December 31st. Upon receipt of the questionnaires, the information is transcribed onto coding forms according to pre-defined rules designed to ensure that the interpretation and re-allocation of financial information conforms to normal accounting procedures. The coding sheets are sent to be keypunched, and when returned, the resulting cards are run through editing programs designed to detect errors and inconsistencies in the data. The data is then corrected and the above

sequence is repeated until all errors have been removed; the databank is subsequently updated. This process requires approximately three man years, which constitutes a significant proportion of the Division's total time allocated to databank development.

Following is a general description of the resultant databanks:

Radio Television Databank

Based on annual Statistics Canada survey data, a databank has been developed at the Computer Sciences Canada (C.S.C.) computer service bureau using the database management system ALADIN. Currently, data for approximately 450 licensees from the years 1974 and 1975 have been entered, but not completely verified.

The data consists of financial statements, historical costs of assets, and technical information on programming and services. At the present time, no standard reports are produced or under development, but a few ad hoc requests for information contained in this databank have been made.

Cable Television (CATV) Databank

Like the Radio Television Databank, the CATV Databank has been developed at C.S.C. using ALADIN. The data is derived from annual Statistics Canada survey data and consists of financial statements, historical costs of assets, and statistics on types of services, types of

distribution networks, and subscribers for a total of 376 companies in 1976. Data is available and verified for the years 1972 through 1976. Although no standard reports are produced, ad hoc requests for information contained in this databank are frequently received from both internal and external groups. Statistics Canada produces an annual report containing statistics on the cable industry; the latest report was produced in 1974 and new editions are being planned. Currently the Statistical Information Services Division is planning to produce an annual handbook on Cable television systems, based on this data. For the initial stage the distribution of the handbook will be retricted to the Department and will complement the Statistics Canada official publication but will have the advantage of greater currency, different reporting structure, and the support of a comprehensive databank which does not exist elsewhere.

Telephone Databank

This databank is currently at C.S.C. and is accessed using ALADIN. The data are extracted from the Statistics Canada annual survey of telephone statistics, and consist of financial information such as income statements, detailed expenses, assets and liabilities, as well as extensive technical and operational data such as number of telephones, telex, circuits, poles, and wire mileage. The data are available for the years 1964 through 1973 for a total of fifteen Canadian telephone companies. Using this data, Statistics Canada publishes an annual report (Publication No. 56-203) entitled "Telephone Statistics".

In order to enable inter-company and time-related comparisons, a second databank, drawn from the annual reports of eleven Canadian Telephone Companies, has been developed at COMSHARE using COMPOSIT-77. It contains mainly financial statement data in time series format as well as some operating data on employees, shareholders, telephones, telephone calls, and central offices. It is used as input to the "Financial Statistics on Canadian Telecommunication Common Carriers" publication.

In addition, several other databanks have been developed within this Division and a general description of each is presented below.

Remote and Rural Databank

In view of the increasing interest and requirement for information within the Department concerning the existing and planned telecommunications facilities in rural and remote areas, and the role of telecommunications in regional development, a databank is to be developed at C.S.C. using ALADIN; data elements and their sources have been identified. The databank will cover a broad spectrum of geographic, socio-economic and telecommunications information on 700 to 800 communities in northern Canada. It is expected that the final databank will expand to contain information on 2,000 to 3,000 communities in Canada. The databank will contain such data as: census data, e.g. languages spoken and understood, education of the residents, and labour force data for each community; telecommunications data, e.g. telephone, radio, television, Cable television facilities, both existing and planned; and community data, e.g. electrical power, transportation, schools, and medical services.

Private and Public Investment Databank

The Private and Public Investment Databank was obtained from the Department of Finance at the request of the Director General of the Telecommunications Economics Branch and is based on general economic data available from CANSIM. The databank resides at C.S.C. and is to be used for the analysis of telecommunications industry construction programs.

Telegraph Databank

The Telegraph Databank consists of three distinct sets of data:

1. Annual data on three Canadian telegraph companies: Teleglobe Canada, Canadian National (C.N.) Telecommunications, and Canadian Pacific (C.P.) Telecommunications. It consists of financial statement data only, for the years 1964 through 1972, and is obtained from the Statistics Canada publication 56-201.

2. Monthly data on Teleglobe, C.N., and C.P., for the year 1972, consisting of financial statement data. It was obtained from a Statistics Canada monthly survey questionnaire.

3. Annual data on Teleglobe Canada, for the years 1960 through 1970, consisting of annual revenues by type of service and by country or telecommunication system. The information was obtained from Teleglobe Canada on request.

It is intended that this databank be developed at C.S.C. using ALADIN; however, work has been suspended due to more urgent demands and a lack of available resources.

Tariff Databank

This databank is volatile and large and has not been automated. The data consists of local and toll service tariffs for the eight members of the Trans-Canada Telephone System (T.C.T.S.).

As the members are not required to notify the Department of tariff changes, reliability of the data is considered high for only four of the members.

Telephone Forecasting Databank

The Telephone Forecasting Databank was developed in response to a request from the Director General of the Branch and consists of the following files:

1. Raw data for telephone companies obtained from a Statistics Canada monthly survey questionnaire; it is used by the Branch in analyses related to companies regulated by the C.R.T.C.

2. Quarterly data for telephone companies generated from the monthly raw data.

3. Seasonally adjusted data generated from the monthly raw data.

4. Seasonally adjusted data generated from the quarterly data.

5. Seasonally adjusted quarterly data generated from the seasonally adjusted monthly data.

6. Quarterly unconsolidated financial data for Bell Canada obtained from their report to shareholders and unconsolidated financial statements submitted to the Department.

7. Quarterly consolidated financial data for the British Columbia Telephone Company obtained from its quarterly shareholders' report.

8. A subset of CANSIM consisting of such data as population, wages, residential construction, retail trade, consumer price indices, gross national expenditure, employment indices, and labour force estimates, by province (where applicable).

The databank exists at C.S.C. and was developed using ALADIN; however, it has not been accessed to date.

Computer Inventory Databank

The Computer Inventory Databank was created for the Communications Research Centre (C.R.C.) to meet their data requirements in a study of computer communications needs in Canadian Business. Some consideration was

also given to the requirements of the Computer Communications Secretariat (C.C.S.). The Statistical Information Services Division was requested to obtain the relevant data files and create a databank which would subsequently be used by C.R.C. and C.C.S..

The databank consists of four basic files:

1. The Canadian Information Processing Society (C.I.P.S.) annual survey for the years 1971, 1973, 1975, and 1976. This file contains basic technical data on each computer which is currently installed in Canada.

2. The International Data Corporation (I.D.C.) file which contains, in addition to basic technical data on computers in Canada, company data such as annual volume of sales and number of employees.

3. A Dun and Bradstreet file which contains company information such as type of business, annual sales volume, number of employees, Dun and Bradstreet code, and principal officer and title.

4. The Price Waterhouse survey data file which contains data obtained from a survey conducted by Price Waterhouse under contract to C.R.C.. Sixty-nine companies were surveyed. Information collected consists of company address, Electronic Data Processing (E.D.P.) budgetary data and facilities, computer centre data, computer-to-computer communications facilities used by computer centre installations, and data on terminals used by each company.

The databank was implemented at COMSHARE using the databank management system QUESTOR, the major users being C.R.C. and the Computer Communications Secretariat.

Terminal Attachment Program (T.A.P.) Databank

The T.A.P. Databank is a computerized information system developed for the Spectrum Engineering Division of the Telecommunications Regulatory Services Branch which has the responsibility for testing and certifying equipment for attachment to the telecommunications carriers' network. The program allows the Spectrum Engineering Division to collect administrative and operational information on the process of certification, and on the equipment examined. Each supplier and/or manufacturer of a device must make application to the Department for certification, and upon approval, affix standard labels to each device to indicate its status with respect to attachment to the carriers' network. The data collected is primarily administrative; one report is presently produced regularly, for use by the Telecommunications Regulatory Services Branch, and fourteen regular reports are under development. The system was developed at C.S.C. using ALADIN.

The Government Telecommunications Agency (G.T.A.) Databank

The role of this Agency is to plan, establish, and manage telecommunications facilities and services that will satisfy the stated needs of Federal Departments and Agencies on an economic basis. A survey of all Federal Government telecommunication usage has just been completed by G.T.A., and the Statistical Information Services Division and is presently investigating its computerization on behalf of G.T.A.. The databank will consist of three basic files containing the following information:

1. An inventory of telecommunication systems in Government Departments and Agencies for whom G.T.A. is responsible.

2. An inventory of terminals located in Government Departments and Agencies for which G.T.A. is responsible.

3. Data from the Annual Telecommunications Report, containing budget expenses and projections for specified fiscal years with respect to Departments and their programs by line or economic objects. This file is intended to monitor, over time, usage and costs of telecommunications systems relative to total budgets for each object program or Department. System specifications have been completed and development estimates presented to the G.T.A..

2.4.2 Data Distribution

The Statistical Information Services Division presently produces and distributes two publications on a regular basis, namely a financial handbook entitled "Financial Statistics on Canadian Telecommunication Common Carriers", and a tariff handbook.

Input to the financial handbook consists of data obtained from the annual reports of eleven Canadian telephone companies as well as Canadian National and Canadian Pacific Telecommunications, the Canadian Overseas Telecommunications Corporation, and Telesat. The financial statement data are analyzed and massaged to enable inter-company and time-related comparisons. Operating data are also available on employees, shareholders, telephones, telephone calls and central offices. The handbook is produced on an annual basis by computer. Though the 1975 issue has not been produced to date, plans are to proceed with the 1975 and 1976 issues. The software to produce the handbook was implemented by COMSHARE using COMPOSIT-77 and a number of specialized programs.

The tariff handbook, produced using the Tariff Databank as input, includes local and toll service tariffs for the eight T.C.T.S. members. It is distributed to regional offices, Branches within the Department, and the carriers. Updates are distributed when they are received by the Division. The production of the handbook is a completely manual operation and it consists of a series of tables which are typed, reduced, and reproduced for insertion in the handbook.

As a result of interest expressed in the other components of the telecommunications sector, such as Cable television and radio and television broadcasting, consideration is being given to the production of similar publications in this area; a Cable television handbook is presently in the design stage.

In addition to regular publications, the Division supplies data on an ad hoc basis in response to requests from various groups within and without the Department. These requests, on the average, require at least one-half man day of direct service time. Where possible, a copy of the request and response is kept for future reference. Requests include provision of copies of the financial handbook, access to data files within the Department, and reporting of specific data or aggregates from various databanks.

2.4.3 Statistical Services

A responsibility of the Statistical Information Services Division is to provide assistance to the Department on sampling and survey methodology and questionnaire design for the collection and presentation of statistics, particularly to ensure the commensurability of telecommunications data. An important aspect is liason with Statistics Canada on survey design in accordance with the Treasury Board "Rule of Ten". An example is the ongoing review of the questionnaire designed to capture financial information on the Cable television companies within Canada.

In its capacity as Departmental representive concerning telecommunications statistics, the Statistical Information Services Division is involved, as part of their work in support of the activities of the Communications Committee on International Telegraph and Telephone - Canadian National Organization (CCITT-CNØ), in the design of a questionnaire for the International Telecommunications Unit (I.T.U.)GAS/5 studies; the data gathered by the survey will be of particular interest to those interested in relationships between Telecommunications development and National Economies.

The Statistical Information Services Division is also interested in co-ordinating responses and/or replies to the I.T.U. questionnaire and other questionnaires received by the Department and which entails direct contact with members of Canadian industry.

2.4.4 Economic and Econometric Investigation

A major responsibility of the Branch is to conduct economic and econometric studies of the telecommunications sector in Canada and in other countries as part of the continuing analysis and policy development activities of the Department. Modelling of demand, production, and financial behavior in this sector of the economy will enable the identification of policy variables, the testing of hypothesis concerning firms decision making and operations, the forecasting of demand for services, the estimation of regulatory impacts, and other research activities supporting the functional responsibilities of the Branch.

Activities (current and planned) relating to the above include work concerning: short term and medium term forecasting and simulation of the telephone industry; demand, production, and financial behaviour of the carriers related to the future development of the telephone network; radio spectrum usage forecast, and economic analysis; forecasts of regional demand for services, and economic analysis; the economic impact of Pay TV systems; and, the concept of the "Information Sector".

The medium term telephone industry forecasting and simulation activities will build on the work of the Institute of Applied Economic Research (I.A.E.R.), particularly the Bernstein model.

This model was designed "to examine the interaction of the procudive factor and financial characteristics of telephone carriers". The main forecasting activity will focus on the capital requirements needed to accomodate the expected demand for telephone services over the coming years. The main objective of simulation will be to analyze the medium term impact of proposed rate changes and to assess the effect of possible modification in the regulatory process, as may result from the cost inquiry, on the production, investment, and financial decisions of the major carriers. Separate models were constructed for Bell Canada, B.C. Telephone, the public carriers (Alberta Government Telephones, Edmonton Telephones, Saskatchewan Telecommunications, Manitoba Telephone System), and the private carriers (Maritime Telegraph, Newfoundland Telephone), and rely on data available from firms' annual reports, additional disaggregated financial data of a confidential nature from Bell Canada, B.C. Telephone, and Statistics Canada, and demographic data from CANSIM. In calibrating these separate models, certain conclusions concerning the firms' characteristics were arrived at, such as the existence of monopoly power, normal vs luxury nature of services, constant vs variable returns to scale, etc. Future activities include the application of the model to economic aspects of the telephone industry, an example of which is cross-subsidization, and the acquisition of the model by the Branch for internal development and implementation.

The Dobell Model, developed in the early 1970's by Professor Dobell under contract to the Department, was not used to any great extent within the Branch until late 1976 when it was somewhat modified from an annual to a quarterly model and employed to forecast revenues and expenditures for Bell Canada and B.C. Telephone. Most of the data used was obtained from Statistics Canada publications and included ten year's data on incomes, price indices, revenues, depreciation expenses, and labour force. The separate models developed are simpler than those of the Bernstein Model; a higher level of data aggregation is used, and fewer tests may be performed. In future the Branch plans to update this model and add it to its growing stock of analytical tools.

Short term forecasting activities will be enhanced by the use of other time series analysis such as ordinary regression analysis and Box Jenkins techniques.

Spectrum allocation has in the past been primarily an administrative task but the increased level of demand and resultant potential congestion of the radio spectrum has created the need to investigate this telecommunications issue from an economic point of view. Such investigations will also provide input to the National Telecommunications Branch participation in the 1979 WARC meeting. Valuation of services, demand forecasting, re-allocation strategies, and technological impacts are aspects of the research activities being planned and initiated. Contracts with Concordia University and Market Mix were let during the past two years to examine the possibility of forecasting regional demand for services.

A major barrier to immediate continuance of such research was uncovered: the data on which such work must be based (the Intergrated Radio Licensing System Databank maintained by the Computer Service Directorate) is oriented toward administrative rather than research activities, and must be re-organized; further, serious difficulties appear to exist in the data which may require theoretical analysis for its manipulation into a form useful for economic and econometric modelling. Investigation of these difficulties is currently underway; future activities in this area will be planned around the outcome of these investigations.

The proliferation of information processing equipment and data processing capability in the last two decades has resulted in a phenomemal growth in data communication. As a measure of this, the growth rate of data transmission has far exceeded that of telecommunication services as a whole. Current plans include the development of a model to forecast the expected demand for non-voice service and to simulate the impact of alternative policy and regulatory decisions on the common carriers.

This growing demand for non-voice services and the technology that it requires has had and will continue to have an important impact on network configuration, the quality and level of services to the general public, investment decisions of common carriers, and the level of intercarrier competition. Moreover, this evolution raises very serious policy and regulatory issues concerning the interface between common carriers on the one hand and the computer industry, the cable industry and the media on the other.

Various O.E.C.D. countries, including Canada, are engaged in a project to elucidate the policy importance to be attached to the economic activity of the production, processing, and dissemination of information. The basic difficulty is the unsuitability of the current manner of producing standard National Accounts. Canadian Economic Services Ltd.(CANECS) is currently under contract to the Department to investigate the theoretical and methodological aspects of reworking Canadian National Accounts data to estimate the resource effort expended on, and policy variable make-up of, information flow in the economy. Future activities in this area will depend on the outcome of this work, and may lead to a significant effort in the disaggregation and analysis of National Accounts data.

Though little activity is currently underway in the investigation of the economic aspects of Cable television services in Canada, planned activities include the development of methods for estimating demand and the valuation of services.

Growing Departmental interest in the role of telecommunications in rural and remote areas has generated Branch intentions to research the demand for telephone and broadcasting services. General theoretical frameworks will be developed within the Branch, and integrated with work elsewhere (e.g. in the National Telecommunications Branch, the Department of Regional Economic Expansion, etc.)

Other planned activities in the area of economic and econometric investigation involve the extensive use of analytical tools for time series analysis, cross-sectional analysis, spectral analysis, seasonal adjustment, filtering, scaling, optimization, all manner of statistical testing, etc.. These activities will centre around demand forecasting and the valuation of telecommunications services, e.g. Pay TV, and will complement those already mentioned.

2.4.5 Monitoring of Regulatory Proceedings

Though the C.R.T.C. has the responsibility of regulating a major portion of the telephone industry in Canada, the Branch participates in this process to the extent that it must respond to the Minister for data and analysis. As a basis for these responses the Financial and Regulatory Affairs Division monitors and performs analyses of industry regulation through attendance at regulatory proceedings and the collection of information: annual statements, submissions, etc. A major part of the analyses performed is financial in nature and involves the application of various accounting and actuarial methods to the interaction of rate increases, rates of return, capitalization strategies, construction programs, methods of depreciation and tax deferral, and choice of financing instruments.

Another major part of the activities concerns the development of regulatory principles and methodology which will permit effective implementation of policy through regulatory action. In support of these activities, complex scenarios of various operations, institutional, corporate, and financial structures are analyzed and the implications assessed.

The next section outlines the major analytical tool employed in most of these analyses.

2.4.6 National Policy and Planning Simulation Model (N.P.P.S.)

The development of the N.P.P.S. model was begun in 1973 by a tripartite team consisting of the Department, Sorès, and Laval University. It was developed as a tool with which to evaluate various policy options and alternatives in the domain of regulated telecommunications. Through the technique of simulation it examines the quantitative impact of various scenarios being considered. It has been used for example in the detection of cross-subsidization in the telephone industry as well as for ad hoc analysis, particularly of an accounting nature, associated with rate applications submitted to C.R.T.C. by the regulated carriers. Such analyses have dealt with rate of return, construction programs, methods of depreciation, and tax deferral, etc., as described below.

Major modifications of the model are anticipated and are described after the following description of its structure and operation.

The N.P.P.S. model consists of four blocks: operations, costing, sharing, and accounting.

The Operations Block describes the structure and operation of the Canadian inter-city telephone switching network and the Canadian inter-city microwave transmission network, the type and level of traffic processed through the network, its routing, and the tariffs applicable to various services. Presently, this

block contains approximately 100 switching nodes, final links, and high usage links as well as approximately 200 transmission nodes and links. Traffic data, available for the years 1971 through 1973, drive a traffic generation module. Network data includes both transmission and switching equipment. Transmission data on towers, terminals, repeaters, channels, and links for channels, etc. are present but consist of mixed years. Switching data, including nodes and their hierarchy, final tree, number of final trunks, etc., are available for 1977 only. It is expected that the near future will see the inclusion of three additional networks (C.N., C.P., and Telesat) which will result in significant changes to this block.

The main function of the Costing Block is to associate costs with the physical components (nodes) of the network and to allocate costs to various services and streams. For this purpose a number of costing concepts and methodologies are employed: the transformation of reproduction costs into historical costs and subsequently into incurred costs involves the use of growth rates, retirement ratios, net salvage rates, survival data, rate of return on equity, costs of common and preferred shares, long term interest rate, debt/equity ratio, deferred taxes, working capital, operating costs, and depreciated assets to expenses ratio. The greater portion of these transmission-related cost data are derived from engineering studies. Switching cost data employed in the N.P.P.S. model were obtained from Bell Journal reports and engineering studies. The extension of the network to include additional carriers as indicated in the description of the Operations Block may impact the Costing Block.

The purpose of the Sharing Block is to simulate revenue agreements between companies that share streams. The output of this block is the post-settlement operating revenue by carrier which represents the results of employing a particular revenue sharing scheme. Any additional and/or revised sharing agreements will impact this block.

The Accounting Block contains the algorithm required to produce financial statements for each carrier in the context of a specified operating, costing, and sharing scenario. It contains approximately sixty variables, thirty of which are simulation variables; any combination of the simulation variables may be exogenously specified, and represents a particular set of assumptions and constraints on costing, accounting, and actuarial methods.

Major sources of data used by the model include Annual Reports of T.C.T.S. Companies, especially balance sheet and income statements. As the information available is in an aggregate form, this input is supplemented by more detailed confidential data from such sources as Statistics Canada, Bell Canada, and the C.R.T.C. (including information submitted in support of rate increase applications). Some detailed data must be derived by making relational, value, and trend assumptions.

The model was originally developed in FORTRAN at McGill University by Sorès, was later transferred to C.S.C., and presently resides at C.R.C. on their SIGMA 9 computer with the Accounting Block enhanced and implemented in APL. Maintenance and development of data and programs comprising the model have been the responsibility of Sorès in the past.

2.4.7 General Financial Analysis

In addition to the responsibilities described previously, the Branch undertakes analyses of a financial nature in support of the policy activities relating to various aspects of broadcasting and Cable television. Activities include: investigation of the capital structure of Cable television companies, analysis of the extension of Cable television services in Newfoundland, and the effect of frequency reallocation on representative broadcasting companies.

These activities involve the use of financial databanks and some computer facilities.

Currently, a set of programs exist for the determination of least-cost methods of extending Cable television services. Known collectively as ARGO, they are resident on the SDL computer and operate on data extracted from a C.R.C. technical databank. Though presently unused, this system is being considered for use in a study of extension of Cable television services in Newfoundland.

3. REQUIREMENTS

3.1 Introduction

The previous Chapter has described the current and future activities within the Branch that are intended to discharge the functional responsibilities of each of the Divisions and of the Branch as a whole. Certain requirements are generated by these activities that should be satisfied in order to improve the effectiveness of the operations of the Branch, particularly if they are undertaken in an E.D.P. environment. This Chapter describes these requirements in general and specific terms.

The data processing requirements of the Branch can be divided into five groups relating to data, software, hardware, expertise, and education. This division does not imply that the respective requirements are independent of each other; rather it is a division intended to emphasize the inter-dependance of the various functions and activities within the Branch, and to lay a foundation for future recommendations.

3.2 Data Requirements

A number of general and specific data requirements have been identified with respect to the current and future activities within the Branch, as well as external activities to which the Branch may offer support. The general requirements fall into three categories: data availability, data characteristics, and data administration; the specific requirements relate directly to present and future applications.

3.2.1 General Data Requirements

The requirements related to data availability include the following:

- access to a wider range of data not presently available to the Department
- regular acquisition of data, particularly for the construction of time series
- flexible and timely access by users.

The data characteristics required for their effective employment include:

- recency and historical completeness
- a high degree of disaggregation
- commensurability within and between data files
- maintenance in forms most useful for major application areas; for example, time series orientation for data files to be used in econometric analysis as opposed to administrative processing.

The requirements related to the administration of data include:

- standard acquisition and maintenance schedules and procedures
- complete documentation of data maintained within the Branch
- maintenance of cross-reference catalogues for all data, including non-computerized files
- centralized co-ordination of data-related activities, including acquisition, editing, verifying, maintenance, updating, and request processing

- awareness of all available data on telecommunications including sources, characteristics, and methods of acquisition.

3.2.2 Specific Data Requirements

A more detailed presentation of data requirements follows. The specific data items necessary for the execution of the primarily analytical activities are described in a manner that reflects the application areas.

The data required to support current and future activities associated with analysis of the Canadian telephone industry include:

- demand data; complete cross-sections and time series of network traffic by origin and destination e.g. number of calls, duration, peak hours, etc.
- revenue data; complete cross-sections and time series of local, toll, directory, incomes, etc.
- data related to the determinants of demand; number of trunks, lines, telephones, switchboards, as well as socio-economic and demographic data, etc.
- data related to the valuation of services; cost and availability of substitute products
- costing data for transmission and switching equipment; towers, terminals, repeaters, multiplexors, etc.
- network descriptions; nodes, links (at a detailed inter and intra-regional level)

- accounting and actuarial data; depreciation expenses and methods of determination, income taxes deferred and methods of determination, growth rates, retirement ratios, net salvage rates, survival data, rates of return on equity, costs of common and preferred shares, long term investment rates on corporate and government bonds, tax rates, debt/equity ratios, working capital, operating costs, number of employees, man hours expended, etc.
- technological data for satellite, cable, etc.
- Terminal Attachment Program data e.g. manufacturer, type of terminal, certification date, etc.

All data are to be in a disaggregated, historical form.

Investigation of the broadcasting industries requires data of the following types:

- demand data; applications, licenses, frequencies, classes of service, geographical areas, etc.
- data related to the determinants of demand; advertising data, socio-economic and demographic data, etc.
- data related to the valuation of services; advertising data, costs and availability of substitute products, etc.
- general corporate data
- program data
- services data
- technological data; forecasts for technical advances, lower costs of production

- results of international research, particularly concerning spectrum allocation in border U.S. areas.

All data are to be in a disaggregated, historical form.

Data requirements associated with activities concerning the Cable television industry include:

- network descriptions
- detailed cost and revenue data on a historical basis; advertising, subscriptions, etc.
- data related to the determinants of demand; advertising data, socio-economic and demographic data, costs and availability of substitute products, etc.
- general corporate data
- program data
- services data.

All data are to be in a disaggregated, historical form.

General economic research generates a requirement for various types of data in disaggregated historical form:

- demographic and socio-economic data including population, growth rates, price indices, gross products, incomes, business activity, etc.; profiles by year, geographical area, etc.
- National Accounts data
- Government and private investment data on a geographic and industry basis
- International data from sources such as Federal Communications Commission (U.S.), I.T.U., O.E.C.D.

3.3 Software Requirements

3.3.1 Introduction

With the exception of the N.P.P.S. model and the ALADIN database management package, there is relatively little software currently being directly employed by the Branch in the activities defined in the previous Chapter. As a result, the software-related requirements described below cover virtually every type and stage of analysis carried out within the Branch. It is not intended that these be considered minimal requirements for the conduct of Branch activities, which many of the data-related requirements certainly are, but as requirements for carrying out comprehensive analyses in a timely, accurate, and efficient manner. Additional investigation is necessary in order to determine those which are high priority requirements. The requirements identified relate to data preparation and entry, data maintenance, data massaging and manipulation, statistical analysis and econometric modelling, financial analysis and simulation, information display, and special purpose computing, including cross-referencing, cataloguing, and text processing.

3.3.2 Data Preparation and Entry

Currently, approximately three man years are allocated to the coding, editing, and verifying of information obtained from Statistics Canada questionnaires and annual reports for the maintenance of the Cable television, telephone, and radio television databanks.

Software and methods exist to assist in the preparation and entry of large volumes of data; further investigation is required to determine the feasibility of applying these to the operations of the Branch.

3.3.3 Data Maintenance

A general requirement exists for greater emphasis on data maintenance procedures allowing flexible and easy access to large amounts of data. Certain applications, such as the anticipated statistical analysis and modelling activities of the Economic Analysis Division argue for the use of data storage strategies supported by "file management" and/or "database management" software packages. Data maintenance activities performed by personnel with relatively little computer experience also argue for the use of such packages as well as the construction of interface software particularly suited to specific applications.

3.3.4 Data Massaging and Manipulation

Data maintained primarily for analytical activities of a statistical or econometric nature usually require pre-analysis manipulation to perform such functions as subset selection, period modification, seasonal adjustment, filtering, and mathematical transformation. This generates a requirement for data massaging software as distinct from the requirement for maintenance or analysis software, although these requirements may in some cases be simultaneously satisfied.

Time series data is the principle example of data requiring sophisticated massaging and manipulation.

3.3.5 Statistical Analysis and Modelling

A strong requirement for relatively sophisticated software is generated by the planned activities of the Economic Analysis Division. Hypothesis testing, correlation analysis, non-parametric tests of association, standard and non-standard regression analysis, scaling, time series analysis, spectral analysis, and numerous other capabilities are required to perform the analyses intended. In addition, a requirement exists for software capable of simultaneous equation solution, constrained linear and non-linear optimization, and eigenvector determination for polynomials over a complex field.

Due to the nature and availability of some of the existing software packages satisfying the above requirements, some tailor-made user interfacing software will likely be required.

3.3.6 Financial Analysis and Simulation

Current and future activities, primarily within the Financial and Regulatory Affairs Division, generate a requirement for software support in the areas of financial analysis and simulation; accounting, actuarial, and investment methods are employed in the investigation of the impact of rate of return and other aspects of a regulated telecommunications industry. Forecasts are obtained through the simulation of management decisions related to capitalization, investment, construction programs, etc.

3.3.7 Information Display

The support and research activities to be undertaken in the Branch generate a possible requirement for software capable of suitable presentation of information to its users. Of interest is table generation software, packages for ad hoc and regular report generation, and plotting software packages for the graphic display of both time series and cross-sectional data.

3.3.8 Special Purpose Computing

Other activities which generate a potential requirement for software include: the development and maintenance of cross-reference and catalogue procedures for the large amounts of information available within and without the Department, especially in support of rate hearings; analyses for which ad hoc software must be constructed (e.g. sophisticated mathematical analyses which existing software is not equipped to handle), text processing to enable the production of publications in a more efficient, timely, and less expensive manner; and all manner of software interfaces required to allow non computer oriented E.D.P. users easy access to powerful software tools.

3.4 Hardware Requirements

In order to support the nature and level of internal computer usage that is indicated by current and planned activities within the Branch, requirements exist for additional low speed terminals and communication equipment in order to cope with a large number of active users, and a high speed terminal consisting of a card reader and line printer to service users with moderate response-time requirements. Keypunch/keyedit equipment may also be required in support of data preparation activities. Plotting facilities for graphic display will be considered.

The computer presently being used for the development, operation, and maintenance of the National Policy and Planning Simulation (N.P.P.S.) Model is a SIGMA 9 presently located at the Communications Research Centre (C.R.C.), Shirley's Bay. Although a Xerox product, Honeywell presently holds the maintenance contract which expires in the year 1980. This generates a requirement to examine alternate methods of processing, in particular for the N.P.P.S. model.

3.5 Expertise Requirements

General considerations plus the above data, software and hardware requirements indicate a strong requirement for intra-Branch expertise. That is, the activities of the Branch require the continuous availability of advice to the staff of the Branch on matters relating to data, software, and hardware.

It is observed that this requirement can be satisfied through the execution of special functions such as that of data co-ordination and methods co-ordination.

The activities of data co-ordination would require knowledge of data available, the methods for obtaining it, and its suitability.

Similarly, the activities of methods co-ordination would require in-depth knowledge of methods of analysis and software, particularly related to suitability, capability, access, and all associated costs.

External resources will likely be a continuing requirement in support of all phases of software development activities within the Branch.

3.6 Education Requirements

Education in the current context is meant to include specific training in data processing methods and tools, as well as a high level of information flow.

The use of financial, economic, and econometric methods, and the software and hardware that may be employed in their implementation, generates a strong requirement for comprehensive training programs for Branch personnel. The recommendations to follow in PHASE II of this study will elaborate on these requirements.

The effectiveness of the Branch depends in part on the degree to which the Divisions are aware of each other's data holdings and analytical capabilities, as well as those external to the Branch. This generates a requirement for channels of communication to be developed and maintained in good order to enable the Divisions to both formulate work plans and make effective use of resources external to each Division. An example is the rationalized integration of activities into the work plan of the Statistical Information Services Division that offer support for the currently-emerging data requirements of the various groups within the Department, particularly of the relatively young Economic Analysis Division.

4. PHASE II

Phase II will begin upon approval of this report outlining the data processing requirements of the Branch. With this understanding of the requirements, based upon an intensive investigation of the current and future activities of the Branch, pragmatic recommendations which should be implemented to improve the statistical, econometric, and financial operations of the Branch will be formulated.

The tasks in this next part of the study, as outlined in APPENDIX II, are detailed as follows:

1. Planning

A plan and work schedule for this phase of the project will be developed in accordance with the known requirement priorities. For example, if urgent requirements within a functional area can be identified, then an interim recommendation can be produced on request to allow early commencement of projects.

A schedule for the investigation of selected external data sources and services will be developed and authorization obtained.

2. Interviewing (External Sources)

Information will be gathered regarding data, services, software, etc. available from such external sources as Statistics Canada, Conference Board, Financial Resources Institute, Data Resources Institute, computer service bureaux, and the Computer Service Directorate.

3. Analysis

With the basic information and priority requirements known, analysis will proceed by:

- categorization of Branch requirements into functional areas
- assessment of emerging analytical requirements, workload, and current capacity and capabilities
- identification of data sources, techniques, models, procedures, and software which most effectively meet the requirements. This will include the assessment of the availability, practicality of use, and costs of data, software, and hardware, while recognizing work schedules.

4. Development of Alternatives

At this point, a set of alternative approaches will be developed which indicate practicality, benefits, and costs. Criteria for selection will be determined through co-ordination between the Branch project co-ordinator and the Systemhouse team.

5. Formulation of Recommendations

Recommendations will then be developed, which will be evaluated in terms of:

- meeting current and emerging analytical requirements
- practicality
- costs and benefits
- timeliness
- required education development, support, and maintenance.

6. Prepararation of Implementation Plan

An implementation plan indicating exactly how the recommendations may be implemented will be prepared, showing:

- training and educational requirements
- support requirements
- procedures
- resources
- schedules
- costs

7.&8. Draft Report.& Review

A draft report indicating the analysis, alternatives, and recommendations will be prepared for review by the client to ensure all study requirements have been met.

9. Final Report

An outline of the proposed final report content appears in Appendix III.

A revised schedule for Phase II appears in Appendix IV.

APPENDICES

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APPENDIX I-3

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APPENDIX II-1

PHASE II ACTIVITIES

1. Planning
2. Interviewing (External Sources)
3. Analyses
4. Development of alternatives
5. Development of recommendations
6. Prepare implementation plan
7. Draft report
8. Review
9. Final report presentation

ANALYSIS AND RECOMMENDATIONS REPORT

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		SA
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		SC
		SA
		SA
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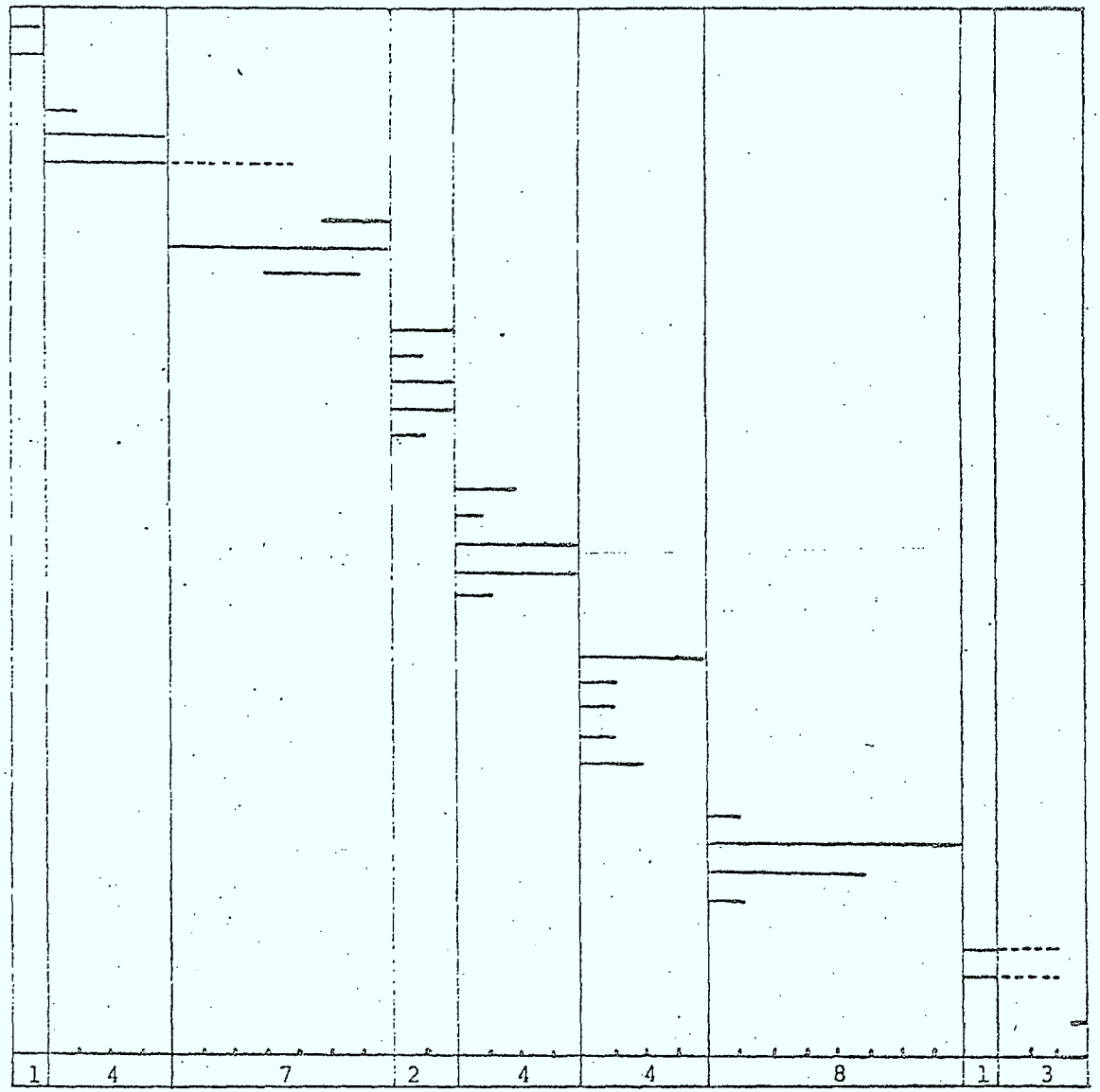
5.	Recommendations	PM
		SC
		SA
		SA
		PC
6.	Implementation Plan	PM
		SC
		SA
		SA
		PC
7.	Draft Report	PM
		SA
		SA
		PC
8.	Review	PM
		PC
9.	Presentation	PM



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