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

PHASE II REPORT

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1. EXECUTIVE SUMMARY

1. EXECUTIVE SUMMARY

1.1 Introduction

Since its inception, the Telecommunications Economics Branch of the Department of Communications has been responsible for the analysis of economic and financial aspects of telecommunications policy, and for providing advice on the economic aspects of telecommunications policy.

Systemhouse was commissioned by the Director General of the Branch in early August of this year to conduct a study of the Branch data processing requirements. This study was judged necessary as a result of the expansion of major policy activities requiring extensive data processing support.

The objective of the study was twofold: to determine the requirements of the Branch in terms of data, software, hardware, training, and expertise, and, to develop recommendations to meet the needs identified. The study was conducted in two phases: PHASE I identified the requirements and culminated in a report approved by management, and, PHASE II involved the development of recommendations which are presented in this report.

1.2 Approach

Having identified, in PHASE I, the Branch's data processing requirements in the areas of data, software, hardware, training, and expertise, the Systemhouse team proceeded to perform a detailed analysis of these requirements, formulate recommendations, and develop an implementation plan.

1.3 Basic Issues

During our analysis of identified requirements, several basic issues presented themselves which impact significantly on the data processing requirements of the Branch. These are briefly described below; further discussion may be found throughout the report.

- HARDWARE

  The equipment of three different computer manufacturers features prominently in the Branch's data processing environment. This has implications for data and software portability, cost justification, and other matters concerning the efficient, flexible use of computing facilities.

  The databanks maintained by the Statistical Information Services Division (DSI) are intended primarily for administrative reporting as opposed to economic and financial analysis. The majority of these databanks reside at CSC on a UNIVAC 1108 Computer; the remainder reside at COMSHARE on a Xerox SIGMA 9 machine. As the use of these databanks for analytical purposes will significantly increase, greater use of analytical packages will result. For most applications of this type, the most appropriate packages are available on IBM machines. This situation gives rise to a need for careful rationalization of the use of hardware resources.

A separate issue concerns the SIGMA 9 computer at the Communications Research Centre (CRC). Although an inexpensive computing resource, used for software development and production running of the N.P.P.S. model, this machine has an uncertain future. Consideration of alternate hardware resources is necessary for applications currently using this resource.

- EDP SUPPORT

The functions of data processing support include training and education, software development, ad hoc analytical support, evaluation, procurement and support, and advising or consulting. There are basically two approaches which can be taken in providing such support: ad hoc or coordinated support.

- EDP RESOURCES

Another basic issue revolves around the source of the EDP support mentioned. Personnel internal to the Branch could be called upon to develop and thereafter supply the expertise required, or, external resources such as the Computer Services Directorate (DMC), Institutes and Universities, Service Bureaux, and Consulting Firms can be configured to optimally satisfy the data processing requirements of the Branch.

- DATA CO-ORDINATION ROLE OF THE BRANCH

  This report formulates recommendations for the Branch to address its internal data requirements; the extent to which the needs of other Branches within the Department are to be considered concurrently is an issue requiring resolution.

- DATA STORAGE/USAGE

  As alluded to in the basic issue involving hardware, the emergence of the two distinct types of applications in which data are to be used raises serious questions of cost effective storage and maintenance regimes.

These basic issues require early resolution to facilitate the development of an effective EDP resource of which the Branch can make use; the recommendations formulated and described in Chapter 4 of this report are directed toward these and other issues.

2. OVERVIEW

2.1 Objective

The objective of PHASE II of the data processing requirements study for the Telecommunications Economics Branch was to assess the emerging analytical requirements of the Branch and relate these needs directly to information on the availability of data, software, hardware, training, and expertise. In addition, an implementation plan was to be developed in accordance with identified Divisional and Branch work plans and priorities. A schedule for the implementation plan was to be designed to meet short and medium term priorities with some consideration given to the long term.

2.2 Approach

As in PHASE I, one of the activities in PHASE II involved conducting extensive interviews with numerous Service Bureaux, Government Departments and other external resources. A complete list of personnel interviewed is included in Appendix I. The purpose of the interviews was to collect information regarding available software, databanks, and services offered to supplement information already gathered by the project team during PHASE I of the study.

The information was then analyzed, evaluation criteria established, and recommendations formulated in the data, software, hardware, training, and expertise areas.

2.3 Requirements Review

During PHASE I of this study, numerous requirements were identified. These requirements formed the basis of the analysis performed in PHASE II and are reviewed briefly below; refer to the PHASE I report for further information.

2.3.1 Data

Both general and specific data requirements were 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 deal with detailed items that relate directly to present and future analysis carried on within the Branch.

2.3.2 Software

The software-related requirements cover virtually every type and stage of analysis carried out within the Branch. The requirements identified relate to the following:

- database creation, maintenance, and access
- data manipulation and massaging
- report generation
- information display
- financial analysis and accounting
- statistical analyis
- mathematical analysis
- modelling
- simulation
- control

A more detailed functional breakdown is presented in Appendix II of this report.

2.3.3 Hardware

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:

- low speed terminals
- access to a high speed terminal
- keypunch/keyedit equipment
- access to plotting facilities
- word processing equipment

2.3.4 Training

The use of financial, accounting, economic, and econometric methods, and the software and hardware that may be employed in their implementation, generates a strong requirement for comprehensive training programs in specific data processing methods and tools.

In addition to this, a requirement for channels of communication and their maintainance in good order exists in order to enable the Divisions to both formulate work plans and make effective use of resources external to each Division. The effectiveness of the Branch depends 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.

2.3.5 Expertise

The above requirements indicated a strong requirement for the continuous availability of advice to the staff of the Branch on matters relating to data, software, hardware, and training. This requirement can be satisified through the provision of the special functions of data co-ordination and methods co-ordination.

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

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

External resources represent a required resource in support of software development activities within the Branch.

3. ANALYSIS

3.1 Introduction

Whereas the previous Chapter dealt with a review of the requirements identified in the PHASE I Report, this Chapter outlines the detailed approach used by the Systemhouse team to formulate recommendations. The recommendations that flow from this analysis will be indicated briefly in this Chapter and assimilated and expanded in Chapter 4.

The analysis of the requirements covered the data, software, hardware, training, and expertise areas of data processing, and integrated the requirements, work plans, and resources available to satisfy these requirements. Emphasis was placed on meeting the short and medium term priorities of the Branch.

3.2 Data

3.2.1 Introduction

In conducting the analysis of the data requirements of the Branch, a distinction was made between fixed characteristics of data and matters concerning its use in the Branch.

In more detail, the following is a breakdown of the fixed data characteristics:

- source — physical location, any hardware or software associated with storage and access
- availability — access, acquisition methods and costs
- technical characteristics — frequency of update, format, form, volume, number of fields etc.

Similarly, the matters of importance to the usage of data within the Branch include:

- data usage — administrative, analytical
- expertise — software, hardware, procedures
- budget — costs associated with the above

These two components were synthesized to formulate recommendations leading to a rational strategy for databank design, development, and maintenance, as well as documentation, data entry, and validation procedures in a cost effective manner.

3.2.2 Observations

The PHASE I Report identified the databanks currently maintained by the DSI. An exhaustive description of the DSI databanks has been collected and is available for inspection. In addition, several other data sources of use to the Branch have been identified:

- DMC (Integrated Radio Licensing System)
- SM§ (Spectrum Management System)
- Statistics Canada (CANSIM database)
- National Bureau of Economic Research (NBER)
- Data Resources Inc. (DRI)
- Financial Resource Inst. (FRI)
- Organization for Economic Co-operation and Development (OECD)
- Conference Board

An examination of the DSI databanks according to the features described in the previous Section, and of the manner in which the Branch makes use of them, leads to the following observations:

- Documentation standards are inconsistent.

- The structure and content of the databanks, in general, renders them inappropriate for analytical purposes.

- Use of these databanks has been primarily outside the Branch.

- Numerous other databanks exist of potentially high use to the Branch both from an analytical and administrative point of view.

Due to these observed difficulties, a rational strategy for cost effective data management cannot be constructed at this time. However, clear recommendations can be made for a data resources survey as well as a study of data usage and methods of storage and retrieval. The information gathered from these activities will allow establishment of procedures for data access/acquisition, entry, validation, and documentation. Chapter 4 will expand on the scope of these activities.

3.3 Software

3.3.1 Introduction

The first step in analyzing the identified software requirements involved a more detailed functional analysis of the requirements in order to identify types and sources of additional information. Evaluation criteria were developed integrating Divisional work plans and available resources. The work plans identified both functional and short/medium/long term priorities. In considering software resources, the following factors were judged the most important criteria: availability, applicability, acquisition, usage, training, and support. The evaluation criteria developed allowed a preliminary assessment of the resources required to satisfy individually identified functions. An integrated evaluation was necessary as many of the functions are interrelated.

3.3.2 Functional Requirements Definition

Broad functional requirements were derived as a result of information gathered during interviews conducted in PHASE I of the study. The functional requirements can be classified as follows:

- database creation, maintenance, and access
- data manipulation and massaging
- report generation
- information display
- financial analysis and accounting
- statistical analysis
- mathematical analysis
- modelling
- simulation
- control

To facilitate detailed analysis, the broad functional requirements were disaggregated; the complete disaggregation is presented in Appendix II.

In order to identify the software available to perform these disaggregated functions, service bureaux offerings and software directories (Datapro, Auerbach, CIPS) were consulted. The software packages identified were then matched against the disaggregated functions in the form of a 'spread sheet', described in the next Section.

3.3.3 Preparation of Spread Sheet

Though necessarily arbitrary, this component of software evaluation provides a means for evaluating software packages in a manner that reflects both functional and time priorities. Each disaggreated function was assigned a weight reflecting its priority in overall Branch activities; these weights were later used in a scoring scheme designed to evaluate the packages. See Appendix II for a detailed breakdown of the spread sheet.

3.3.4 Evaluation Criteria

The evaluation criteria used were divided into four categories: suitability, resource requirements, relative advantages, and support. Scoring weights were assigned to these categories and to their detailed components.

The evaluation criteria used and their corresponding weights appear in Figure 3.1.

3.3.5 Evaluation of Individual Packages

The factor weights of each component of the evaluation criteria were applied according to the disaggregated functions. The software packages received scores in each of the following groupings:

- database creation, maintenance, and access
- data manipulation and massaging
- report generation
- statistical analysis
- mathematical analysis
- modelling

FIGURE 3.1

EVALUATION CRITERIA		WEIGHTS
1. SUITABILITY		(25)
. AVAILABILITY, PORTABILITY	(2)	
. RANGE OF APPLICABILITY AS PER SPREAD SHEET	(3)	
. UNIQUENESS	(1)	
2. RESOURCE REQUIREMENTS		(25)
. ACQUISITION	(1)	
. CONVERSION	(2)	
. TRAINING	(1)	
. USAGE	(3)	
3. RELATIVE ADVANTAGES		(25)
. DATA	(1)	
. PROCESSING	(2)	
. DISPLAY	(1)	
4. SUPPORT		(25)

The areas of Financial Analysis and Accounting, Simulation, and Control were not treated in the same manner; see Section 3.3.7 for an explanation of how these areas were evaluated.

See Figure 3.2 for the results of applying this scoring procedure. Note that groups of packages are identified. The packages in each of these groups can be considered equal in calibre due to the minimal difference between scores.

These results were considered preliminary and recommendations were not formulated until an integrated evaluation was performed, as described in Section 3.3.7.

3.3.6 Functional Progressions

There are several groups of functions which are usually performed serially. Two examples of such functional progressions are:

- database creation, maintenance, access
  → data manipulation, massaging
  → report generation

- database creation, maintenance, access
  → data manipulation, massaging
  → analysis (financial, accounting, statistical, mathematical, econometric)
  → modelling
  → simulation.

These functional progressions required the use of software package combinations and influence final software evaluation.

FIGURE 3.2

INDIVIDUAL PACKAGE SCORES

Database Creation, Maintenance, Use

MARK IV	76.9	ALADIN	62.3	TOTAL	53.0
SYSTEM 2000	69.4	EASYTRIEVE	60.0	IDMS	49.8
DATAMAN	66.9	DATABANK	59.2	ADABAS	48.8
		EXTRACTO	57.9	IMS	42.3
				INQUIRE	33.4

Data Manipulation, Massaging

IMSL	66.5	TROLL	62.1	SAS	40.9
		MASSAGER	61.8	BMD	40.9
				X-11	40.1
				SPSS	31.9

Report Generation

MARK IV	75.0	ALADIN	60.4	MATOP	45.7
		SYSTEM 2000	59.1		
		EASYTRIEVE	58.1		
		MASSAGER	57.3		

Statistical Analysis

IMSL	66.8	SPSS	51.1	STATPAK	32.9
SAS	66.5	BMD	50.9		
MASSAGER	66.4				

Mathematical Analysis

IMSL	72.3	Other (TROLL, MATOP, MSPX/MIP)	22.9

Modelling

TROLL	70.4	IMSL	62.3	BMD	50.1
IMSL	68.1	MASSAGER	61.5	SPSS	43.0
		SAS	58.8	STATPAK	29.0
		MATOP	57.6		

3.3.7 Integrated Evaluation

As indicated above, the separate evaluation of software packages is not sufficient to allow categoric recommendations to be made. Due to the serial nature of many of the Branch's detailed functions, and in addition, to the nature of the Branch's requirements for financial analysis and accounting, simulation, and control software, an integrated evaluation step was performed.

The evaluation criteria employed in this step are qualitative in nature. As in the previous evaluation, suitability, resource requirements, relative advantages, and support were employed; overall software/hardware compatability and commonality of use were also considered important evaluation criteria.

Main points of contention were the use of DATABANK/MASSAGER/SIMSYS versus TROLL versus ALADIN/TSP versus FORTRAN/IMSL, the use of ALADIN versus MARK IV versus SYSTEM 2000 versus EASYTRIEVE, the use of IMSL versus SAS version SPSS, the use of financial packages elsewhere than at CSC, and the use APL in a broad range of applications. Service bureaux characteristics were also elements that entered this evaluation, particularly in respect of support levels, security, backup, dataset control, etc.

Recommendations concerning software followed from this analysis and are presented in Section 4.3.3.

3.4 Hardware

The equipment considered as part of the analysis included computer terminals, keypunch/keyedit equipment and plotting facilities. The components of analysis included:

- volume of usage
- type of usage
- ease and cost of access to existing facilities
- existing Branch facilities

The recommendations following from this analysis are presented in Chapter 4.

An analysis of text processing applications in the Branch would involve an examination of:

- types of documents
- volume of documents
- form and format
- budgetary sourcing of materials
- special training/personnel
- costs
- timeliness requirements.

Many of these items were considered beyond the scope of our analysis; further information gathering and analysis is necessary in order to formulate recommentations in this area.

3.5 Training

The recommendations formulated in the data, software, and hardware areas give rise to the nature and level of the total data processing resources necessary to support the EDP functions of the Branch.

As indicated earlier in Chapter 1 of this report, the extent to which Branch personnel form this EDP resource will determine the training requirements of the Branch. The recommendations to follow in Chapter 4 have been formulated to allow flexibility in this regard and have considered the existing expertise within the Branch.

3.6 Expertise

The total EDP capability required by the Branch will be formed by Branch personnel and by external expertise such as DMC, Institutes and Universities, Service Bureaux, and Consulting Firms. Recommendations formulated in this area are developed in conjunction with our training recommendations.

4. RECOMMENDATIONS

4. RECOMMENDATIONS

4.1 Introduction

The recommendations address the requirements identified in PHASE I of this study and were developed through consideration of priorities and application of evaluation criteria. The recommendataions are oriented toward the short and medium term and are designed to operationalize the use of data processing tools as soon as possible. Recommendations concerning data, software, hardware, training, and expertise are presented below.

4.2 Data

4.2.1 Data Resources Survey

4.2.1.1 Introduction

The recommendation to conduct a data resources survey is a direct result of the requirement for access to a wider range of data not presently available to the Branch, regular data acquisition, particularly for the construction of time series data, and the establishment of regular acquisition and maintenance schedules and procedures.

4.2.1.2 Objectives

The objectives of the survey are threefold:

- to determine the data available concerning the communications industry, and the characteristics of such data
- to identify requirements for liaison with other Branches, Government Departments, Agencies, etc.
- to communicate to the other Branches, Government Departments, Agencies, etc., the current and future data needs of the Branch.

4.2.1.3 Approach

The preferred approach is to conduct detailed interviews with key personnel in several areas including:

- all Branches within the Department, with special attention being given to DMC
- Bell Canada, B.C. Telephone, and other TCTS members, as well as Telesat and CN/CP
- Canadian Radio and Television Commission (CRTC)
- other Government Departments such as Statistics Canada
- Conference Board and Agencies such as NBER, DRI, FRI, OECD.

The procedure for conducting this survey can be outlined as follows:

- In conjunction with defined work plans and priorities within the Branch, identify the most urgent data requirements as well as anticipated requirements considering purpose, analysis to be performed, and detail required.

- Identify the Branches within the Department, other Government Departments, and Agencies to be surveyed.

- Interview key personnel in the selected Branches, Government Departments, Agencies, etc., in order to collect information on:

  - current and planned databanks
  - nature of the data (public, confidential, etc.)
  - availability (format, frequenty, form)
  - validity and limitations
  - procedures (edit, update, and access).
  - technical consultants

- Assimilate and document the information collected during the interviews.

- Evaluate the options of acquisition versus access to the data required. The criteria to be used include:

- cost of acquisition/access
- frequency of update
- historical completeness
- reliability
- requirement for the data (ad hoc versus continuing).

- Develop procedures for obtaining the data, including methods of access/acquisition, updating, etc.

- Prepare a report based on the results of the interviews and the analysis performed.

- Commence negotiations, where necessary, to obtain the required data.

4.2.2 Data Management Review

4.2.2.1 Introduction

In 1973, the DSI conducted a review of database management systems existing at that time. As a result, ALADIN was chosen and is currently the major tool employed for data management in the Branch.

Since that time:

- the Branch has expanded its activities to include significant analytical processing of data as opposed to administrative processing

- considerable advances have been made in the development of database management software.

These two developments lead directly to the recommendation to conduct a data management review.

The objectives of this review are to examine the present and intended usage of all databanks, to identify existing database management systems capable of supporting the identified usage, and to determine the most cost effective method of storage and retrieval.

4.2.2.2 Approach

Each databank currently maintained by the DSI should be examined to determine:

- content
- source
- form of the original data (machine readable, questionaire or survey, report or publication, etc.)
- procedures (editing and validation)
- data entry (method, time, frequency, volume, cost)
- current usage (administrative, analytical)
- anticipated usage
- current storage and retrieval methods
- expenditures (current and projected)

The synthesis of these findings for all databanks will lead to the determination of cost effective methods for storage and retrieval of data useful to the Branch.

4.3 Software

4.3.1 Introduction

The analysis as described in Section 3.3 can be summarized in the Software Selection Table shown in Figure 4.1. This Table highlights the basic issues of importance in satisfying the software requirements of the Branch. These are:

- the basic hardware-oriented issue of using the Univac 1108 at CSC or IBM equipment elsewhere
- the administrative versus analytical functions to be performed
- the time series versus cross-sectional organization of data used for analysis.

In some cases, a choice of software packages is indicated; selection of packages will depend on service bureaux selection, user knowledge, budgetary considerations, ad hoc versus production nature of applications, etc.

4.3.2 Observations

Points to be kept in mind include:

- software packages and service bureaux selection are interrelated
- cost/effectiveness of administrative/analytical storage structure
- a mix of time series and cross-sectional reporting and analysis is expected; it is therefore desireable to have compatability in software and location.

FIGURE 4.1

SOFTWARE SELECTION TABLE

DATA ORGANIZATION SERVICE BUREAU	APPLICATION TYPE ADMINISTRATIVE	ECONOMETRIC	FINANCIAL
TIME SERIES			
CSC	ALADIN	ALADIN/TSP	ALADIN/ FLARES/ FIPACK
(IBM)	MARK IV or SYSTEM 2000 or EASYTRIEVE or TROLL or IMSL/FORTRAN	DATABANK/ MASSAGER/ SIMSYS	(IBM Library) or (SDL MPS-F)
CROSS-SECTIONAL			
CSC	ALADIN	(TSP)	ALADIN/ FLARES/ FIPACK
(IBM)	MARK IV or SYSTEM 200 or EASYTRIEVE	MARK IV or SYSTEM 2000 and SAS or IMSL or (TROLL)	(IBM Library) or (SDL MPS-F)

NOTE: Software packages in brackets are less suitable.

4.3.3 Recommendations

Based on the above analysis and other considerations, the following recommendations are presented; these should be considered subject to changes in Branch priorities and commitments as they arise.

- For applications involving econometric methods, use an IBM-equipped service bureaux with the indicated packages.*
- For administrative applications or those requiring the use of financial or accounting packages, use CSC (ALADIN, FLARES).*
- Evaluate possibility of moving the N.P.P.S. model to an IBM-equipped service bureau.
- Evaluate IBM-equipped service bureaux, including SDL, IST, CSG, Datacrown, IBM, Computel, etc.
- Though the majority of packages listed are generally available, access should be acquired to less commonly available software: SAS, IMSL, LIBRARIAN or PANVALET.
- Evaluate APL and its use.

* Requires input from the data management review.

4.4 Hardware

4.4.1 Low Speed Terminals

Within the Branch there are presently three low speed printer-type terminals available for the exclusive use of Branch personnel.

Based on the current level of computer usage, we do not recommend the acquisition of additional low speed printer-type terminals. However, the replacement of one or more of the present terminals with CRT-type terminals is desireable to facilitate convenient interactive processing.

To assist the Branch in determining when additional terminals are necessary, we recommend that a simple monitoring procedure be employed; user, service bureau, sign on, and sign off time should be recorded. At such time when additional terminals are required, an evaluation of all available hardware is recommended.

4.4.2 High Speed Terminal

The current level of usage does not warrant the purchase/lease of a high speed terminal, but access to one is necessary. The minimum configuration should include a card reader and line printer.

Most service bureaux have high speed terminal facilities in their local offices, and in addition DMC has sufficient high speed terminal facilities available for use by the Branch.

4.4.3 Keypunch/Keyedit Equipment

Keypunch facilities are available for the use of Branch personnel in DMC.

The present volume of data and frequency of update does not justify the purchase and/or use of keyedit equipment for on-line entry procedures.

4.4.4 Plotting Facilities

Our considerations of the plotting facilities currently available in the marketplace were directed at potential Branch usage rather than the provision of an exhaustive description of hardware capabilities.

For internal applications, we recommend the use of printer plotting capabilities available in packages such as MASSAGER, TROLL, and APL, if these packages will be generally used by the Branch. High-speed printers and, in some cases, fine-plotting terminals such as the Multi-Writer are the output media employed.

For applications requiring more sophisticated display, eg. publications and presentations, we recommend such plotting packages as CALCOMP and CISGO. The use of such software packages will require access to flat-bed and/or drum plotters.

4.4.5 Text Processing Equipment

As indicated in Chapter 3, information gathered for PHASE II of this study is insufficient to make recommendations concerning the acquisition of text processing equipment. However, the expected level and type of usage for such equipment justifies a recommendation for further investigation.

4.5 Training

As indicated in previous Sections of this report, training and expertise are highly related. This Chapter's Sections on Training and Expertise reflect our understanding of the best manner in which the total EDP support role for Branch activities can be provided.

We recommend training in four areas: software packages, hardware, procedures, and general EDP.

4.5.1 Software Packages

In the context of the software recommendations in Section 4.3, we recommend that:

- Branch personnel be identified for training, by considering the nature of each package's use and the skill levels required

- schedule, location, duration, cost, and content of existing courses for recommended software be identified

- where no courses exist, courses appropriate to Branch needs be developed

- training schedules be established.

4.5.2 Hardware

Similar to the recommendations for training associated with the use of software packages, we recommend that:

- Branch personnel be identified for training; clerical, support, and professional staff should be included

- seminars related to the use of low speed terminals be developed.

4.5.3 Procedures

The development of several procedures was recommended in the areas of data and software earlier in this report. We recommend that:

- training be developed for procedures concerning data preparation, editing, validation, and data set control

- Branch personnel be identified for training. This training is to be directed primarily at clerical, databank and research support staff.

4.5.4 General EDP

In addition to training recommendations resulting from recommendations formulated in the data, software, and hardware areas, we recommend that training be given in the following areas:

- Introduction to Data Processing
- Job Control Language.

4.6 Expertise

The major Branch functions include data development, economic research and analysis, and financial research and analysis. In support of extra-Branch activities, the Branch engages in information dissemination and advising on economic and financial aspects of the communications policy. The organizational structure required to carry out these functions consists of a Branch Director General and three Divisional Directors. Each Division requires general and specialized data processing support.

We recommended that a co-ordinated data processing support function be established. A possible means for the provision of such support is depicted in Figure 4.2. In such an environment the EDP Support Co-ordinator would be responsible for configuring external and internal resources to provide the following functions to the Branch.

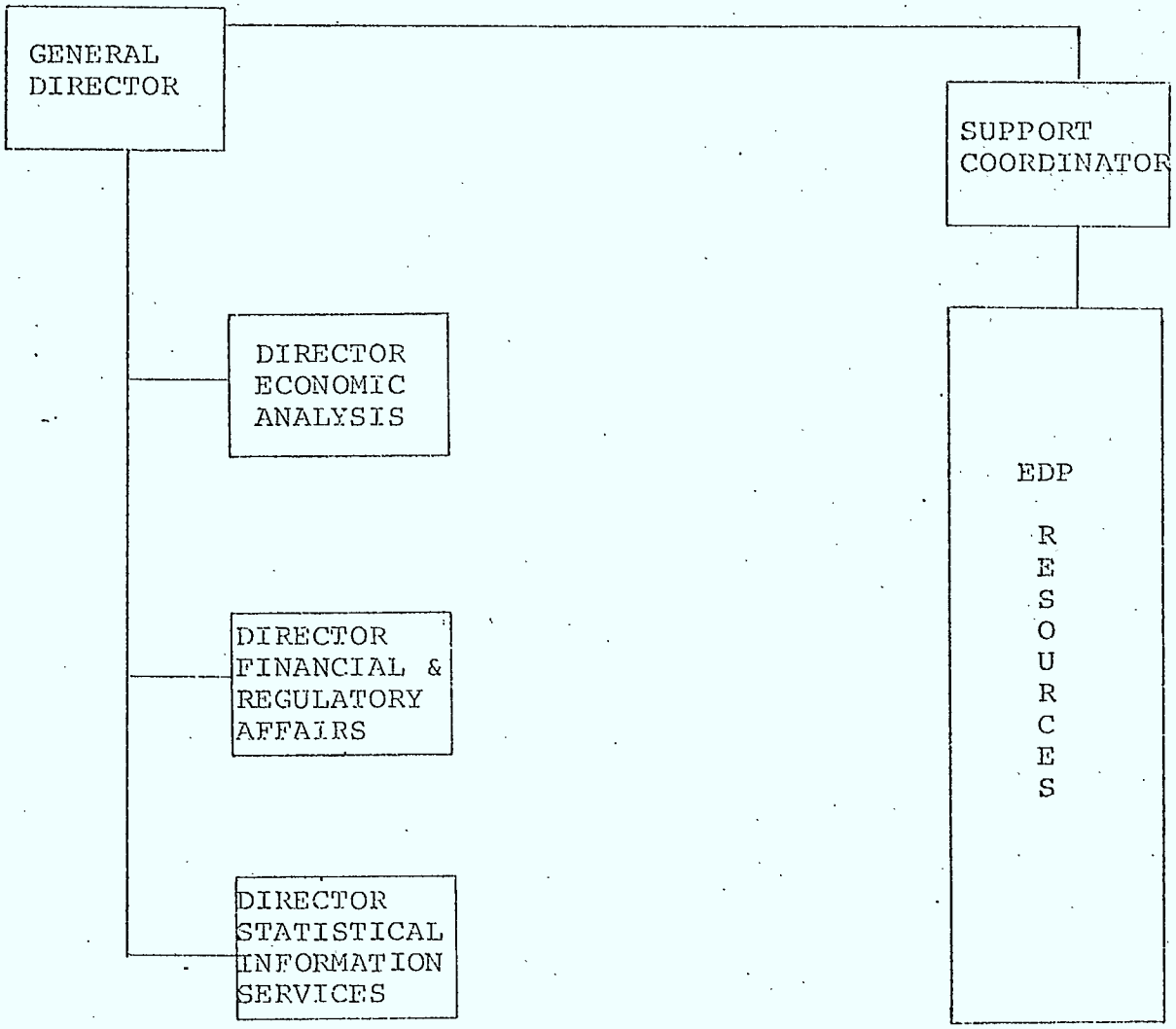
- Training and education for software packages, hardware, procedures, and generalEDP.

- Software development for data management, report generation, statistics, modelling, simulation, and package interfacing.

- Ad hoc analytical support for applications involving statistics, modelling, mathematics, etc.

FIGURE 4.2

CO-ORDINATED EDP SUPPORT



- Evaluation, procurement, and management of software packages and hardware.

- Expert advice on procedures, software, and hardware.

The type and level of expertise required to perform this function involves professional data processing personnel, from programmers through analysts to management consultants.

5. IMPLEMENTATION PLAN

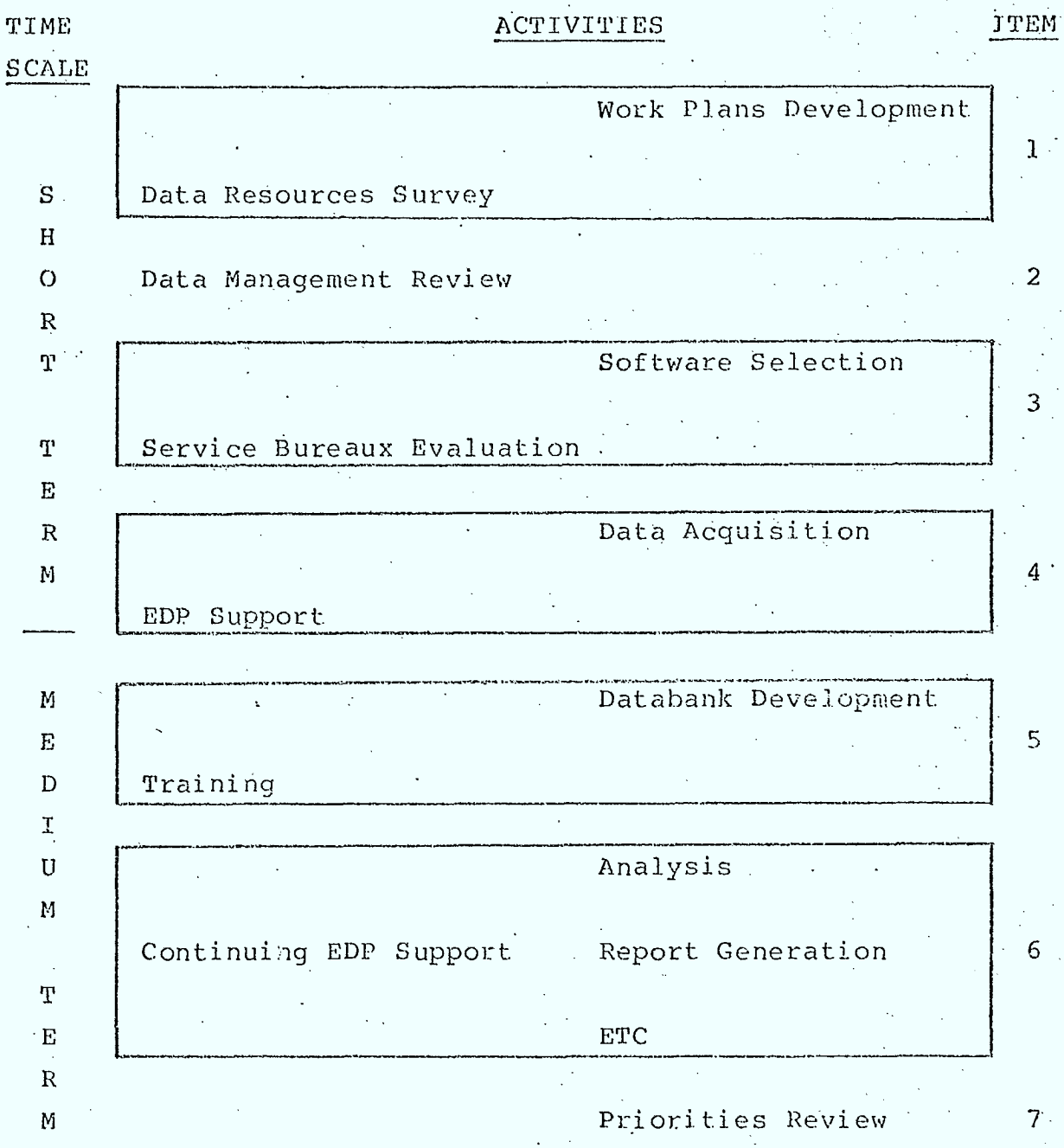
5. IMPLEMENTATION PLAN

The recommendations of this report, when coupled with schedules reflecting Branch priorities and work plans, constitute an implementation plan to equip the Branch with the total data processing resources required to support the wide range of activities in which it is engaged. Figure 5.1 depicts a possible scenario for development of data processing capabilities for use in the Branch.

As indicated, the implementation plan is primarily concerned with the short and medium term; the Priorities Review schedule item can be considered to be a re-initiation point for items 1-6.

The items have been grouped according to approximate concurrence, and have been arranged in two columns to suggest a possible distinction between the personnel and EDP resources to be used in executing the activities indicated. Generally speaking, the items in the right-hand column could be performed by Branch personnel, and those in the left, by extra-Branch personnel with particular knowledge and expertise in the EDP area.

FIGURE 5.1


TIME SCALE
ACTIVITIES
ITEM
Work Plans Development
1
S
Data Resources Survey
H
O
Data Management Review
2
R
T
Software Selection
3
T
Service Bureaux Evaluation
E
R
Data Acquisition
M
4
EDP Support
M
Databank Development
E
5
D
Training
I
U
Analysis
M
Continuing EDP Support
Report Generation
6
T
E
ETC
R
M
Priorities Review
7

6. RECOMMENDATIONS SUMMARY

6. RECOMMENDATIONS SUMMARY

The following is a very brief listing of the recommendations formulated to equip the Branch with the data procesing resources required to support the wide range of activities in which it is engaged. Reference should be made to the body of the report for supporting information.

- data
  - data resources survey
  - data management review

- software
  - ALADIN or MARKIV/SYSTEM 2000/EASYTRIEVE for administrative purposes
  - DATABANK, MASSAGER, SIMSYS or TROLL, and, SAS and IMSL for analytical purposes
  - IBM-equipped service bureaux for mixed administrative/analytical purposes
  - evaluate IBM-equipped service bureaux
  - evaluate APL

- hardware
  - no additional low-speed terminals
  - possible replacement with CRT-type terminals
  - terminal monitoring procedures
  - access to high-speed card reader/printer
  - access to keypunch equipment
  - no need for keyedit equipment
  - access to printer plotter facilities for internal use, line plotter facilities for presentation and publications

- training
  - identify Branch personnel to be trained
  - identify courses
  - develop courses as required
  - develop training schedules

- expertise
  - co-ordinated EDP support

APPENDICES

I. PERSONNEL INTERVIEWED

II. DETAILED SPREAD SHEET

APPENDIX I

PERSONNEL INTERVIEWED

LIST OF PERSONNEL CONTACTED DURING PHASE II

Statistical Information Services Division

E. King

Economic Analysis Division

M. Andrieu
P. Neogi

Financial and Regulatory Affairs

G. Henter
M. Estabrooks

Communications Research Centre

W. Verbestel

Market Mix Inc.

Dr. E. West

Conference Board of Canada

L. Murphy

I.B.M.

T. Scott
B. McManus

APPENDIX I-2

I.P. Sharpe Associates

B.J. Daly

Economic Council of Canada

A. Stewart

R. Preston

Bank of Canada

M. Lemieux

Service Bureaux

I.B.M.
Systems Dimensions Limited
Datacrown
Canada Systems Group
Computel
Computer Sciences Canada
Comshare
Dataline
Industrial Life Technical Services

Other

Informetrica
Data Resources Incorporated
Financial Research Institute

APPENDIX II

DETAILED SPREAD SHEET

DETAILED SPREAD SHEET SHOWING FUNCTIONAL AND TIME PRIORITY WEIGHTS

Database Creation, Maintenance, Access

Backup, security	2
Data compression	1
Time series	5
Administrative	5
Text, documents	2
Associated access language	4
Interactive browsing	2

Data Manipulation, Massaging

Shift, collapse, lag, difference, accumulate	3
Scale, filter	3
Mathematical transformations	4
Seasonal adjustment	4
Sampling, categorization	2

Report Generation

Time series	5
Administrative	5
Survey	3
Document	
Word processing	2
Text processing	2
Typesetting	1

Financial Analysis and Accounting

Sales	5
Profit and loss	5
Balance sheet	5
Cash flow	4
Lease or buy	2
Break-even analysis	3
Capital investment	4
Rates of return	4
Risk analysis	2
Stock planning	2
Depreciation rates	4
Interest rates	4
Tax	5
Resource control	2
Funding	2

Statistical Analysis

Moments	5
Hypothesis-testing	
t, F, X2, Kruskal-Wallis, etc.	4
Confidence Intervals	3
Analysis of variance, covariance	5
Correlation	5
Contingency tables	3
Factor analysis	4
Discriminant analysis	3
Cluster analysis	3
Principal component analysis	3
Spectral/harmonic analysis	3
Scaling, filtering, seasonal adjustment	4
Probability functions	2

Mathematical Analysis

Mathematical programming	
Linear	4
Separable	2
Non-Linear	2
Mixed integer	2
Location of extrema	3
Differentiation	2
Location of zeroes	
Gaussian, Hermite, Laguerre, Legendre quadrature	3
Complex functions	3
Eigenvectors	4
Systems of algebraic equations	5
Partial differential equations	3
Function evaluation	
Erf	4
Gamma, Bessel, polynominal	2
Integration	
Romberg, Hermite, Simpson	3
Elliptic, Fresnel	3
Interpolation	3
Curve fitting	3
Spline smoothing	3
Fourier series, transforms	3
Matrix algebra	4

Modelling

Probit, logit analysis	2
Curve fitting	3
Regression	
Simple & multiple linear	5
Forward, backward, stepwise	5
Ordinary, 2 & 3 stage least squares	5
Asymptotic	3
Auto-regressive, moving average	5
Nonlinear	4
Best-subset	3
Distributed lags	5
Periodic, harmonic	4

Simulation

Monte Carlo	1
Time-discrete	2
Time-continuous	4
Stepwise	4

Control

Dataset Librarian	5
Security, back-up	4
Indexing, cross-referencing	3
Accounting	2
Documentation	3

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