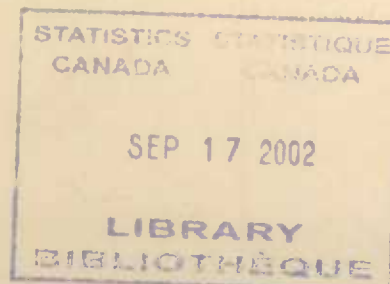


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Workshop on Advanced Data Processing Techniques in Support of Census Taking

**Presented by
Statistics Canada**

**in Ottawa, Canada
From September 23 to November 1, 1991**

**under the aegis of
The United Nations**

**Carol Boily
Workshop Coordinator
Census Operations Division
January 15th, 1992**

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1. INTRODUCTION

This document describes the workshop held in the Fall of 1991 at Statistics Canada in Ottawa. The event dealt with advanced data processing techniques in support of census taking and it was meant for developing countries. The participants came from 22 Sub-Saharan African countries and had been selected by the United Nations.

The United Nations Population Fund (UNFPA) and the Canadian International Development Agency (CIDA) provided the funding for this event. The Department of Technical Co-Operation for Development (DTCD) engineered the project.

The workshop was the third and last of a series dealing with censuses. In the two previous years, Statistics Canada had organized workshops on methodology and cartography. The organization of a workshop on advanced data processing techniques using microcomputers was the first of its kind by Statistics Canada.

The Census Operations Division organized the workshop by calling on the expertise of international organizations, the personnel of numerous divisions within Statistics Canada and also with companies from both the U.S. and Canada.

The first objective of this document is to describe the contents of the workshop to the sponsors and to the participating countries. The second objective is to create a base of discussion for the development of future courses. The paper is divided as follows:

1. List of the participating countries and their representative;
 2. Description of each component of the workshop;
 3. Appendices to describe certain products presented at the workshop.
-

2 COUNTRIES AND PARTICIPANTS

2.1

Country: Benin

Participant: Barthelemy Bewa

Position: Chef du Centre Informatique
Institut National de la Statistique et de
l'Analyse Économique (INSAE)

Address: B.P. 323
Cotonou
Benin

Phone: 31-41-01
31-11-03

Census Information:

The last census of population goes back to 1979. The next one should occur in 1992. They will soon start the testing of a pilot version before starting the data entry.

Hardware and Software at the INSAE:

The INSAE will use 24 Bull Micral for their next census; for software, they use RODE/PC, Dbase programs and other microcomputer software.



2.2

Country: Burkina Faso

Participant: Zakarie Sanou

Position: Chef du Service Informatique
Institut National de la Statistique
et de la Démographie (INSD)

Address: B.P. 374
Ouagadougou
Burkina Faso

Phone: 30-85-62

Census Information:

Burkina Faso takes a census every ten years. The last census of population occurred in 1985 and the next one will occur in 1995. For the next census, they will use the IMPS system.

Hardware and Software:

In his country, Sanou had access to microcomputers (IBM/PS2, IBM/AT, IBM/XT and Bull Micral). The software used was RODE/PC, SPSS, ISSA and the IMPS system (Concor and Cents4).



2.3

Country: Cameroun

Participant: Lionel Wilson Gwandua

Position: Chef, Division de l'exploitation Recensement
Général de la Population et de l'Habitat

Address: B.P. 7094
Yaounde
Cameroun

Phone: 203071

Census Information:

Cameroun had their last census of population in April 1987; by the end of 1989, they had finished entering all the census data. The next census is in 1997.

Hardware and Software:

In his country, Lionel has access to IBM microcomputers, IBM 4381, 4361, 36, 38, A400, NCR PC6, Bull Micral 30, 60 & 90. He uses Wordperfect, Lotus, Dbase, Page Maker, MS Chart, Harvard Graphics, Clipper, Mortpak, Word, Wordstar and finally the IMPS system which they use for surveys.



2.4

Country: Central African Republic

Participant: Justin Bakpa

Position: Chef du Service de Traitement des Données
de l'enquête démographique

Address: B.P. 696
Bangui
République Centrafricaine

Phone: 61-45-74 or
61-25-54

Census Information:

The Central African Republic had their second general population census in 1989; they prepare and plan for the next interim population survey.

Hardware and Software at the workplace:

In his work, Justin has access to an IBM/PC microcomputer, Bernoulli boxes and a HP laser printer. The accessible software was IMPS Version 1.1, Lotus, Multiplan, Excel, Word, SPSS and MCPDA.



2.5

Country: Tchad

Participant: Bandoumal Ouagadjio, Démographe

Position: Directeur technique du Recensement
de la population Direction
de la Statistique

Address: B.P. 453
N'Djamena
Tchad

Phone: 51-31-64

Census Information:

There has been no general census of the population since 1960. Two limited administrative surveys were taken in 1964 and 1968. A general census of the population will be taken in March 1993. The country will take a pilot census in March 1992.

Hardware and Software:

The detailed list of hardware and software was not available at the time of publication.



2.6

Country: Congo

Participant: Gilbert Mvilakanda

Position: Démographe, Responsable du Traitement
informatique des données de recensement
Direction des Statistiques Démographiques

Address: B.P. 2031
Brazzaville
Congo

Phone:

Census Information:

The country has taken a population census every ten years since 1964. The next one should happen in 1994.

Hardware and Software:

Gilbert has access to various compatible microcomputers. He uses Word, Symphony, dBase, Cents, Lotus, Harvard Graphics and Pagemaker.



2.7

Country: Côte d'Ivoire

Participant: Marie-France Niangoran

Position: Ingénieur informaticienne
Direction de la Statistique et de la
Comptabilité Nationale

Address: B.P. V 55
Abidjan
Côte d'Ivoire

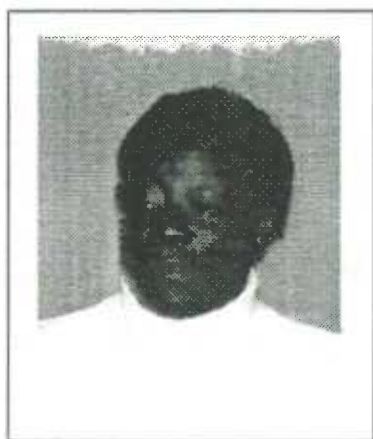
Phone: 21-42-08 (Travail)

Census Information:

The last census of population taken by the country was in 1988. The final tables were published in October 1991 (during the workshop). Marie-France was eager to see them after the workshop. Their next census is in 1998.

Hardware and Software:

Marie-France has access to an IBM 4341 running MVS, an IBM/9375, Commodore PC, IBM PS/2. For software, she uses Cobol, PL1, Wordperfect, dBase, Concor, Cents, Rode/PC, Lotus and Ariel.



2.8

Country: Gabon

Participant: Marie-Claire Abogue Ndong

Position: Ingénieur informatique
Direction Générale de l'Informatique

Address: B.P. 2156
Libreville
Gabon

Phone: 76-06-46 P.4103
76-06-46 P.4103
76-67-23/25 FAX

Census Information:

The last census of population was in 1980. Gabon is preparing to take another one in 1992-1993.

Hardware and Software:

Marie-Claire has access to minicomputers (Mini6 running GCOS, DPS6 running HVS and HVS6), microcomputers (IBM, Epson, Micral and Mac) with Word, Excel, Lotus, Multiplan, PC Tools, Macdraw and Macpaint. She also uses dBase, Basic, Cobol, Turbo Pascal, Gepeto, Orus and etc.



2.9

Country: Lesotho

Participant: Matilda K. Mofoka

Position: Programmer-Analyst
Bureau of Statistics

Address: B.O. Box 455
Maseru 100
Lesotho

Phone: 32-38-52, x215



Census Information:

Lesotho has taken its last census in 1986. The next one is due in 1996 and they plan to use IMPS as software.

Hardware and Software:

Matilda has access to an ICL ME 29 mainframe with CO-CENTS. Using IBM compatible microcomputers, she uses SAS, dBase, Wordperfect, Desk top Publishing, Planperfect and Graphics.

2.10

Country: Mali

Participant: Moustapha Diawara

Position: Chef du bureau d'étude de la Division
Informatique Direction Nationale de la
Statistique et de l'Informatique

Address: B.P. 12
Bamako
Mali

Phone: (223) 222455
(223) 224873



Census Information:

The last census of the population was in 1989 and the next one is planned for 1994.

Hardware and Software:

Moustapha has access to a DPS 4000 Honeywell Bull and Bull Micral 45. He uses CO-CENTS, dBase, Wordstar and Wordperfect.

2.11

Country: Madagascar

Participant: Jean Razanadrasara

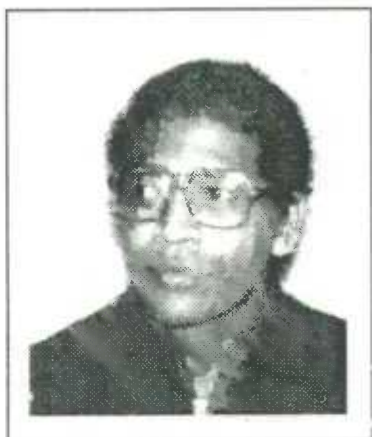
Position: Chef du Service Traitement et Analyse des données Direction Générale de la Banque des données de l'État (DGBDE) Direction du Recensement

Address: B.P. 485
Antananarivo
Madagascar

Phone: 465.05

Census Information:
The last census of population was 1975.

Hardware and Software:
Jean has access to 2 Compaq Deskpro 286 and 4 Copam+. For software, he uses Pc Tools, dBase, Foxpro, Lotus, Qpro, Multiplan, WordPerfect, Word4, PW, Chi Writer, Flow, PE 2, Basic, Pascal, Fortran, IMPS, SPSS and various other utilities.



2.12

Country: Mauritania

Participant: Sylli Ould Eleyatt

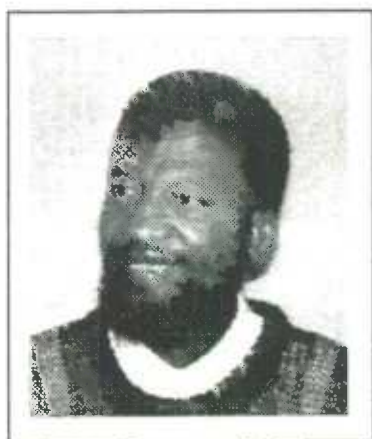
Position: Informaticien en service
Office National de la Statistique

Address: B.P. 240
Nouakchout
Mauritanie

Phone: 530-70/516-12

Census Information:
The last census of population in Mauritania occurred in 1988. The next one is due for 1998. Programs in Basic were used, along with the IMPS system with Concor and Cents adapted in Arabic and French.

Hardware and Software:
Sylli has access to IBM-PC's PS/2, Micral 75, PC-Wang and PC-XT. For software, he uses IMPS, Ariel, SAS, ISSA, SPSS-PC, HTPM, dBase, Lotus and various other utilities.



2.13

Country: Mauritius

Participant: Anand Cheerkoot

Position: Senior Systems Analyst
Data Processing Division

Address: Level 4, Anquetil
Building
J Koenig Street,
Port Louis
Mauritius Island (Ile Maurice)

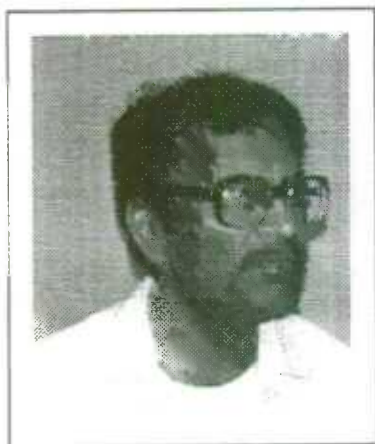
Phone: 201-1890

Census Information:

The last census of population taken by Mauritius was in 1990. The next one will be in the year 2000. Mauritius used the IMPS programs written by the International Statistical Programs Center staff.

Hardware and Software:

Anand could access the following hardware & software: IBM/PC, IBM/AT, IBM PS/2, ICL, Apricot, Acer, Tandy, ALR, Twinhead, Copam, Unisys, Mitac, Bull Micral series and Compaq Deskpro, Compaq Systempro (Unix), ICL ME 29, TME OS, Bull DPX/2000, IBM 36, IMPS, Sydonia, Harvard Graphics, Wordstar, Word, Excel, Lotus, dBase, Oracle, SQL Plus and SQL Forms.



2.14

Country: Niger

Participant: Aboubacar Tanimoun Dari

Position: Chef de Service Informatique
Bureau Central de Recensement

Address: B.P. 862
Niamey
Niger

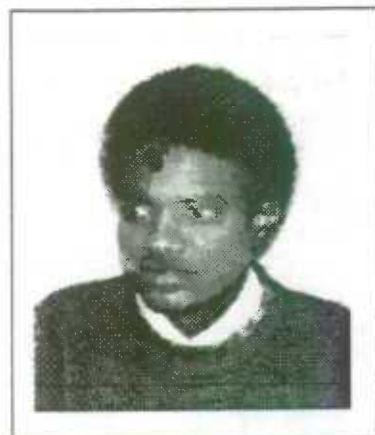
Phone: (227) 72-25-06

Census Information:

Niger used the software IMPS to take their latest census in 1988. They also use the IMPS System for all their surveys.

Hardware and Software:

At work, Tanimoun has access to the following hardware and software: Microcomputers Bull Micral, IBM PS/2, IMPS, Lotus, dBase, WordPerfect and Realia Cobol.



2.15

Country: Nigeria

Participant: Adekunle O. Shogo

Position: Systems Manager
National Population
Commission BAB -

Address: Animashaun,
P.M.B. 12628
Surulere, Lagos
Nigeria

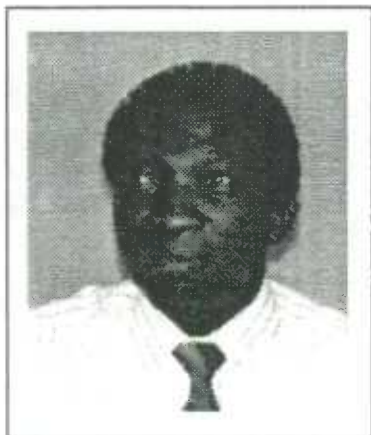
Phone: 31-41-01
31-11-03

Census Information:

Nigeria had their last census of population in 1973. There is one planned for 1991 using the IMPS System.

Hardware and Software:

This information was not available.



2.16

Country: Rwanda

Participant: Innocent Ngenzi

Position: Responsable de l'exploitation
des données du Recensement
Service National de Recensement

Address: B.P. 46
Kigali
Rwanda

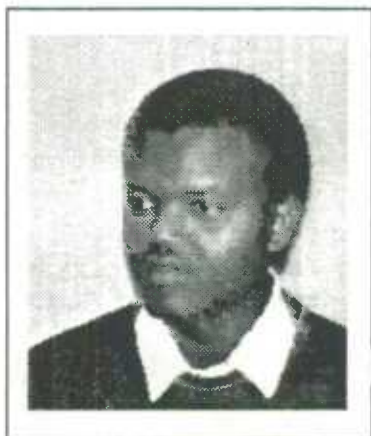
Phone: Office: 75992 - 75987

Census Information:

Rwanda had their latest census in August 1991. The preceding census goes back to 1978.

Hardware and Software:

This information was not available at the time of publication.



2.17

Country: Sénégal

Participant: Adama Marra

Position: Ingénieur Informaticien
Direction de la Prévision
et de la Statistique -

Address: B.P. 116
Dakar
Sénégal

Phone: 24-68-53

Census Information:

The last census of population in Senegal was in 1988 and the next one is due for 1988. The country uses IMPS to process their censuses and surveys.

Hardware and Software:

Adama has access to the following hardware and software: IBM/PC's and compatibles (80286, 80386SX), IMPS, dBase, Lotus, Pascal, Wordperfect and SPSS.



2.18

Country: Sierra Leone

Participant: Sia Alice Bockarie-Torto

Position: Chief Programmer
Central Statistics Office

Address: Tower Hill
Freetown
Sierra Leone

Phone: 223400

Census Information:

The last census of the population of Sierra Leone was in 1985 using CENTS4 as the software. The next census will be in 1996, and again, they will use IMPS.

Hardware and Software:

Sia has access to a minicomputer Wang VS-80 and uses Cobol, RPGII, Fortran, Basic, Concor, Xtally, Cents, Unedit. In addition, she has access to ALS 286 microcomputers with Lotus, dBase, Wordperfect, Ventura, Norton Commander, Printmaster, SPSS, IMPS and Harvard Graphics.



2.19

Country: Sudan

Participant: Adil Ahmed Mohamed

Position: Senior Systems Analyst
Department of Statistics

Address: B.P. 700
Khartoum
Sudan

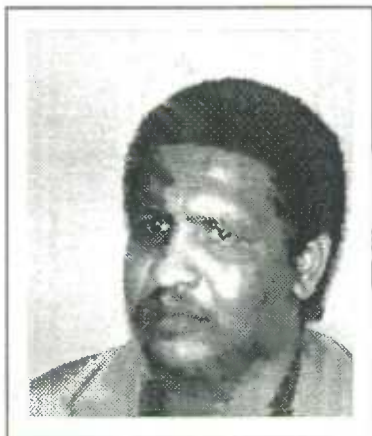
Phone: 70419

Census Information:

Sudan has had its last census in 1983 using CONCOR for data editing and various COBOL programs for the rest. There will be another census in 1993, and the country will most probably use IMPS.

Hardware and Software:

The hardware list includes a mainframe ICL ME-29 Model 45 and 11 IBM/PC's. They use the following software: TME, PS/2, DDE, Cobol, Fortran, Basic, RPGII and IMPS.



2.20

Country: Uganda

Participant: Anthony Jude Walakira

Position: Statistician Computer Programmer
Statistics Department Ministry of Planning
and Economic Development

Address: P.O. Box 13
Entebbe
Uganda

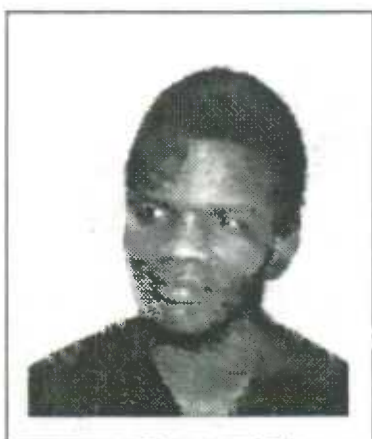
Phone: 042-20165

Census Information:

Uganda has taken its last census in 1991. They are now entering the data using the IMPS system. For tabulation, Anthony thinks that they will use TPL.

Hardware and Software:

Anthony has access to ICL, NCR and AST microcomputers, Epson and HP printers. He uses IMPS, TPL, Norton Commander, Harvard Graphics, Pagemaker, WordPerfect, Lotus, Relia Cobol, dBase and various other PC software.



2.21

Country: Zaïre

Participant: Bungu Munta

Position: Démographe à la Direction de la
Démographie Institut National de la
Statistique Ministère du Plan

Address: 6ième rue Limete
Kinshasa
Zaïre
B.P. 20, GOMBE,
Kinshasa Zaïre

Phone: 71775, 33312, 3331

Census Information:

Zaïre had its last census of population in 1984. There will be another one in 1994.

Hardware and Software:

Bungu has access to a HP 3000 and various microcomputers (IBM/PC, AST, Compaq, Toshiba and Zenith). He uses CENTS, Lotus, Wordperfect and Project.



2.22

Country: Zambia

Participant: Keith Steve Chipako

Position: Head of Data Processing Unit
Central Statistics Office

Address: P.O. Box 31908
Lusaka
Zambia

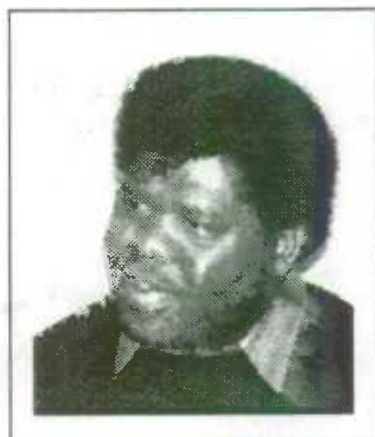
Phone: 25-33-65

Census Information:

The last census of population taken Zambia was in 1990. The country is now entering the data. Their next census will be in the year 2000.

Hardware and Software:

Keith has access to IBM PS/2, IBM XT's, ICL DRS 20 microcomputers, Bernoulli boxes, various Epson printers and a HP Laserjet II printer. There is also an IBM 4301 mainframe used as a backup. For software, Keith uses IMPS, PCGlobe, Harvard Graphics, PC tools, Norton Utilities, SPSS, Wordperfect, Wordstar, Multimate, dBase and Cobol Compilers (Microsoft and Realia).



3

DESCRIPTION OF WORKSHOP

3.1

Date, Site and Equipment, Board and Lodging

The workshop lasted six weeks, from September 23, 1991 through November 1, 1991. During that period, our African participants got a taste of our crisper temperatures, but they endured them gracefully.

Each group (French and English) had its own classroom on the 4th floor of the R.H. Coats Building in Statistics Canada Headquarters. However, during the strike of the Public Service, the workshop moved for a week at the Université du Québec situated in Hull, Québec.

Each participant had one microcomputer 386-DX with color monitor with the latest version of the IMPS software.

Board and lodging were under the responsibility of the Canadian Bureau for International Education. During the workshop, participants would contact Mr. Maurice Lelièvre of the CBIE for all aspects of their travel, lodging, passport, etc.

Most of the participants stayed at the YMCA in Downtown Ottawa and commuted to Statistics Canada using public transportation; when the workshop moved to the Université du Québec à Hull, Statistics Canada provided a shuttle bus for transportation to and from the residence and the university.

3.2

Contents

The Workshop was provided in two languages, French and English. Bilingual instructors usually delivered the lectures alternatively. In some cases, two separate persons delivered the course at the same time; exceptionally, instructors would make a presentation in English while simultaneous translation was provided for the French speaking participants.

The two groups of participants used adjoining classrooms and had extensive opportunities to mingle amongst themselves. Several of them were sufficiently proficient in the other language to converse and exchange freely.

The French translation of some of the documentation, that is, manuals originating from the United Nations and from the US Bureau of the Census, were not available for the Workshop. Statistics Canada has undertaken to translate these documents and provide them to the participants.

3.2.0 Opening Ceremony

Mr. Benoit Laroche, the 1991 Census Manager said a few words of welcome and introduced Mr. Giovanni Carissimo, Chief of the Technical Co-operation Co-ordination Unit of the Statistical Office. Mr. Carissimo addressed the participants and welcomed them to the workshop. Mr. Djamal-Eddine Benzine, Technical Advisor from the Computer Methods and Applications at the Statistical Office also delivered a statement to the participants.

Following the statements, Mr. Paul Johanis presented an overview and contents of the workshop.

3.2.1 Planning and Integration

Mr. Paul Johanis, Chief, Census Planning, Census Operations Division, presented this topic. Mr. Johanis presented his findings based on his own experience at Statistics Canada.

3.2.2 Questionnaire Development

Staff members of the Publication Division gave an overview of the production of various questionnaires and forms; participants made a tour of the production area where forms and questionnaires are designed.

3.2.3 Tour of in-house Printing Facilities

The participants made a tour of the Publication Division and Printing Shop. They learned the steps of the publication process, from the conception through the printing of the products. The participants received handouts and brochures on the topics presented.

3.2.4 Software PERFORM by Delrina

Mr. Shelly Sofer, Representative from Delrina Technology, presented PERFORM, a microcomputer software used for designing forms. It is noteworthy to mention that PERFORM is the software that the ISPC uses in the design of the POPSTAN questionnaire.

3.2.5 Software PC-EDIT

Mr. Mathieu Pageau, now working as a Consultant for Computer Associates, presented the software PC-EDIT. Mr. Pageau, who wrote that software while working at the United Nations, was very convincing in his presentation of the product.

For more information on PC-EDIT, please consult Appendix C.1.

3.2.6 Software X-TABLE

In addition to PC-EDIT, Mr. Mathieu Pageau also presented the software X-TABLE.

For more information on X-TABLE, please consult Appendix C.2.

3.2.7 Software POP-MAP

Mr. Patrick Gerland, Computer Demographic Software Specialist at the United Nations presented the new Software POP-MAP. This software, developed in collaboration with the Vietnam Institute of Computer Science, displays population data with maps and graphics and provides database/spreadsheet facilities.

For more information on the software POP-MAP, please see Appendix C.3 of this report.

3.2.8 Data Collection

Jocelyn Tourigny and Anis Ashraf, both senior methodologists, respectively presented the French and English course material on data collection. In addition to the usual documentation, the participant received a VHS training cassette for our 1991 Census that contained three subjects:

- a. Census - We count on you! (13:09 minutes);
 - b. The census: an operation that counts (26 minutes);
 - c. Management of a census (15 minutes).
-

3.2.9 Field Trip to the Ottawa Computer Show

The participants visited the Ottawa Computer Show during the afternoon. This yearly event which occurred very appropriately during our workshop, was a gold mine of information for the participants. Several hundred companies presented their latest products in all aspects of computers, and especially in microcomputers hardware and software.

3.2.10 Optical Mark Reader (OMR) Technology

National Computer Systems (NCS) is a company based in Minneapolis which specializes in OMR Technology. In the last couple of years, its technology was used to perform the capture and data entry of several censuses around the world.

Mr. John Hayhoe, Sales Manager for Africa & Middle East, Mr. Larry Tolle and Richard Lalonde presented the NCS products. They made a 2-hour presentation using simultaneous translation for the French participants. A VHS recording of the presentation is available by contacting the company. The subjects of the presentation:

- a. The Optical Mark Reader Technology;
 - b. Overview of NCS OMR Census projects;
 - c. OMR Census Forms Design Overview;
 - d. OPSCAN 5 Census Application Demonstration
 - e. NCS Capabilities in Africa
-

3.2.11 Automated Coding

Mrs. Judy Kirk, Head of the Automated Coding Section, presented this theme. It consisted of an overview of all the census steps involved, plus a detailed explanation of automated coding. The participants visited the Automated Coding Section to see actual production.

Mrs Kirk used simultaneous translation for the French participants.

3.2.12 Computer Assisted Coding (CAC)

Mr. Gervais introduced the Computer Assisted Coding topic using simultaneous translation for the French participants. His agenda included goals, objectives and concepts of CAC.

3.2.13 Integrated Microcomputer Processing System (IMPS)

The IMPS System represented the nucleus segment of the workshop and it lasted two intensive weeks.

Mr. Leo Hool, invited lecturer from the International Statistical Programs Center in Washington, took responsibility for the English-speaking participants. Mr. Jean-Marc Hié, Technical Advisor at the Economic Commission for Africa, accepted our invitation and came all the way from Addis Ababa to look after the French participants. Our participants greatly appreciated the presence of these two distinguished lecturers.

APPENDIX B contains more information on the IMPS system.

3.2.14 Data Capture

Mr. Peter Elliott, Direct Data Entry (DDE) Sub-task manager of the 1991 Census project, presented this topic in both English and French. Main areas covered included key entry process flow, specifications, security and verification strategy. Each participant received a booklet on DDE upon conclusion of the presentation.

-
- 3.2.15** **Quality Control and Monitoring of Operations**
-
- Jocelyn Tourigny and Rick Ciok, both senior methodologists from the Social Surveys Methods Division, presented the French and English course material on Quality and Monitoring of Operations. They showed how to implement controls in the various steps of a census using examples. Finally, the lecturers showed how to use a software such as LOTUS 1-2-3 to achieve this.
-
- 3.2.16** **Field Trip to Revenue Canada Taxation Facilities**
-
- Mr. Peter Elliott escorted the participants on a tour of the Revenue Canada Taxation facilities (Ottawa) where a portion of census data are keyed in. This visit provided the participants with an on-site experience of key-entry data capture, from document registration, to original entry and key verification.
- The participants were divided into two groups (one English, one French); Revenue Canada staff were very cooperative in responding to the many questions presented by the participants.
-
- 3.2.17** **Overview of Edit and Imputation**
-
- Mrs. Lorna Bailie, Manager of the Edit and Imputation Task for the 1991 Census and Mr. Daniel Lachance gave an overview of the topic.
-
- 3.2.18** **Tour of Edit and Imputation Production Area**
-
- Mrs. Marjorie Kiefl and Mr. Daniel Lachance escorted respectively the English and French participants through the Edit & Imputation production areas. This tour gave a good insight of Statistics Canada techniques and procedures on the related topic.
-
- 3.2.19** **Methodology behind Edit and Imputation**
-
- Ms. Rick Ciok and François Pageau, both methodologists, presented respectively to the English and French participants the methodologies behind Edit and Imputation. This included, concepts and definitions, current Statistics Canada population census systems and methods. They also talked about the current research undertaken to improve future censuses.
-

3.2.20 Practical Application of Edit and Imputation

Mrs Patricia Greenhalgh, and Gerry Ouellette, presented respectively to the English and French participants a typical application of Edit and Imputation. They used actual data examples to illustrate the edit and imputation processing.

3.2.21 Approach to Weighting Sample Data

Mr Michael Bankier and François Pageau, both methodologists, presented an extensive session on weighting sample data; it included census estimation techniques, simple ratio estimations, cell ratio estimation, Raking Ratio Estimation (RRE), Generalized Least Squares Estimation (GLSE), redundant constraints on the adjusted weights, Coefficient of Variation (CV), prototyping system using the Interactive Matrix Language procedure of SAS, etc.

3.2.22 Software Considerations and System Development

Mrs. Sylvie Lalonde, Senior Analyst responsible for the Edit and Imputation system, presented the system development portion. Sylvie covered various subjects such as: Project Charter, Project Plan, Staffing, System Standards, Work Units Development, Special Cases and, finally, the Evaluation and Planning Processes.

3.2.23 Wrap-up of Edit and Imputation

Mrs Lorna Bailie wrapped-up the Edit and Imputation series of modules by presenting future processing plans; she also answered questions from the audience using simultaneous translation.

3.2.24 Technologies and Equipment at Xerox Canada

Statistics Canada is a major user of Xerox products and systems, especially those dealing with publishing. The company invited all the participants to attend an afternoon presentation at their headquarters. Our hosts, Mr. Allen R. Deevey and Scott Finlayson presented the latest Xerox equipment, such as copier, duplicator, Facsimiles, typewriters and printers. However, the emphasis was on the Xerox Integrated Systems; for example: Imaging Systems, GlobalView Workstations, Network Services, Document Search and Retrieval, multinational Language Support and Encryption Units.

Mr. David W. Halayko, Chief MSAT Trials, invited all the participants at the Communication Research Centre (CRC) to attend a half-day presentation. The topics included satellite communication and portable satellite communication terminals. Portable terminals and satellite communications offer voice and data communication in remote locations where there are no communications links.

Our hosts at the CRC were Mr. Halayko and Michel Ouellet, Engineer Trials Implementation; they presented us a prototype for a fleet management using an application with the trucking industry, called ROADKIT. This demonstration was a good example of the potential in satellite communications and portable terminals. They also demonstrated a portable briefcase terminal that can be used to access the public telephone network.

Please consult Appendix A to learn more about Satellite Communication and Portable Terminals.

3.2.26

Tour of Laboratories at Communications Research Centre

Our hosts, Mr. Rolf Mamen, Director of the David Florida Laboratory, invited the participants on a tour of the laboratories where Canadian satellites are assembled. Each person dressed in white uniform and followed the guides through sanitized, pressurized laboratories to get a glimpse of a modern scientific laboratory.

3.2.27

SAS-PC

SAS Institute Canada sent two lecturers from Montréal, Mr. Denis Lebrun and John Bertone. The lecturers demonstrated the microcomputer version of SAS with an on-line session with the company's headquarters in North Carolina. SAS is increasingly utilized by Demographers, Statisticians and people responsible for censuses.

3.2.28

Software for Text proofing

The French participants received a presentation on the software HUGO and information on LE GRAMMAIRIEN and COLLINS ON-LINE from Mr. Claude Raymond from Logidisque Inc's, a company from Montréal. HUGO and LE GRAMMAIRIEN are very successful French correcting text software used in several French European countries. Many of our participants showed great interest with these software.

Mr. Louis Boutet, Chief in Systems Development Division, demonstrated the software GRAMMATIK IV for the English participants. Several similar products exist on the market, but we chose GRAMMATIK IV because of its good reputation amongst Statistics Canada users. We thank Mr. Scott A. Mesick of REFERENCE SOFTWARE from San Francisco for sending the requested documentation to the participants.

3.2.29

Selection, Tabulation and Display of Data

Mr. Louis Nolet, Chief of Systems and Integration Section at the Census Operations Division presented the Products And Services System (PASS) being developed at Statistics Canada.

PASS is an information system environment used at Statistics Canada for the efficient creation of various census products. PASS, being a state-of-the-art technology, is designed to adapt to the rapidly changing technology. It improves the product creation turnaround time, reduces system user training needs, thus increasing census customer satisfaction.

Mr. Nolet presented the group with the required concepts when implementing such a system. He elaborated on the need to generate a sound information model of the survey data, the elaboration of a comprehensive meta-data library system and the creation of a geography database for spatial definitions.

Mr. Nolet spent a portion of his presentation talking about the technology platforms of the PASS system: the PC/Window 3, the TCP/IP and the Unix operating system and relational data base management systems. Mr. Nolet also explained how PASS will be used to specify and create all 1991 Census dissemination products, such as publications and electronic media.

3.2.30

Dissemination of Census Data - Part I

In Statistics Canada, data is officially released by the Communications Division. Mrs. Marianne Weber, Assistant-Director from that division, presented one of their periodic publication called the **Daily** and showed a film on data dissemination using the optical disk technology.

3.2.31

Data Dissemination - Part II

François Roy, Systems Analyst and Jerry Stinson, Associate-Director, respectively lectured to the French and English participants on topics related to data dissemination. They talked about geographic codes, tabulations, aggregated data by geographic regions (printed output, summary tapes); profile approach, cross-tab approach and finally, computer related issues.

3.2.32 Software POWERPLAY

Mr. Jamie Malizia, Representative from COGNOS INCORPORATED, demonstrated the software POWERPLAY. This microcomputer software is a Windows-Based Executive Information System (EIS).

3.2.33 Analysis and comparison of Census Processing Methods

Mr. Paul Johanis presented this module which dealt with census data processing methods used around the world. This presentation was based on a paper by Arij L. Deckker entitled "NEW OR UNCOMMON COMPUTER METHODS IN POPULATION CENSUS DATA PROCESSING" which was presented at the 48th I.S.I. Session in Cairo, September 9-17, 1991.

The participants analyzed and discussed approximately a dozen charts of Mr Deckker's report.

Mr. Arij L. Dekker's address is: 2995 BW Heerjansdam, The Netherlands

3.2.34 Graphics Software and Optical Technology

COREL SYSTEMS CORPORATION invited the African participants to spend an afternoon at its Headquarters in Ottawa and learn about its family of products. Ms. Diane Latraverse and Mr. Kelly Fraser conducted the presentation which included the Graphics Software CorelDRAW and a comprehensive demonstration of optical software and equipment such as WORM, CD-ROM, multifunction optical drives and jukeboxes.

The participants were taken on a very instructive tour of the COREL facilities; namely: the research & development area, the assembly room where the software packages are prepared and shipped, the marketing department, etc. Finally, each person left with a few souvenirs, for example: a sweater, a mug, etc. Mr. Keith Steve Chipako (from Zambia) was the most fortunate after winning a CorelDRAW software package drawn amongst the guests.

3.2.35 Local Area Networks (LAN)

Mr. Mark Pytlik, Senior Analyst in charge of the Local Area Networks (LAN's) in Statistics Canada presented the subject to the English participants; his presentation included a basic course in LAN's and a description of the various networks in our organization.

Mr. Louis Boutet gave a similar presentation to the French participants by proposing a real-live demonstration on a 3-COM LAN, followed by a description of its required equipment.

3.2.36

Field Trip to Montréal, Québec

The participants took a well-deserved day of rest from the workshop by making a trip to Montréal. Evelyn Ryan, Sonia Latour and Carol Boily guided the group which left the YMCA at 8 o'clock in the morning and returned around eleven that evening. It was quite an exhausting trip, but also enjoyable because it was a good opportunity to exchange amongst everybody.

The African participants savoured smoked meat at Ben's for lunch and Shish-Kabab at La Maison Grecque for dinner. A sightseeing trip around the city followed a tour of the Église Notre-Dame, the Chapelle Bonsecours, the Vieux-Port, and naturally, an afternoon of shopping in the downtown area.

3.2.37

Field Trip to Kingston, Ontario

Everybody gathered for a Sunday excursion to Kingston, about 100 miles from Ottawa. The autumn weather was just superb in the Ottawa Valley. While our driver was looking after his radiator problem, we all got off the bus to pick apples in a nearby orchard.

3.2.38

Case Study POPSTAN 1990

The POPSTAN Case Study is a model census application developed by the International Statistical Programs Center (ISPC) using the Integrated Microcomputer Processing System (IMPS). The POPSTAN application comes with the census questionnaire and with all the pertinent IMPS programs. Hence, this material is a marvellous tool for consultation by IMPS users during the development of a census application.

The case study started in the second week of the workshop and lasted until the end.

3.2.39

Tour of Statistics Canada' Main Computer Centre

Mr. Jean-Paul Burelle escorted the participants on a tour of Main Computer Centre. This included the associated areas such as the printing room, the cassette and tape library, the consulting services counter, the auxiliary rooms and telecommunication facilities. The participants were able to appreciate our physical and logical security measures.

3.2.40

Wrap-up of Workshop

Mr. D. B. Petrie, Assistant-Chief Statistician, presided at the closing ceremony and handed the certificate of achievement to each participant. Were also present at the ceremony: Mr. Béla Prigley, Director, International and Professional Relations Division; Mr. Benoit Laroche, Manager of the 1991 Census of Canada, Mr Gerry Gervais and Mrs Danielle Baum from the Publications Division and finally, Mr. Paul Johanis and Carol Boily.

Mr. Anand Cheerkoot (Mauritius Island), representing the other participants, gave a statement of appreciation to Statistics Canada. At the same time, Anand handed a beautiful sculpture that will remain as a souvenir of the group. Each of the participants then received a few souvenirs, such as an Enumerator's kit (cap, t-shirt, carrying bag), a Canada 1991 Year Book, a set of personal business cards prepared by Mrs. Danielle Baum, etc.

After the ceremony, each of the participants received their personal series of diskettes containing:

- a. The latest version (Oct 23, 1991) of the IMPS software that had just arrived from the ISPC in Washington;
- b. The latest release of the REALIA COBOL Compiler with the updated documentation. For those countries that did not have a registered COBOL compiler before, the REALIA Organization provided them with a complete set of documentation. That was, in effect, putting all the 22 countries in good standing with REALIA. It is noteworthy that Mr. Djamal E. Benzine was instrumental in finding and securing funds for this extra expense.
- c. Two diskettes of various utility software .

A dinner followed at the V.I.P. room of Statistics Canada and ended at 20h00.

3.3

People and Organizations involved

The Census Operations Division staff provided the support for the administration and organization of the workshop; this required that several people in the division were involved with its preparation and its delivery; most specifically implicated with the daily activities of the workshop were Paul Johanis, Carol Boily, Sonia Latour and Evelyn Ryan.

The personnel of the Publications Division also contributed significantly to the success of the event. In particular, we want to underline the dedication and accomplishments of Danielle Baum.

The preparation and delivery of the workshop involved the participation of a large number of national and international organizations; Statistics Canada expresses its gratitude to the following persons and/or organizations for their significant contribution to the event:

Dr. Giovanni Carrissimo, Chief
Technical Co-operation Co-ordination Unit
United Nations

Jean-Marc Hié, Regional Advisor (From Ethiopia)
Economic Commission for Africa
United Nations

Mathieu Pageau, Software Specialist
United Nations

Kathleen E. Chamberlain, Chief
International Statistics Programs Center (ISPC)
U.S. Bureau of the Census

Rolf Mamen, Director
The Department of Communications Canada

The Department of Revenue Canada
The Canadian Bureau for International
Education (CBIE)

L'Université du Québec à Hull

Djamal-E benzine, Technical Advisor
Statistical Office
United Nations

Patrick Gerland, Demographic Software Specialist
Software and Support for Population Data Processing
United Nations

David W. Halayko, Manager
The Department of Communications Canada

Leo T. Hool, International Technical Advisor
International Statistical Programs Center (ISPC)
U.S. Bureau of the Census

Alain Mazet, Director
Translation Services
The Secretary of State of Canada

Maurice Lelièvre
The Canadian International Development Agency

In addition to those public organizations, Statistics Canada acknowledges the generous participation of the following persons and of corporations who went out of their way to donate their time and resources:

John Hayhoe, Sales Manager for Africa
and Middle East
National Computer Systems
Minneapolis, MN, U.S.A.

Scott A. Mesick, Sales Associate
Reference Software International
San Francisco, CA, U.S.A.

Denis Lebrun and John Bertone, Representatives
SAS Institute (Canada) Inc
Montréal, Québec

Claude Raymond, Sales Director
Logidisque Inc
Montréal, Québec
Charles Godwin, Director General

Shelly Sofer, Representative
Delrina Technology Inc
Toronto, Ontario
Allan R. Deevy, Consultant

Realia Cobol (Ottawa)
Ottawa, Ontario

Scott Finlayson, Consultant
Xerox Canada Ltd
Ottawa, Ontario

Michael Cowpland, Président
Corel Systems Corporation
Ottawa, Ontario

Lou d'Alo, Representative
Dan Software Inc

Xerox Canada Ltd
Ottawa, Ontario

Diane Latraverse, Account Executive
Corel Systems Corporation
Ottawa, Ontario

Jamie Malizia, Representative
Cognos Incorporated
Ottawa, Ontario

The following appendices contain some of the material presented during the workshop. In addition to providing information on the contents of the workshop it is also a good opportunity to show our appreciation to those organizations and companies for their important contribution to the event.

The texts were copied or scanned directly from their documentation and literature.

Acknowledgement

The final text for this publication was prepared generously for publishing by:

Baum Publishing
and Electronic Design
408-15 Murray Street,
Ottawa, Ontario, K1N 9M5
Tel.: (613) 237-2918

communications keeps users in touch no matter where they are within satellite coverage.

Applications are unlimited: emergency services, exploration teams, diplomats, military organizations, news reporters, executives, environmentalists, and scientific teams are only a few of the groups which will benefit from CAL's Portable Briefcase Terminal.

CAL provides a turnkey solution to meet demanding communication requirements, including satellite access through service providers, and a ground distribution network.

FEATURES

- Lightweight
- portable (14.75" x 19.25" x 5")
- GPS/Loran C Option
- RS-232 interface
- data communications
- satellite access
- programmable
- universal power (110 AC, 220 AC, 12 V DC)
- typewriter-like keyboard
- user-friendly design
- remote terminal to max. of 10 ft.
- stand-alone capability of 2 hrs. on self-contained rechargeable battery pack
- LCD display

BENEFITS

- easy-to-carry
- convenient to transport and store
- automated positioning
- remote access via computer and fax
- economical
- private
- ability to store frequently used messages
- international usage
- easy to compose and respond
- quickset-up
- flexibility within working area
- ideal for remote locations where electrical power is not readily accessible messages are easily read under any lighting



A.2.2

Mobile Earth Terminal (MET) from CAL

The MET-200 is a low cost data terminal designed specifically for reliable communications between a centrally-located dispatcher and vehicles anywhere.

The MET-200 operates in a cost-effective, half duplex mode, similar to mobile radio operation. It automatically provides position reports at intervals of 15, 30, 60, or 120 minutes, as selected by the dispatcher. This interval can be altered at any time to increase or decrease the frequency of reports. The MET automatically handles log in, call set-up and data transfer without operator intervention - all these functions are transparent to the operator.

The MET-200 consists of the following equipment:

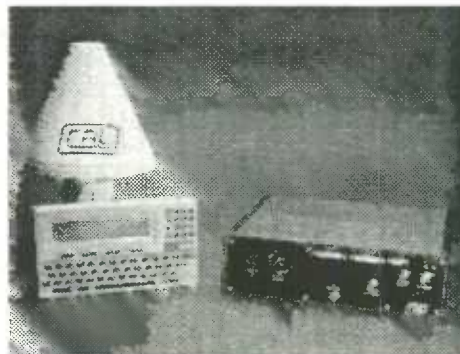
Compact keyboard/display unit - is easily mounted in a vehicle to alert the operator of incoming messages. It enables the operator to read incoming messages under any lighting condition, and to compose and respond simply by pressing characters on a typewriter-like keyboard.

Modular transceiver - houses the transmitter, receiver, Loran-C unit and power supply. It provides a link between the operator's keyboard/display unit and the antenna. It transmits the position of the vehicle as determined by Loran-C and sends/receives messages.

Antenna - is a rugged, lightweight unit, covered with a durable plastic cover which is dust and water resistant. It is used for both L-band satellite data communications and for receiving position signals from the Loran-C network. It can be mounted anywhere on the vehicle with a view of the satellite. Once installed, the antenna is automatically aligned with the satellite.

For information on the CAL products:

Subsidiaries: CAL Corporation	CAL Systems Corporation	CAL Systems Limited	Astro Pacific Pty Ltd
1050 Morrison Drive Ottawa, Ontario Canada K2H 8K7 Tel.: (613) 820-8280 Telex: 053-3937 Fax: (613) 820-8796	12210 Plum Orchard Drive Silver Spring, Maryland 20904, USA Tel.: (301) 572-2628 Fax (301) 572-9657	1, Portsmouth Enterprise Centre Quartremain Road Porthmouth, Hampshire PO3 5QT, UK Tel.: (705) 662996 Fax: (705) 673518	103-105 Northbourne Avenue Canberra ACT 2601 Australia Tel.: (62) 572619 Fax (62) 473796



A.2.3

Portable Briefcase Terminal LBT-1 from SkyWave Electronics
DESCRIPTION

The LBT-1 is a lightweight briefcase satellite terminal designed to provide voice or data communications anywhere in the world via Inmarsat's existing L-Band mobile service satellites.

Weighing only 32 lbs including antennas, batteries and carry bag the LBT-1 is the world's most convenient to use and easily transported satellite terminal. To place a call, simply remove the terminal from its carry bag, affix the antennas point, in the direction of the satellite and dial your call on the telephone handset provided.

For a data call a similar procedure is followed and an RS-232 data port is provided for connecting data terminal equipment such as a laptop computer.

Set up time is only a minute or two. The LBT-1 can even be operated indoors through a glass window.

A full hour of operation is provided by internal rechargeable NiCad batteries. Packed in its carry bag the LBT-1 meets airline size limits for carry-on luggage.

The outstanding performance of the LBT-1 has been made possible by the use of state-of-the-art technology in a number of areas. The modems are implemented using digital signal processing techniques: ACSSB (amplitude companded single sideband) for voice, and DMSK (differential minimum shift keying) for data and call setup.

Battery operation for extended periods is made possible through the use of low power circuitry, particularly in the transmitter.

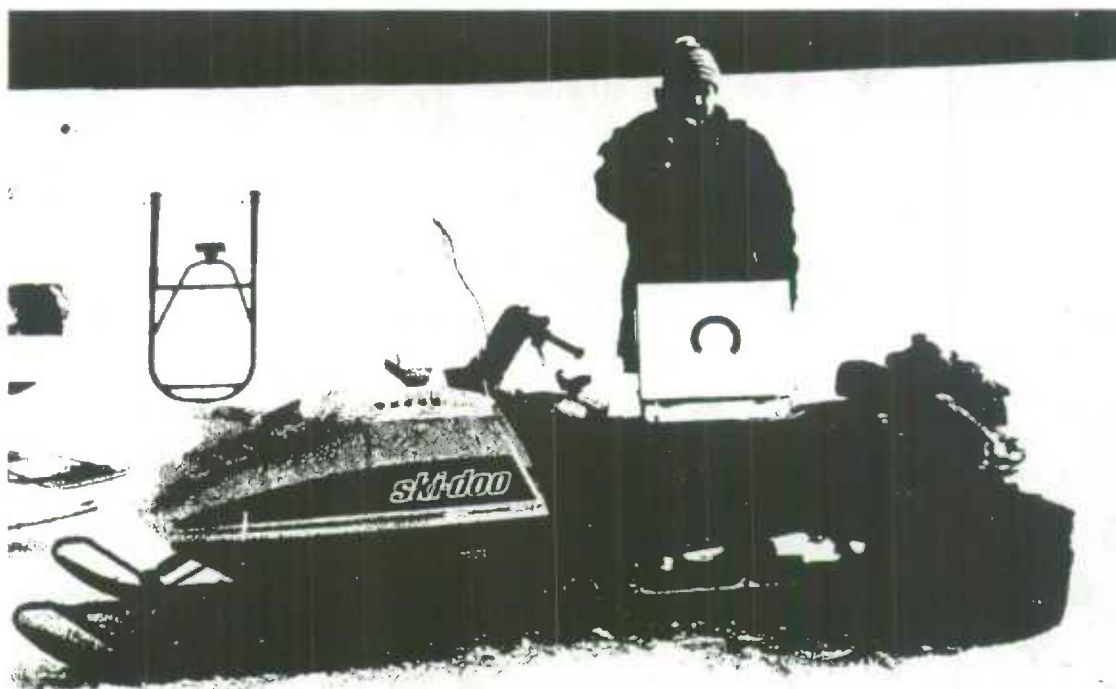
Novel flat patch-array microstrip antennas provide the high gain and circular polarization required while minimizing weight and maintaining compactness of the terminal.

The hub end of the satellite link requires a C-Band terminal with G/T of 32 dB/K or more and would normally be provided by the appropriate Inmarsat signatory.

Within the hub terminal Skywave's SCU-1R synthesized satellite channel unit is used to provide modulation/demodulation and signalling functions. Built into the SCU-1R are digital echo cancellers and both 4-wire E&M and 2-wire FXS telephone network interfaces.

Teleglobe Canada is the first Inmarsat signatory with plans to offer interim services to a limited number of users by November 1989. Teleglobe's 18 meter hub station at Weir, Quebec will provide coverage of the Atlantic Ocean Region. Coverage of Pacific and Indian Ocean Regions is planned to commence in 1990 and 1991 respectively.

For information on service please contact Michel Gelinas, Product Manager, Mobile Satellite Services Marketing, Teleglobe Canada (514) 289-7231.



APPLICATIONS

FEATURES

VOICE MODE

Advanced data processing techniques in support of census taking

- News gathering
- Diplomatic communications
- Environmental operations
- Scientific expeditions
- Law enforcement
- Security
- Exploration and development
- Government communications

- Full-duplex voice
- 400bps data
- Dial-up operation
- Lightweight
- Battery powered
- Operation via Inmarsat satellite

- Modulation.....ACSSB
- Operating C/No....43-51 dB-Hz
- VF BW200-3000 Hz
- Mode.....Full-duplex
- Occupied BW5 KHz

DATA MODE	SIGNALLING	ANTENNA POINTING	R F
<ul style="list-style-type: none"> • Modulation.....DMSK • Asynchronous300, 600, 1200bps • 2400bps with flow control • Synchronous.....2400bps • ModeFull-duplex • InterfaceRS232C (DB-25) 	<ul style="list-style-type: none"> • Digital (DMSK) 	<ul style="list-style-type: none"> • Visual (LCD) • Audible (earpiece) 	<ul style="list-style-type: none"> • Tx Band.....1636.5-1645.0 MHz • Rx Band.....1535.0-1543.5 MHz • Channel Spacing ..5kHz • Frequency Accuracy. \pm 2.5kHz • EIRP27dB/K • G/T9dB/K • Ant Gain17dBic

POWER	BATTERIES	MECHANICAL	ACCESSORIES (INCLUDED)
<ul style="list-style-type: none"> • + 12vdc at 5A • 115/230 vac, 50/60 Hz 	<ul style="list-style-type: none"> • Internal NiCad • 1 hour operation • Internal charger • 115/230 vac 	<ul style="list-style-type: none"> • Briefcase only..18" x 13" x 4.5" • Carry Bag..... 19" x 14" x 8.5" • Weight..... 32 lbs inclusive 	<ul style="list-style-type: none"> • Antenna, cables, handset, carry bag, charger, operator manual.

ACCESSORIES (OPTIONAL)

SCU-1R hub channel unit.
 Sky Wave Electronics Ltd
 300 March Rd.
 Kanata, Ontario
 Canada K2K 2E2
 Tel.: (613) 592-0908
 Fax (613) 592-2104

APPENDIX B:

INTERNATIONAL STATISTICAL PROGRAMS CENTER (ISPC) DATADICT Data Dictionary

B.1

1.1 What is DATADICT?

The DATA DICTIONary system (DATADICT) is a software package which creates a specialized data dictionary file containing a description of structure and contents of a census or survey data file. This description includes names for the data items in the file, their locations within the records and the set of values they each may have. This specialized data dictionary file is used by the other components of the Integrated Microcomputer Processing System (IMPS) to access data in the file being described. The CENTRY data entry system, CONCOR editing system, CENTS tabulation system, and QUICKTAB frequency and cross-tabulation system all use a dictionary created by DATADICT. DATADICT also provides a neatly printed description of the data file which can be used by both subject matter specialists and programmers.

1.2 Why Use DATADICT?

The chief reason for using DATADICT is to provide a consistent and organized description of a census or survey data file. This description can be used by all the people who must work with the data contained in the file. The names and values defined in the data dictionary provide subject matter specialists and programmers with a common understanding of the contents of the file. In addition the name and location information in the data dictionary provide CENTRY, CONCOR, CENTS and QUICKTAB with the necessary information to correctly access data in the file. This means that when using these packages the programmer only needs to know the name of the data item to be referenced. Each time that name is used the same location in the data file is referenced reducing the possibility of errors.

B.2

CENTRY Census Data Entry

1.1 Overview of CENTRY

The CENTRY (CENsus and survey data enTRY) system is a screen-oriented, menu-driven software package for the development of data entry applications, the entering, verification, and modification of data, and the collection of statistics on the data entry operations. CENTRY was developed by the International Statistical Programs Center (ISPC) of the United States Bureau of the Census in order to provide a complete, simple, fast and inexpensive method of data entry and update for censuses and surveys using a standard microcomputer configuration.

The use of microcomputers for data entry has become an accepted industry standard. Microcomputers have advantages over traditional data entry machines since the microcomputers may be used for a wide variety of other purposes at the conclusion of a census or survey when fewer dedicated data entry units are needed.

ISPC has developed an Integrated Microcomputer Processing System (IMPS) for processing the data collected for national censuses and surveys. CENTRY is the data entry component of IMPS. CENTRY is not copy-protected, so the user cost for the system is minimal. CENTRY is written in the C language to assure acceptably fast performance levels. As part of IMPS, CENTRY uses the same data dictionary as other IMPS components. The use of a common data definition makes it advantageous to use CENTRY when CONCOR and CENTS are being used. Other data entry packages require a separate definition of the data being entered.

Versions 1.0 and 1.1 of CENTRY were oriented toward census data entry. These versions have been used in many national censuses and in some surveys around the world. Due to the demand among national statistical offices for data entry and editing software for more complex surveys, the current version 2.2 was developed.

The design objective of versions 2.1 and 2.2 was to accommodate the requirements of survey data entry without sacrificing the simplicity and ease of use of version 1. A milestone development was the ability to implement consistency checks at data entry time by calling a CONCOR program from within CENTRY. System limits have been greatly expanded and many features added. Section 1.3 describes the differences among versions in greater detail.

1.2 Major Features of CENTRY

Some of the most important features of CENTRY 2.2 are:

- Easy-to-use menu-driven operations
- Easy-to-design data entry screens
- Questionnaire-oriented data entry
- Retrieval and modification of questionnaires
- Selective field verification (double entry) of questionnaires
- Operator performance statistics
- Automatic range checking
- Programmable (CONCOR) consistency checking
- Geographic and questionnaire ID checking
- Automatic duplication of fields
- Field entry sequencing
- Interactive skip pattern definition
- ASCII output file (ready for input into CONCOR)
- Protection of data against power failures

CENTRY has two main modules: the "Developer" for application design and the "Executor" for data entry functions. The Developer is used to design the screens to be used during data entry. The Executor is the module used by the data entry keyers. The Executor includes a copy of the program designed by the Developer. Normally, a programmer designs the CENTRY application by using the Developer, then data entry personnel enter the questionnaires using the Executor.

B.3 CONCOR Consistency and Correction

1.1 What is CONCOR?

The CONSistency and CORrection system (CONCOR) is an integrated system of computer programs which can identify and change invalid and inconsistent data being prepared for tabulation and analysis. CONCOR was developed to facilitate the editing of population and housing data from national censuses as well as other types of statistical data such as data from agriculture censuses, labour force studies, and education surveys.

A CONCOR (version 3.1 or above) program may be run in 'batch' mode, or it may be run interactively through CENTRY, the data entry module of IMPS.

1.2 Why use CONCOR?

The main reason for using generalized software packages instead of custom coded programs is the savings in programmer time. In general, once a user becomes familiar with the software package, the time that is spent on developing an application is significantly less than the time that would have been spent writing and testing programs to perform the same functions. Although this advantage is not true of all generalized software packages, it certainly applies to CONCOR. Programmer time is a valuable commodity in most national statistical agencies. Software packages that can free the programmers from the time-consuming task of developing custom software for applications such as data editing will allow them to spend more time on other processing tasks for which there is no generalized software.

Turnover of data processing staff is quite high in many national statistical offices. CONCOR is easier to learn than standard programming languages and requires less expertise. A major disadvantage of developing custom software is that the task of maintenance is difficult and sometimes impossible, given the high turnover rate. Documentation of custom software is often inadequate as a tool for training new staff. CONCOR is fully documented. This User's Guide can be used as a self-study manual for learning CONCOR, or it can be used to supplement formal training.

Another advantage of CONCOR is that it serves as a tool for communication between programmers and subject matter people. The CONCOR language for specifying edits can be understood by both groups, and edit statistics reports clearly show the result of each

CONCOR is fully supported by the ISPC, meaning that if any problems occur with the software, ISPC staff will respond as quickly as possible with a solution.

CONCOR is quite flexible in its editing capabilities. However, like any generalized package, it has limitations, and these are discussed later in this chapter. An advantage of CONCOR over other generalized editing packages is its ability to produce hot deck imputations. Also, the user is provided a great deal of flexibility in developing techniques for editing and changing the data.

B.4

CENTS Census Tabulation System

1.1 What is CENTS?

The CENsus Tabulation System (CENTS) is the tabulation component of the Integrated Microcomputer Processing System (IMPS). CENTS is a system of computer programs which tabulate, summarize, and display statistical tables. CENTS was originally developed to facilitate the tabulation of population and housing data from national censuses in developing countries. However, the system can easily be applied to other types of statistical data, such as agriculture censuses, labour force studies, or education surveys.

CENTS was developed by the International Statistical Programs Center (ISPC) of the United States Bureau of the Census.

1.2 Why use CENTS?

The main reason for using generalized software packages as opposed to custom-coded programs is the savings in programmer time. In general, once a user becomes familiar with the software package, the time that is spent on developing an application is significantly less than the time that would have been spent writing and testing programs to perform the same functions. Although this is not true of all generalized software packages, it certainly applies to CENTS. For a variety of reasons, programmer time is a valuable commodity in most national statistical offices. Software packages that can free the programmers from the time-consuming task of developing custom software for applications such as table generation will allow them to spend more time on other processing tasks.

Turnover of data processing staff is quite high in many national statistical offices. The CENTS user language is easier to learn than standard programming languages and requires less expertise. A major disadvantage of developing custom software is that the task of maintenance is difficult and sometimes impossible, given the high turnover rate. Documentation of custom software is often inadequate as a tool for training new staff. CENTS is fully documented. Moreover, this User's Guide can be used as a self-study manual for learning CENTS, or it can be used to supplement formal training that is offered by ISPC. CENTS is fully supported by ISPC. This means that if any problems occur with the software, ISPC staff will respond as quickly as possible with a solution.

CENTS can produce the majority of table formats. However, like any generalized package, it has limitations, and these are discussed later in this chapter. The major advantage of CENTS over other generalized tabulation packages is its ability to produce publication-quality tables. The user is provided a great deal of flexibility in formatting tables. Placement of text such as headings, stubs, captions and footnotes are under the total control of the user.

The CENTS user can 'draw' table formats interactively and preview the tables without tabulating data. The user arranges the table text and specifies table matrix calculations, such as row and column sums. CENTS would then print the tables with "dummy" cell values. Since the table

calculations are performed on these predictable dummy values, they may easily be verified. The table formats can be developed by the subject-matter specialist or less experienced programmer using CENTS long before the data are ready for tabulation. Thus, when the data are ready for tabulation, the CENTS programmer need only concentrate on the tabulation logic.

B.5

CENTRACK Census Management and Control System

1.1 What is CENTRACK?

CENTRACK is an interactive census management and control system that helps census managers monitor the processing phases of a census. During census processing, CENTRACK assists in avoiding the duplication or omission of census enumeration areas (EAs). It also allows for the production of the census preliminary counts and management reports. Once the census data are keyed, CENTRACK provides the mechanism to validate the geographic identification of the keyed data. Additionally, it identifies EAs for which the manual and computer counts are not within an acceptable tolerance level (duplicates and omissions). Finally, CENTRACK allows for census files containing data for lower geographic levels to be combined into files containing higher geographic levels. The design of CENTRACK takes into consideration the needs expressed throughout the years by statistical offices to monitor the data collection and processing stages of their censuses. It also incorporates the design ideas of several customized systems used in specific countries, as well as some of the ideas used in mainframe generalized management and reporting systems, such as CONTROL. More importantly, CENTRACK takes advantage of the user-friendly environment provided by microcomputers.

CENTRACK requires a good cartographic system that accurately defines all the geographic and administrative boundaries for the census. This geographic base serves to develop a geographic coding scheme that identifies each geographic, administrative, and statistical area down to the EA. CENTRACK requires this hierarchical coding scheme in order to generate a database with the EA (or any other geographic level) as the unit of control. This system monitors every phase at the EA level. The first phase is usually the reception of the questionnaires from the field by the central office. The last phase is usually the keying of the census data. It should be noted that CENTRACK can monitor any set of phases at the EA level. For example, you may want to monitor each of the phases or steps involved with the computer edits, sorts, and tabulations of data files. This manual will describe the use of CENTRACK in monitoring the phases of data entry, even though it can be used to track any given set of activities or phases.

CENTRACK can print a master transmittal form to keep track of the status of each EA. The census personnel use these transmittal forms to record each phase through which the EA has passed. Later, the census personnel enter this information into the CENTRACK database which serves as a basis for its operational control functions.

CENTRACK's functions are the following:

1. Avoiding the duplication of enumeration areas (or whatever level the unit of control is defined as; i.e. households).
2. Avoiding the omission of enumeration areas.
3. Obtaining more accurate and timely preliminary counts.
4. Obtaining management reports such as productivity and phase completion reports. At any time, the user may request a status or productivity report that contains information about the status of each processing phase.
5. Providing a mechanism to validate the geographic identification of the keyed data. CENTRACK also identifies enumeration areas for which the manual counts and computer counts are not within an acceptable tolerance level. CENTRACK adds the computer counts directly from the census data file.
6. Combining portions of census data files into higher geographic levels. CENTRACK analyses the combined census data files for completeness (incorrect or missing EAs.)

1.2 Differences from Version 1.1

- Regional or subset CENTRACK applications can be merged into a country or master application
 - Ten phases instead of six may be tracked in one application
 - A global master phase control form can be generated
 - Master phase control forms may be up to 200 characters in width
 - When posting the completion of work, the date is requested only at the outset of a posting session
 - Error numbers have been assigned to each error that may occur while posting; CENTRACK entry forms include a column to record the error numbers
 - CENTRACK applications created under version 1.1 are automatically converted to version 1.2.
 - CENTRACK may be executed from the IMPS menus
 - System file backup is no longer handled within CENTRACK; it can be executed from the CENTRACK submenu of the IMPS menus. For further discussion on system file backup, see the IMPS installation guide.
 - The use of color must be defined outside of CENTRACK; it is no longer included in the system setup. For further discussion on the definition of color, see the IMPS installation guide.
 - The name of the operation being tracked can be stated and saved in the system setup; it will be used in report headings and on CENTRACK screens
-

1.3 System Requirements

CENTRACK is written in CLIPPER programming language. It will run on an IBM PC or fully compatible microcomputer having a minimum of 640 kilobytes of memory and a hard disk drive.

The CENTRACK system files require about 500 kilobytes of storage space. The storage space needed for the user's database will vary depending on the application. For example, the CENTRACK database files for a country, with a population of approximately 4,500,000 living within approximately 13,000 enumeration areas, requires about 3 megabytes of storage space. To install CENTRACK, refer to the IMPS Installation Guide.

1.4 Data Requirements

CENTRACK has a few requirements on the census data entry files. They must be fixed format ASCII files and their access must be sequential. The geographic identification codes must be present on each record in the same position. CENTRACK assumes that there can be only one housing record and a variable number of population records per questionnaire. Any other record type would be ignored. Each record must contain a code for record type in the same position. All the census data records for an EA must be together, although they do not need to be in ascending order within an EA. CENTRACK only reads the data entry file; no rewrite takes place.

An accurate record layout will be necessary. CENTRACK will ask you to provide the length and starting position of the geographic fields, as well as the upper limits to the values of each geographic field. It will also ask you for the length and starting position and valid codes for the record type and sex fields. You must also provide the record length of the longest type of record. CENTRACK will ignore all other fields on the record.

B.6

QUICKTAB Frequency and Cross-Tabulations

QUICKTAB was developed primarily as a tool to assist in the quality control of data entry, editing and tabulation. It provides a simple and rapid way to find out what values are contained in a data file. Inspecting the contents of a data file during both pilot and production processing allows for the early detection of problems, when corrective action is less costly in time and effort.

DATA ENTRY - QUICKTAB can be used for early identification of errors in data collection, coding or data entry. Generating frequency distributions of each data item can identify items with many invalid or nonresponse values. Distribution of valid values for each item can be inspected to determine whether they are reasonable for the particular geographic area. Questionnaires generating data sets with abnormal distributions should be examined to determine the source of the unexpected results. If QUICKTAB is used to examine the initial batches from data entry, it may be possible to quickly correct the sources of some of the problems discovered. Cross-tabulations of some data items also may be helpful.

EDITING - QUICKTAB is extremely useful for examining the effects of computer edits. One requirement of successful editing is that the process not change the distributions of values in the collected data. By running QUICKTAB on both the unedited and edited files, distributions before and after editing can be obtained easily and compared. The distribution of the valid responses should not change in any significant way. If they do, then the reason for the change should be determined and evaluated. Of course, there should be no invalid responses in the edited data file.

TABULATION - QUICKTAB can be used to produce basic totals and cross-tabulations for checking tables produced by CENTS. This is a quick means of finding fundamental errors in the tabulation logic. In addition, such a check may detect whether records have been accidentally skipped during CENTS tabulations.

**APPENDIX C:
C.1**

**UNITED NATIONS (STATISTICAL OFFICE)
Software PC-EDIT**

1.1 OVERVIEW TO PC-EDIT

PC-EDIT is an easy to use intelligent data entry and editing package. It is designed for demographers and statisticians with little or no prior experience in data entry and data processing. No programming experience is required to use the package quickly and efficiently. The user determines the degree of program control and sophistication. The only requirement for its use is a basic understanding of file layouts and the principles of data entry.

PC-EDIT can be used for processing any type of questionnaire, generating either a flat or hierarchical file. It can process up to 64 different record types per file, which is useful for processing a survey containing several record types. It is well-suited for processing census and survey data. Data files resulting from PC-EDIT are in ASCII format and can be used as input to other editing and tabulation software packages. There is also an option for editing data files created with other data entry packages.

The PC-EDIT package has six major features:

- File layout definition, describing the characteristics of the data to be entered. The edit rules governing data entry, verification, modification and batch editing are also specified in this file. PC-EDIT logic allows for range checks, skips, structure checks, automatic field duplication and filling, and automatic incrementing of values. It also allows for the creation of working variables, consistency checks, and error messages.
- Screen formatting capabilities. A form is designed on screen that resembles the questionnaire. The screen design can be used for data entry, verification, and modification.
- Interactive intelligent data entry, using the screen design or not. The Data Entry Program creates an ASCII data file.
- Partial or complete verification of data entry. The specified edit rules are applied to the reentry of selected data fields. The program compares the reentered values to the original values and flags differences between the two.
- File modification and updates, including the insertion and deletion of records and cases.
- Batch editing of existing ASCII data files created or not by the PC-EDIT Data Entry Program. There is also an option for converting a data file created with other software into a file containing fixed length records for use with the Batch Editing Program.

In addition, special options exist for zero filling of blank fields, file management, setting screen parameters, and for limiting access to individual program components of PC-EDIT.

PC-EDIT is very easy to learn and use in a relatively short period of time. It contains demonstration programs in English and French, enabling users to learn to use the system by themselves. The system also includes ready to print user documentation and example layout files. With a relatively simple questionnaire, a beginning user could create a layout file that includes a moderate number of edit checks and begin entering and verifying data in one day or less. Of course, additional edit rules could be added as the user gains experience with the program.

The U.N. Department of Technical Cooperation for Development distributes the PC-EDIT package free of charge to UNFPA-supported projects and institutions. The PC-EDIT program is continually being improved. If you have any problems, questions, or suggestions, please write to:

Project Coordinator,
Software and Support for Population data Processing
Department of Technical Cooperation for Development
Room DC2-1570
United Nations
New York, N. Y. 10017, U.S.A.

What's New in PC-Edit 4.0

PC-Edit version 4.0 offers several improvements and resolves various problems reported by users of PC-Edit version 3.0. The new advanced features are briefly summarized below and described at length in the succeeding pages.

More compact size and much greater speed on any PC configuration.

Increased depth of Security from system to multi-user level, with individual password and specific control to access only authorized functions, layout and data files.

Local Area Network (LAN) support.

New Operator Statistics to manage productivity.

New commands in layout editor to modify a record type and any text field, modify starting positions, define a subset of fields in an existing data file, copy rules between fields, display cross-edit fields used, and insert new variables. Contextual display for edit rules is now available in the status line to ensure logical access. Keys to move and modify field edit rules have been improved.

Caps only, Negative values, Implicit and Explicit Decimals,

C.2

Software X-TABLE Introduction

Xtable 1.0 is an easy to use package for producing frequencies and summary cross-tabulations of census or survey data. The software's speed, performance and features allow use for any task from production of working tables to presentation or publication of tables.

Data in any form can easily be summarized from frequency distribution and simple contingency tables to complex stub and banner cross-tabulations.

The software is designed for demographers and statisticians. The main prerequisite for any user is familiarity with record layouts and the concept of cross-tabulation.

The package features a user-friendly interface; structured menu system; context sensitive help windows; and full-screen editor presentation. It is easy to learn and use with the help of a demonstration program, example layout and data file, and user guide.

Some unique advantages

No Programming

In several ways, Xtable procedures simplify the production of complex cross-tabulations, frequency counts, statistical breakdowns, and other statistical tables without any programming skills or knowledge !

- Special facilities to easily create new variables, use dates and compute durations, time periods, ages, intervals.
- Multiple category-set definitions for each field with automatic category generation and editing capability.
- Interactive table definitions using a spreadsheet-oriented interface.
- Multiple volumes processing. A system without hard disk can produce tables from data sets stored in several floppy disks and in a more powerful system, the volumes will be multiple tapes or disks (magnetic or optic: CD-ROM, WORM, etc.).
- Advanced virtual screen to display and browse outputs (automatic scrolling), with options to format table layouts and perform calculations such as percentages, means and ratios.
- Special features to process hierarchical levels of data and aggregate results for different administrative or geographic divisions.
- Open architecture supports file layout creation from dBASE file and data tabulations directly on native file format (DBF). Output tables can be produced in ASCII, delimited or Lotus 123 format for further use in spreadsheets and desktop publishing software.

High performance

Xtable is specially designed for PC architecture and developed in Assembler and C languages to provide the best performance on any hardware

configuration. This high speed performance is available either in stand-alone or LAN version.

Integrated system

Xtable 1.0 forms an integrated and complete system for statistical data processing using PC-Edit 4.0 as interface to easily enter and validate statistical data at high speed.

Distribution policy

This package has been developed under the auspices of the UNFPA-funded "Computer Software and Support for Population Data Processing Project" of the United Nations, Department of Technical Co-operation for the Development.

The main objective of the project is to facilitate productive use of computer technology throughout the UNFPA-supported technical cooperation programmes for developing countries.

This package aims to provide statistical agencies and potential users at lower levels of administration in less developed countries with inexpensive solutions to process data. UNFPA-supported projects and institutions may obtain the software free of charge.

Main features of Xtable 1.0

- Data File Layout Definition: record type definition (single or multiple) and field characteristics. Common definition with PC-Edit. Option to import data file structure from dBASE file.
 - Unlimited number of observations.
 - Supports multiple record types for hierarchical files (up to 64 different record types per file).
 - 1024 fields per file.
 - Computed fields and constant values practically unlimited.
 - Field length of 255 characters.
 - Alphanumeric, Numeric and Decimal field support with classification option (discrete/continuous).
 - Special support for Not Applicable and Missing values defined per field.
 - Long label for field names (55 characters).
 - Fixed record length up to 4096 characters.
- Frequencies:
 - Maximum number of values for all frequencies equal to 17,000 with 520 Kb RAM (and up to 27,000 with 640 Kb RAM).
 - Up to 255 frequencies per run.
 - Descriptive statistics (according to level of measurement for field).
 - Distribution bar chart.
- Cross-tabulations: each tabular dimension can include several nested variables.
 - Break-down can go up to 7 dimensions (4 in rows, 3 in columns).

Up to 65,535 cells per table.

Within each table, possible descriptive statistical computation on one or two extra-variables.

Unlimited number of table descriptions.

Up to 255 tables per run.

Up to 6 record rejection criteria per table to select valid cases.

- Descriptive Statistics are available within tables:

Versatile percentages with special options to define (at the display time) the base for percentages (their denominator) which can be calculated either on the whole table, on the rows or columns margins, or by sub-tables.

Summary statistics for one or two extra-fields: sums, means, ratios.

Automatic summary statistics selection according to variable type and other statistical considerations for frequencies.

- Screen Display: image editor for interactive table viewing and browsing (virtually unlimited screen with automatic scroll to adjust display in screen limits).
- User Customization to manipulate table structure, content and presentation format. It provides control over missing value treatment, case selection, layout, titles, total position, etc.
- Output Reports and Printing are presently generated in ASCII, delimited or Lotus 123 (WKS, WK1) format and users can print the files from the DOS, or from their own word processor, spreadsheet or desktop publishing package.
- Customized System Parameters (screen attributes).
- Multi-level Security using passwords to access any function.
- Speed of Execution.

For maximum efficiency, Xtable reads data only once for all tables created and selected for the file.

Read access with four high capacity buffers (64 Kb each) for high speed performance.

Optimized modality resolution and dynamic table creation.

- Storage requirement and Working space. Compared to other statistical packages, Xtable is a very compact software requiring less than 360 Kb storage. No working copy of the data file is created, so voluminous working space or large memory is not required to produce only a few, or many, simple or complex cross-tabulations.
- Local Area Network (LAN) Support. Xtable is compatible with all types of PC networks. The same Xtable version can run either in standalone mode or multi-user environment and offers the same performance in either environment.

- Single and Multi-user Version (program sharing, file sharing/locking, job and user status, audit trail, recovery and fault tolerance).
- Unlimited Number of Users.
- Windows 3.0 supported for multitasking and background operations.
- Data Format Compatibility with all standard DOS applications (database, communications, etc.). Any ASCII file can be processed once the records have a fixed length format. Native dBASE 0 file format support (DBF). Special options for zero filling of numerical blank fields, and partial fixed length conversion.
- Minimum Configuration: IBM-PC, XT, AT, or compatibles, 384 Kb of memory, DOS 2.0 or later, a floppy disk drive.
- Software, documentation and demonstration available in English (French and Spanish forthcoming).

In several ways, Xtable procedures simplify the production of complex cross-tabulations, frequency counts, statistical breakdowns, and other statistical tables without any programming skills or knowledge:

- Special facilities to easily create new computed variables and to define various category sets for each field.
- Interactive table definitions using a spreadsheet-oriented interface.
- Advanced visual screen to display and interactively browse outputs, with options to format layout, to compute statistics and percentages and to export output in various file formats.
- Special features to process hierarchical levels of data (geographic and administrative subdivisions, etc.) and to aggregate them.

Another Xtable feature is its ability to process multiple volume files. A system without hard disk can produce tables from data sets stored in several floppy disks, and in a more powerful system the volumes can be multiple tapes or disks (magnetic or optical).

Xtable is specially designed for PC architecture and developed in Assembler to provide the best performance on any hardware configuration. This high speed performance is available either in stand-alone or LAN version, single or multi-user environment, mono or multi-task.

C.3

Software POP-MAP

Population database and maps, with spreadsheet and graphics

Project INT/88IP42 has been fortunate to employ the strong computer skills of the Institute of Computer Science, Government of Vietnam in Hanoi for the design and development of a new software aimed at supporting a variety of population activities with maps and graphics database spreadsheet facilities to be used with microcomputers such as are available in most UNFPA field offices and national offices of government departments responsible for components of the population programme.

PopMap has been created to supply a practical and integrated solution to the specific problems existing in population activities and support, and the capability to dynamically link a population database with easily accessible retrieval tools to display statistical data in a spreadsheet format as well as draw graphics and maps. The system is menu-driven; it offers an easy-to-use graphical user interface (GUI) and is designed for demographers, statisticians, planners and decision-makers with little or no prior computer background or experience in database, graphics and map manipulation. The only requirement for its use is a basic understanding of data retrieval principles.

Commercial geographical information systems (GIS) are developed for the capture, storage, management, retrieval, analysis, and display of spatial data. These systems assist resource and spatial data managers in their planning and decision making, as well as routine record keeping and inventory. Since these systems use geographic data extensively, cartographic solutions are offered to most queries. GISs are generally highly professional applications that require computer resources and specially trained staff.

Without being a true GIS, PopMap provides some elements to set up a simple but complete geographical information system for thematic and interpretative needs.

PopMap can provide the basis for an interactive information and decision support for population activities. Combining graphics, spreadsheet and mapping capabilities with an integrated geographical database, the software package is developed to provide maps and graphics database support for planning and administration of population activities having important geographical or logistical context or for facilitating geographic or graphic expression of population indicators and related data. Up to 4 levels of administrative and geographical hierarchy are supported for each application.

A very useful possibility offered by PopMap is an exploratory loop. In such an iterative process, the finished product can be interactively modified to make any desired change. The exploratory loop can be used to focus on some special spots found from a main map (using a "Point & Shoot" option), extra variables may be displayed, facilities located, ... In fact, there is an unlimited number of possibilities to pass from one area to another, from one hierarchical level to another, and to continue the spatial exploration. PopMap allows the user to easily play "what if" with the data.

PopMap: main features

For data security and integrity, PopMap comprises three modules:

- DatEd, a database editor for declaring the structure and content of the database. Use of DatEd allows users to create new applications or modify existing ones, to enter and update data or import statistical and/or other data available in machine-readable form (screen 1).
- MapEd, a map editor for entering map outlines, boundaries, borders, rivers, routes and facility locations. With MapEd base map and data for population activities and other relevant facilities can be prepared by defining available geographical items using the keyboard, a mouse or a digitizer (screen 2).
- PopMap system allows to select the target geographical area. Data selection from the database is either by direct identification of particular data by name or by selection criteria stated in logical form with the usual relational operators conjoined by AND or OR with reference to quantitative, qualitative or geographical characteristics.
- The retrieved data then may be examined in scroll fashion and manipulated in a simple spreadsheet prior to being graphed or mapped (screen 4).
- The system provides statistical graphic generation facilities for easy specification of pie-charts, clustered or stacked bar charts, line graphs or scatter diagrams. The system provides automatic sealing and legend-generation and allows for addition of titles, comments or highlighting.
- The system provides map generation facilities for easy retrieval, up or down scaling of boundary maps for super-imposition and overlay of line or feature data and for coloration or shading of areas according to quantitative or qualitative value of selected indicators or activities. Legends are generated automatically. Once generated, maps may be titled and commented and printed at the option of the user (screen 5).
- "Point and Shoot" mode allows zooming on different individual facility locations as users move the cursor on the map (screen 6).

Possible application

The new PopMap software is expected to be useful for the following:

- Map Library: database of sketch maps supporting census or survey data collection, base maps library for various uses;
- Population Geographical Database: statistical data from censuses, surveys, vital registration and administrative sources stored by administrative hierarchical levels for different time reference are easily accessible;
- Presentation, Research & Analysis: population statistical publication, spatial distribution analysis and relationships, patterns and trends detection using maps, graphics and spreadsheet display for population characteristics, census or survey results;

- Evaluation and Planning analysis, planning, vocational decisions and management of health, family planning and educational facilities in relation with social, demographic and economic variables to implement integrated development policies;
- Management Support: for population programme and follow-up activities with maps showing locations of schools, markets, activities, family planning centres, clinics and other facilities; for graphical analysis and training support for family planning staff and others;
- Logistics Support: identification of service areas, potential and optimum sites and physical constraints imposed by communication and transportation facilities, housing and demographic needs, health and sanitary conditions.

Software distribution

PopMap will be provided together with two example applications:

- World application with four-level hierarchy (world, region, sub-region, country) containing global population indicators and global map of country outlines and locations of important UNFPA-supported facilities. Selected demographic estimates and projections for 1950, 1955,...,2025 from the World Population Prospects, 1990 of the UN Population Division.
- Vietnam application with four-level hierarchy (country, region, sub-region, province) containing some demographic indicators, three types of facilities (clinic, kindergarten, school) and some individual facility characteristics (doctors, beds, teachers, etc).

These applications will provide examples of the types of maps and graphics that can be developed with the system at international, national or lower geographical levels. They also will make it easier to learn PopMap and may be useful for other population studies. The PopMap software now is in its final test status and soon will be available for distribution. All modules are working but still need some error correction and modification.

Use of PopMap requires maps to be entered with a digitizer or mouse. Prospective users of PopMap are encouraged to prepare by identifying reliable sources of area maps and deciding what statistical and facilities data they wish to include in the database.

Hardware requirement

The system (and the preview example) will expect the following minimum microcomputer configuration:

- IBM-compatible microcomputer,
 - 80286, 80386/SX processor with 640KB RAM;
 - 80287 or 80387 math co-processor (optional);
 - Fixed disk storage (hard disk with minimum 5MB free space);
 - EGA or VGA color graphics display;
 - DOS operating system;
 - Microsoft compatible mouse (optional);
 - HP Laserjet compatible or HP Paint-Jet or Dot-Matrix printer (optional).
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C.3

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