74-285

PROPOSAL NO. 111

STRUCTURING OF A MODEL OF DATA TRANSMISSION NETWORKS IN CANADA

PREPARED FOR

THE DEPARTMENT OF COMMUNICATIONS
OF CANADA
SOCIAL/ECONOMIC PLANNING BRANCH

IN RESPONSE TO

REQUEST FOR PROPOSAL LETTER
DATED FEBRUARY 25, 1971

ACRES

ACRES INTERTEL LIMITED

OTTAWA CANADA

P
91
C655
S866
1971

74-285

PROPOSAL NO. 111

STRUCTURING OF A MODEL OF DATA TRANSMISSION NETWORKS IN CANADA

PREPARED FOR

THE DEPARTMENT OF COMMUNICATIONS
OF CANADA
SOCIAL/ECONOMIC PLANNING BRANCH

IN RESPONSE TO

REQUEST FOR PROPOSAL LETTER
DATED FEBRUARY 25, 1971

P
91
C655
S866
1971

P
91
C655
8866
1971

P
91
C655
S866
1971

Table of Contents

		Page
1.	STATEMENT OF WORK	1
2.	THE WORK PLAN	2
	Phase I - Model Definition	2
	Phase II - Model-making and Testing	4
	Model: General Description	
	Phase III - Simulation and Conclusions	7
3.	DATA REQUIREMENT	8
4.	CREDENTIALS	9
	Corporate experience	9
	Personnel	13
	Project organization	14
5.	PRICING	15

APPENDIX 'A' - personnel biographies

F. Gall	T.W. Chi
M.H. Kassner	E.A. McBean
R.M. Cardis	I.W. McCaig
L.M. Basu	O. Sigvaldason
L.V. Corbett	E.E. Treloar
A.M. MacKenzie	M. Thompson

APPENDIX 'B' - modelling projects

COMMUNICATIONS CANADA
MAR 7 1974
LIBRARY - BIBLIOTHÈQUE

1. STATEMENT OF WORK

In reply to Department of Communications request for proposal letter and terms of reference dated 25 February 1971 Acres InterTel Limited offer to provide consulting services and carry out the work outlined as follows at the cost indicated in the pricing section.

1.1 Define and structure of a Data Traffic model for the purpose of:

a) Identifying spatial distribution of data transmission in Canada.

b) Simulating changes in the traffic patterns induced by changes in rate structures.

c) Forecasting the growth in total data processing traffic to 1980 with and without changes in rate structure.

1.2 Operate the model for the various rate structures:

flat rate, transaction oriented tariffs or other suggested by the operation of the model.

1.3 Report and draw conclusions on the tariffs tested on the model.

Acres InterTel Limited has an extensive knowledge of the Canadian public and military network -- terrestrial and satellite, capacity and coverage -- only limited additional updating information of this kind will be necessary.

Because the Department of Communications during the course of a current study has already or will be shortly gathering most of the information concerning data traffic, carriers pricing methods (rules used by carriers to separate costs etc) and main user of data transmission facilities, Acres InterTel Limited costing does not include data gathering but covers normalization and inter-

pretation of data from the various sources and its transformation to suit the requirements of the model.

Should it be found necessary for Acres InterTel to undertake significant Data gathering or survey work the cost for such services will be negotiable.

2. THE WORK PLAN

The terms of reference for the structuring of the data transmission traffic model outlines the relationship between this project and the major study. Since the model is in fact an integral part of the study it should be designed in close cooperation with members of the D.O.C. study group. For this reason we propose to carry out the study in three phases: first a Model Definition phase followed by a Model Making phase and Testing phase. Finally, a Simulation and Conclusions phase during which the various tariffs will be tested on the model; this phase will include the preparation of a final report on findings and conclusions.

Phase I - Model Definition

Expected duration: 8 April to 22 May 1971.

The main components of Phase I will be the following:

a) Identification of the broad, overall aims of the entire study and precise definition of the intended use for the model. Definition of the decision-making process.

b) Creation of a mathematical objective function which embodies most or all of the aims defined in a).

c) Definition of the general physical parameters in the Data Communications network to be modeled; origins and destinations, number of routes available or planned transmission systems (i.e. terrestrial links, satellite links, networks dedicated to data only, etc . . . .), equipment.

d) Definition of the units used for modelling volume of traffic, Erlangs, message length, rate of transmission, inter message gap length etc .

e) Generation of the equations describing cost within the system, physical constraints and routing options for traffic flow.

f) Detail specification of Data required for model building and operation.

g) Evaluation of information concerning cost and traffic available from Department of Communication and those already existing at Acres InterTel.

h) Final choice of the traffic model suitable to represent the decision-maker problem.

REPORT. At the end of Phase I it is proposed to produce a report which at the same time will: summarize progress, include the detail specification of the model to be structured in Phase II, and define additional data required to complete the project.

The construction of the objective function for a mathematical model requires a high degree of interaction between the Decision-maker/Model user.

It is in our opinion imperative to go through this distince Model-definition phase before plunging into the construction of the model. During this phase members of our staff will have to be in semi-permanent contact with members of the D.O.C. study group.

Phase II - Model-making and Testing

Expected duration: 22 May to 27 August 1971.

The nature of this work is such that it would be unrealistic at the proposal stage to ascertain the exact model that will be used. In fact, an explicit description of the model should be the result of the work carried out in Phase I.

A priori, with our current understanding of the objectives of the Department, the type of model we are considering is the one described in the following paragraphs.

MODEL: General Description

Although we propose to consider various types of models in cooperation with the Department of Communications during Phase I, we recommend an optimal seeking form of model. This form of model is appropriate if the optimized quantity incorporates the interests of the users of data transmission facilities, the common carriers and the general public. Tariff structures examined by such a model can be shown to have benefits for all parties and as such are realizable.

The Department's aims in restructuring tariffs for data transmission would appear to be

1) provide incentives to growth of data transmission traffic within Canada,

2) provide a reasonable economic return to the common carriers,

3) maintain or improve the current (1970) level of service for both voice and data transmission.

These aims can be represented mathematically in a linear programming formulation (1) where the model is based on the maximization of consumers'

(1) S.C. Littlechild, 'Peak-load pricing of telephone calls'. The Bell Journal of Economics and Management Science Vol. 1 No. 2 Autumn 70.

plus producers surplus, subject to the constraints that for each item of equipment capacity should be adequate to serve the volume of voice and data transmission traffic at an acceptable level of service. This objective function can also be termed as maximizing net benefit, (2)

max (net benefit)

or

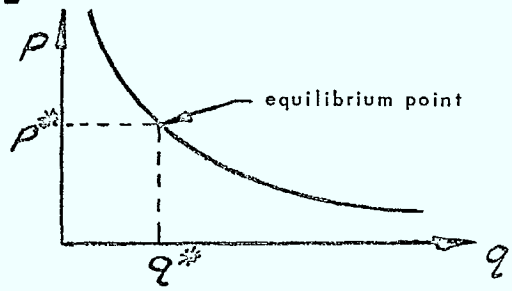
max (gross benefit - total cost)

or

max (consumers' surplus + total revenue - total cost)

The consumers' surplus can be defined as the difference between what a consumer would be willing to pay for a goods or service and what he actually pays. Mathematically this can be expressed as

$$S = \left\{ \int_0^q p(q)\, d(q) \right\} - p^* q^*$$



Consumer Demand Curve

The mathematical formulation for the model could be as follows:

$$\sum_j \left[\int x_j\, P_j(x_j)\, dx_j - C_j x_j \right] - \sum_i B_i Y_i$$

where X_j = the mean number of transmissions or transactions per hour on route j

Y_i = effective capacity provided on equipment i for data transmission traffic

C_j = traffic cost on route j

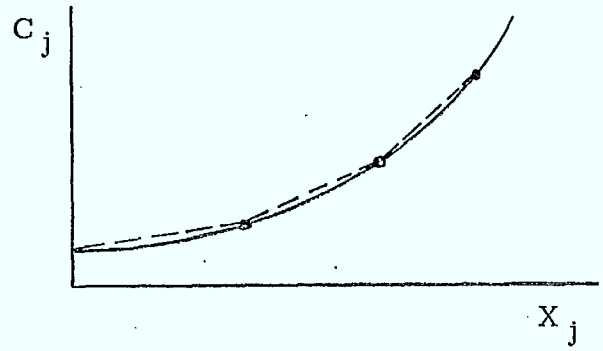
B_i = cost of equipment i

$P_j(X_j)$ = price at which mean demand per hour on route j is X_j

It should be noted that neither C_j or B_i need be constant, but could be construct

(2) I. Pressman 'Peak-load Pricing' same journal as (1)

from piece-wise linear functions providing C_j and B_i are concave-upward, continuous functions of X_j and Y_i respectively (3)



Since it may be appropriate to break the day into several periods in which the tariff structure varies, a more comprehensive model taking into account the demand in each period and the cross-eleasticities between periods would be built along the general lines of Pressman's model (2).

The constraint set for the linear programming model would include the capacity constraint

$$\sum_{j \in V_i} h_j x_j \leq y_i \qquad i = 1, \ldots m$$

where h_j = ratio of maximum demand to mean demand for transmissions on route j

V_i = set of routes that use equipment i

Profit and tariff constraints could be added to the extent that the linear programming model would approach a deterministic simulation model.

Since the model should report changes in traffic pattern as induced by changes in one or more factors in the rate structure, the assumption of fixed routing between origin and destination will not be adopted. In lieu of this approach several routes will be available for transmission and the traffic volume will flow

(3) G. Hadley 'Linear Programming' pp 466.

in such a manner as to maximize the objective function i.e. produce maximum net benefits to both user and common carrier.

REPORT. During the structuring of the model close liaison with the Department will be maintained. Toward the end of Phase II a progress report will be prepared and operation of the model will be demonstrated.

Phase III - Simulation and Conclusions

Expected duration: 27 August - 26 October 1971.

This phase is the analytical phase of the project and will include the following components:

1. Definition of the laternative approaches to establishing tariff structure
2. Operation of the model under the different rate structures.
3. Analysis of data derived from the simulation.
4. Preparation of final report.
5. Model documentation.

Pricing of Phase III is based on a six weeks active simulation and analysis period. Past experience indicates six weeks as a minimum to obtain useful results for a model of this magnitude.

FORECASTING DATA TRAFFIC

While it is reasonable to assume that the volume of data traffic is somewhat price elastic, a number of other factors may more significantly affect the growth of data transmission by 1980.

In 1970 it is estimated that computer communications represents about 3% of Bell activity (with a forecast of 20 to 25% by 1980). Paralleling computer communications growth there is a strong trend toward voice and other

analog signals digitization which in turn will mean further "Data transmission" increase.

At the present the main users of Data communication are from the governments and business milieux. Evolution of technology and particularly lowering of the cost of terminal units may bring in a new category of user, the average Canadian citizen (re C.A.C. proposal for a Community Information Network).

Those are only few of the possible new generators of Data.

It is presumed that uncovering these trends fall within the terms of reference of the task force on computer and communication. If so it is suggested that this kind of Data be made available for inclusion in the model.

3. DATA REQUIREMENT

The type of Data required for the project falls under the following main categories:

1. Traffic: origin - destination
   number of calls, transactions, nature of messages, length, intermessage gaps - daily fluctuation

2. Costs: of the main components of the systems - depreciation rates - installation costs
   - methods of cost separation used by the carriers for Data, Voice, local and long distance

3. User demand curves: - price vs. volume relationship

4. Network: - routes, capacities *

5. Technological trends: - concentrators, multiplexers - wide band networks

6. Potential users: - analysis of demand from small business, households, etc

7. Current users growth trends.

*Acres InterTel has most of the network information valid up to 1970; some updating will be necessary.

4. CREDENTIALS

Acres InterTel Limited submits, for consideration and comparison, credentials in two areas:

- Corporate experience
- Personnel

Corporate experience

Acres InterTel offers extensive credentials relevant to the work.

Firstly the comprehensive, continuing, familiarity with the Canadian telecommunications environment forms a necessary base and complement to the second major area, namely, the analytical and architectural capabilities required for the construction of the desired model.

In addition, Acres InterTel's experience in technical market analyses, comprising field acquisition of representational base data, projection and inference of future trends, etc, may be regarded as an essential supporting service to the central thrust of the model work.

Telecommunications Environment Considerations

The actual system to be simulated by the desired model comprises the in-being Canadian system plus up-coming extensions to the system.

For the present purposes, the 'Canadian telecommunications environment' may be considered to comprise:

- the operating companies and their physical systems
- the manufacturing and supply industry
- the legislative and regulatory apparatus
- the user

In the course of the last decade, Acres InterTel ('InterTel Consultants Ltd.' prior to 1967) has undertaken many projects either for or intimately concerned with each of these sectors. A representative, but by no means exclusive, list of projects includes:-

- Interference Analysis and System Inventory, 1960 - 66 (Client: Department of Transport).

  In this project, all * multi-channel radio (UHF - microwave - tropo-scatter) systems in Canada were catalogued, including main system parameters and displayed on 1:500,000 maps; same treatment was applied to military transceivers (radars, navaids, TACAN etc). Each station (e.g. microwave repeater, radar station) was then analysed as to electro-magnetic interference it both emitted and received to and from other stations within its propagation range.

- Feasibility Study for the utilization of the Mid-Canada Line communications System (Client: C A E)

  Relevance of this project was the capital cost/potential revenue relationships in the possible uses of this 3,000 mile system.

- Comprehensive Consultation Services to Norcom Telecommunications Limited

  This project included complete system engineering of the Norcom microwave network, from planning to implementation supervision; maintenance program; contract counselling (negotiations with client's customers, Northern Telephones Ltd. and the CBC).

- Major consultancy assistance to Directorate, National Telecommunications Branch, Department of Communications: in the comprehensive survey of the Canadian Terrestrial Broad-band System (comprising TCTS, CN-CP

* comprising many hundreds of stations.

Telecommunications Private) as to actual and potential capacity, economics (marginal capital and operational costs) etc compared with projected satellite system costs.

- Financing of Telesat Canada: Technical counsel to the Underwriting Syndicate

In conducting our role in this project, fundamental considerations included capital costs, separations, required tariff patterns as well as future projections of different mixes of probable revenues over the life of the first generation satellites.

- Military Projects

Acres InterTel has completed and is active on many analyses and studies for the various arms of DND. Typical projects, most relevant to the present requirement comprise:-

- Continuing monitoring and critique of the CN-CP Telecommunications System Design for the overall DND Telecommunications network.
- Analysis and Design of total internal message handling system for new SHAPE (Supreme Headquarters Allied Powers Europe) Headquarters in Casteau, Belgium.
- Consultancy assistance (a past and current project) on SAMSON (Strategic Automatic Message Switching Operational Network) DND, Ottawa.

Modelling projects (detailed description in Appendix B)

Project 1272C	Digital Computer study of Agricultural Adjustment possibilities (Government of Prince Edward Island)
Project 1416	Railway Crossing study System Evaluation (The St. Lawrence Seaway Authority)

Project 1616A	Electric power generation and distribution (Electricity Generating Authority of Thailand)
Project 2098	Electric Power System Development Planning (State of New England, U.S.A.)
Project 2073	Kaptai Reservoir Operating Rules (The East Pakistan Water and Power Development Authority)
Project 2161	Economic Study of Nickel Mine (Great Lakes Nickel Company)
Project 2306	Development of Engineering of Economic Water Quality Simulation Models (Government of Canada)
Project 2707	Review of Hydro-Quebec Studies, Rupert, Broadback and Nottaway Rivers.

- Technical Market Studies

Many market studies have been completed for a range of clients in both the private and government sectors. These studies are typified by a detailed survey and analysis of users' current and future requirements, trends etc.

In the bigger studies, trend analyses and projections of the market dimensions were done by computer methods including linear programming, exponential forecasting etc. Two examples of the larger type of study have been the International satellite telecommunications market and more recently, world airports and airport systems (with emphasis on electronics telecommunications and navigational aids).

PERSONNEL

The end product of the study will be based on the work of individuals combined, co-ordinated and integrated in accordance with past and current experience in both directly similar and closely related civil and military projects.

The personnel proposed for the study demonstrate significant experience in the following several areas:

a) The Canadian telecommunication environment.

b) Telecommunications systems and traffic engineering.

c) Data transmission.

d) Computer systems.

e) Operations research tools and techniques:

- modelling
- simulation techniques
- mathematical programming

f) Mathematics and statistics.

g) Economics and financial expertise.

h) Costing of services.

i) Market analysis.

j) Technological forecasting.

k) Computer programming.

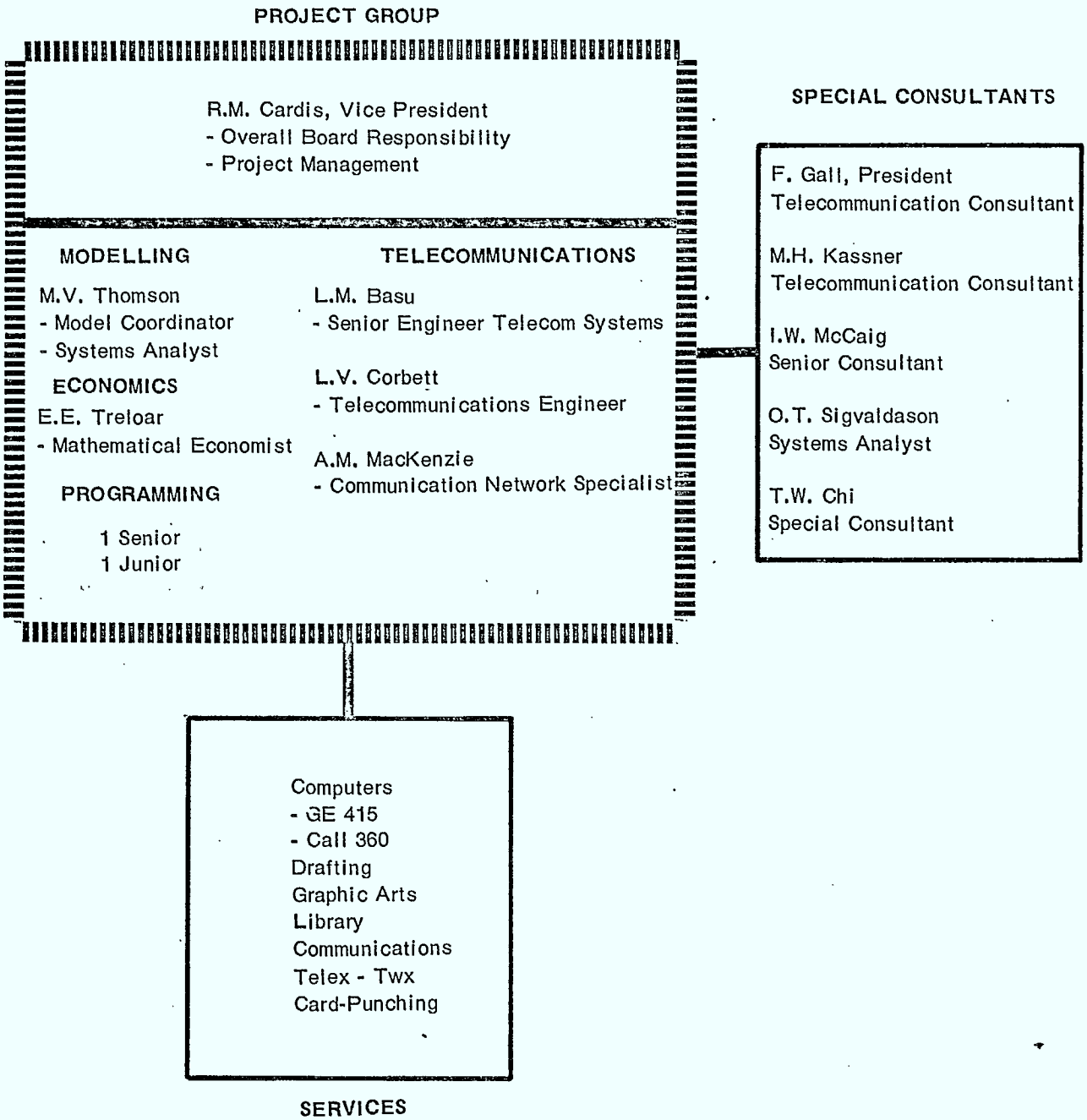
PROJECT ORGANIZATION

Acres InterTel Limited proposes for the duration of the project the 'organization' shown in Figure 1.

A Project Group, whose members' global experience covers all the areas of expertise defined in preceding page, will be available on an 'as required basis' for the duration of the project; the members of the group will assume continuing responsibility for the work done in their respective areas of expertise.

To provide additional support to the Project Group a team of special consultants with outstanding technical and managerial background will be available on an ad-hoc basis at all critical turns of the project. The services of these experts from Acres InterTel, Harvard University and Acres Consulting Services is included in our pricing.

Biographies for all participants for the project are provided in Appendix 'A'.



PROJECT ORGANIZATION

FIG. 1

5. PRICING

Pricing philosophy

Consistent with our three phases Work Plan we present, in the following, separate price estimates for each phase of the project.

Though we will undertake to carry out all phases at the estimated prices, we believe that for a project of this nature the cost-benefit of the project would be enhanced by providing for the review of the scope and pricing of Phases II and III at the conclusion of the respectively preceding phases. In the case of Phase II the data analized and work accomplished during Phase I may suggest a model of smaller magnitude.

Phase III consists for the major part in operating the model; experience has shown that the number of simulation runs to be made to achieve desired objectives is frequently determined by the results obtained in the initial runs. The price estimate for Phase III covers the utlization of the model for a period of approximately six weeks. Should the Department wish to carry out additional simulation in excess of the six weeks estimated, the extra cost involved will be subject to negotiation on a pro-rata basis.

Estimated Price

Phase I

Approximate duration: 6 weeks

Price estimate:

Professional fees	$ 12,800
Disbursements (computer, travel, telephone etc)	$ 2,500
Phase I total	$ 15,300

Phase II

Approximate duration: 23 weeks

Price estimate:

Professional fees	$ 32,400
Disbursements (computer, travel, telephone etc)	$ 4,800
Phase II total	$ 37,200

Phase III

Approximate duration: 6 weeks

Price estimate:

Professional fees	$ 13,700
Disbursements (computer etc)	$ 3,200
Phase III total	$ 16,900

TERMS: Our usual terms call for 10 to 20% payment at the start of the project followed by monthly progress payments. Other reasonable terms will be acceptable.

APPENDIX 'A' - personnel biographies

LALIT M. BASU

EDUCATION	Allahabad University, India M.Sc. Physics and Electronics 1945 Marconi College, England Advanced Radio and Radar Engineering Honeywell Controls Limited, England Process Instrumentation International Computer and Tabulator Training School, England Computer Programming.
PROFESSIONAL AFFILIATIONS	Association of Professional Engineers of the Province of Ontario - Member Institution of Electronic and Radio Engineers, United Kingdom - Member Institution of Chartered Engineers, United Kingdom - Member
PROFESSIONAL HISTORY	
1946 - 1950	Lecturer in Physics, Patna University, India.
1952 - 1959	Engineer, Marconi Company Limited, England.
	Development of single channel and multichannel radio equipment in VHF microwave bands.
	Feasibility studies, field surveys, system design, supervision of tendering and assistance with installation for major wide-band communication systems.
	Special designs to meet customer's requirements.
	Customer liaison for all technical and commercial matters including system planning, surveys, installation and commissioning for various systems.
	Field trials of various types of communication equipment.

1959 - 1965 Senior Telecommunications Engineer, Burmah Oil Group of Companies, United Kingdom and India.

Responsible for the direction of a telecommunication department comprising 30 engineers plus other technical and non-technical personnel.

Responsible for the system design, field survey, procurement, installation and commissioning of a communication, instrumentation, telemetering and remote control complex for an 800 mile crude oil pipeline in India.

Responsible for the preparation of system proposals for future expansion, negotiations with Public Authorities on operation licences and construction permits, and reporting to management on pipeline transportation problems.

1965 - 1966 Senior Products Engineer, Associated Electrical Industries, England.

Design and environmental testing of a large electronic telephone exchange.

1966 - 1968 Senior Products and Project Engineer, Integrated Electronic Services Division, Standard Telephones and Cables Limited, Enfield, England.

System designs for centralized supervisory electronic systems for the oil and gas industries, water distribution networks, and power distribution networks.

S.T.C. Project Engineer-in-Charge for digital supervisory systems associated with the following projects:

- Marathon Oil Pipelines Project, West Germany
- S.S.E.B. Dalkeith - Kaimes Power Distribution Project - United Kingdo
- Kuwait Power Distribution Project, Kuwait
- Sonatrach Gas Pipeline Project, Algeria

1968 - 1970 Acres InterTel Limited, Ottawa, Ontario.

Feasibility studies and system design for microwave and landline telecommunication systems.

Technical and cost interaction study for the Terrestrial and Satellite Systems in Canada for Department of Communication.

1968 - 1970 (cont'd)

International Satellite Market Study for Department of Industries.

Northern Communications Study for Department of Communications.

Field investigations and system design of a comprehensive telecommunication network to cover the load dispatching and communication requirements to 1985 of the electric power generation, transmission and distribution utility covering the entire Departmento del Valle in Colombia, South America.

Northern Communications Catalogue and Common Carrier/Private System Interconnection Study for Telecommission, Department of Communications.

Rene M. CARDIS

EDUCATION	St. Jean de Losne, France. 1st and 2nd Baccalaureat. Ecole Central TSF, Paris, Electronics. French Air Force, Nimes and Auxerres. Electricity Electronics and Radar. USAF Denver, Colorado, Gun control radar. Conservatoire des Arts et Metiers, Paris. Math. Elec. Eng. Carleton University, Ottawa, Ont. Completing B.Sc. (Math).
PROFESSIONAL AFFILIATIONS	Member IEEE (1958) Member Association of Professional Engineers of Ontario

PROFESSIONAL EXPERIENCE

1951-1954	French Air Force, Sergeant radar instructor.
1954-1957	Societe Francaise Radio Electrique, Paris, France. Engineering Tech Grade 3. Radar design and development of an early warning radar set (ACAL 1 Radar) Development on moving target indicator system, design of sweep circuits, modulation circuits, video amplifiers and others used in conjunction with a storage tube non-coherent MTI system. (ACAL 11 Radar). Engineer - Technical representative to the Department of National Defence - Indian Government, New Delhi, India.
1957 - 1961	Project Officer, Modification and improvement of military airborne equipment. Design of control tower communication systems.
1962 - 1966	Engineering Section Head, Radar and Electronic Warfare. Design of microwave components, rotating joints directional couplers. Microwave propagation studies related to satellite tracking stations. Design and modification of jammers.

1967 - 1968	InterTel Consultants Ltd., Ottawa, Ontario. Project Officer. EW Group. Consultant services in microwave equipment design, digital computer analysis of operational procedures, handbook; test procedures, training school design.
1968 -	Acres InterTel Limited, Ottawa, Ontario.
1968	System Engineer responsible for the integration of all Electronic Warfare equipment and for the interfacing with the computer system for the new DDH 280 class of destroyer.
1969-70	Senior Engineer in charge of a world market study for airport equipment covering the period 1970-90. The study involved the use of modern technological forecasting methods such as Delphi. Preparation of computer models for the world air transportation system.
1970	Vice President.

Levi Victor CORBETT

EDUCATION: B.A. Sc. (El. Eng.) University of British Columbia, 1952

PROFESSIONAL EXPERIENCE

1944 - 1945 Air Radio Division, Department of Transport, Ottawa, Ont.

Radio range operator responsible for:

1) Radio-telephone communication with passing aircraft.
2) Operation of CW point-to-point communications.
3) Weather observations.
4) Assisting the officer-in-charge in the maintenance of the range station.

1952 - 1955 Canadian Army Signals Engineering Establishment

Engineer. Inspection and testing of new and repaired electronic measuring instruments. Responsible for the environmental testing of low frequency transportable transmitter.

1955 - 1962 Computing Devices of Canada Ltd., Ottawa, Ont.

1955 - 1957 Field engineer in the Guided Missile Section firing range at Point Petre near Picton, Ontario. Re-location of the tracking radar set (AN/MPQ-18) from its mobile van to a permanent building. Installation of a Doppler radar set. Set up and operate the radar display console, the radar plotting board. Bendix FM-FM telemetry ground station, an ASCOP Pulse Modulation telemetry ground station, a range timing system, and kinetheodolites.

1957 - 1960 Development engineer in the Instrumentation Department participating in the design and development of various airborne navigation computers and ground support equipment.

1960 - 1962 Quality Control Supervisory Engineer in charge of test group.

	1962	Senior design engineer in charge of 5 technicians and responsible for the installation of the wiring and special measuring instruments in an RCAF CF-100 aircraft for the Defence Research Board.
1962 - 1964	TMC (Canada) Ltd., Ottawa, Ont.	
	Production Engineer, HF transmit-receive equipment.	
1964 - 1968	InterTel Consultants Ltd., Ottawa, Ont.	
	1964 - 1965	Interference analysis on Canadian microwave systems. Surveys of equipment in VHF-UHF microwave range.
	1965 - 1966	Assistant to project engineer, D.O.T. Satellite Earth Station, Mill Village, N.S.
	1966 - 1968	Technical representative to D.N.D. on installation of HF SSB equipment and antennas.
1968 -	Acres InterTel Limited, Ottawa, Ont.	
	1968	Satellite market survey for Department of Industry, Trade and Commerce for Canadian industry.
	1969	Assisted in preparation of proposals for various telecom systems.
	1969 - 1970	Technical representative to D.O.C. for evaluating briefs accompanying applications for the establishment of new microwave systems.
	1970	Assistant to project engineer on world airport survey for Department of Industry, Trade and Commerce.

FREDERICK GALL

EDUCATION	University of Aberdeen, Scotland B. Sc. Electrical Engineering 1945
PROFESSIONAL AFFILIATIONS	Association of Professional Engineers of the Province of Ontario Institution of Electrical Engineers, United Kingdom - Member Membre, Corporation des Ingenieurs du Quebec
PROFESSIONAL HISTORY	
1970 –	President, Acres InterTel Limited
1968 - 70	Executive Vice President, Acres InterTel Limited. Executive responsibilities also Responsible for the direction of various studies including, typically: International Satellite Communications Market Study, Department of Industry, Government of Canada Economic-technical aspects of the proposed domestic satellite communications system, Telecommunications Policy and Administration Bureau, Government of Canada Technical Adviser to financial underwriter team for Telesat Canada Electric power system communications
1960 - 1967	Vice President, InterTel Consultants Ltd., Ottawa, Canada. Executive responsibilities, also Project management of systems engineering assignments in Canada and overseas: technical market analyses in telecommunications.
1958 - 1960	Director of Planning, Telser de Venezuela, Caracas, Venezuela. Responsible for Systems Engineering, Operations and Maintenance of company and government telecommunication systems.
1957 - 1958	Supervisor Systems Engineering (Radio Relay) Canadian Marconi Company -

1953 - 1957	Systems Engineer (Radio Relay), Canadian Marconi Company, Montreal, Quebec.
	Systems engineering and field assignments in Canada and Latin America in VHF - UHF - Microwave - Troposcatter
1948 - 1953	Engineer, Telecommunication Division, Marconi's Wireless Telegraph Company, London, England.
	Development, systems and installation engineering in Britain, East and West Africa.
1945 - 1948	Technical Signals Branch, Royal Air Force.
	Operation and maintenance of telecommunication, radar and navigation radio aid facilities.

Max Herbert KASSNER
P. Eng.

EDUCATION: B.Sc. (Elec. and Telecom. Eng.) London University, England.
M.Sc. (Physics) McGill University, Montreal, P.Q.
Diploma (Bus. Admin.) McGill University, Montreal, P.Q.

PROFESSIONAL EXPERIENCE

1952-1960 Canadian Marconi Company, Montreal

Microwave System: Installation, maintenance, design modification.
Pinetree System: i/c prototype development (FASC, diversity switch, antenna and cable systems, ancillary equipment).
DQ 38 Microwave Equipment: Prototype design, sub-systems.
Mid-Canada Line: i/c all Marconi installations (80 personnel).
Logistic support, Knob Lake Sector.
Superintendent, Winisk Sector (260 personnel).

1961-1963 ITT of Canada, Montreal.

Standards Laboratory: i/c calibration for DEW Line, RCAF Van Cal, commercial equipment.
USAF, France: i/c quality control and standards laboratories.
AMC, Ottawa: Air traffic control, development of maintenance procedures.

1963-1967 InterTel Consultants Ltd., Ottawa
CAMESA, D.N.D.: i/c of Electron Devices Division.
NATO, Paris: Canadian delegate at Technical meetings.
D.O.T. Satellite Project: Resident engineer at Satellite Ground Station, Mill Village, i/c acceptance tests.
H.F. Communications: i/c nationwide market survey for SSB potential.
Field Survey in Ecuador: i/c field survey for two separate microwave routes Quito - Guayaquil.

1963-1967	InterTel Consultants Ltd., Ottawa (Contd)
	Systems Specifications: i/c developing specifications for 960 channel CCIR quality microwave system for ENTEL, Ecuador.
	D. N. D., Navy: i/c design for test facility.
1968	Acres InterTel Limited, Ottawa Vice President.
	D.O.C. Analysis of Canadian Microwave facilities, cost of increasing channel capacity and population coverage.
1969	D.O.C. Survey of communications in the Canadian North in relation to environmental factors, natural resources, transportation and economic development.
	ENTEL, Chile: Plan for Study and Analysis of Telecommunications in the Province of Magallanes, in relation to economic growth.

Albert Morley MacKENZIE

EDUCATION	Riverdale Collegiate Institute, Toronto, Ontario. DeVry Institute, Chicago, Ill. R.C.A.F. Radio and landline communications, radio warfare, cryptography, Communications Security. R.C.A.F. Officers Staff School.
PROFESSIONAL AFFILATIONS	Member, Society of Technical Writers and Publishers.

PROFESSIONAL EXPERIENCE.

1939-1940	Northern Electric Company, Toronto, Ontario. Central office installation.
1941-1965	R.C.A.F. (Rank on retirement Flight Lieutenant.) Point-to-point CW, HFDF, voice, ground and air operation. Communication centre supervision, organization, personnel management and direction. Morse, teleprinter and procedural instruction, supply and general administration, 1941 to 1954. Chief Operations Officer, Communications Control H.Q. Rockcliffe, Ontario. Direction to all RCAF stations, co-operation with RCN, Canadian Army and government departments requiring network service; liaison with commercial carriers on network requirements, 1955 - 1959. Staff Officer to Controller of Royal Air Force Telecommunications and Secretary of Royal Air Force Signals Traffic Committee, H.Q. Signals Command, Medmenham, England from 1959 to 1961. Staff Officer, Directorate of Communications, Communications Organization Section, RCAF HQ, Ottawa. RCAF Member Methods and Procedures Sub-Committee of Joint Telecommunications Committee, 1961 to 1964 Canadian Forces Communications System (HQ CFCS) section head Methods and Procedures, 1964-1965.

1965 - 1968	InterTel Consultants Ltd.
	Assistant to the Consultant to the Interdepartment Committee on Defence Communications during CN-CP Study of DND communications.
1967	In charge of SHAPE Technical Centre study to combine peacetime/wartime/emergency message handling and distribution throughout new SHAPE complex at Casteau, Belgium.
1968	Acres InterTel Limited
	Study of and recommendations for Ontario Department of Lands and Forests HF/VHF and private line communications system under Ontario Research Foundation auspices.
1969	Research traffic projection and costing of civil government communication requirements applied to the SAMSON system.
1970	Feasibility study on electronic transmission of mail.
	Interconnection study of private communication systems with those of the Canadian common carriers as part of Department of Communications Telecommission.

Dr. T.W. CHI

EDUCATION	National Taiwan University BSc in Civil Engineering, 1959
	Manhattan College, New York M E, Sanitary Engineering, 1965
	Harvard University, Department of Engineering and Applied Pysics PhD Engineering, 1970 PhD Research; Models of Waste Water Transportation. Included optimization studies of location of treatment facilities within a region.
PROFESSIONAL HISTORY	
1970 - Present	Research Fellow, Harvard University
	Population Dynamics Study, October 1970 to present: Development of mathematical models for simulating concepts of population dynamics; use of LP model for data gathering -- criteria established for data estimation.
	Development of a water quality model for salinity studies in East Pakistan; development of a simulation model for flood protection studies.
	Environmental systems models: linking different pollution models between environmental sectors (air, water and land); simulation models for educational purposes -- better understanding of physics.
	Consultant to Meta Systems Incorporated
	Assistance in water quality of optimization model.
1965 - 1968	Osti (Mississippi River, Big Sunflower Project): Flood program, agricultural patterns; simulation and optimization models for flood programs -- primarily for investment; flood control and crop patterns -- primarily investigations on modelling methodology for multipurpose river basin development and for use in investment decisions.

1963 - 1965	Research Engineer, Manhattan College. Two months with Hydroscience working on New York harbour project: solving boundary value problem for water quality model, also studies on salinity intrusion. Research on investigations in the mechanism of Anaerobic Digestion.
1961 - 1963	Associated with Research Institution, National Taiwan University. Experiments for Provincial Government on water quality (technician).
1959 - 1961	Chinese Air Force in Taiwan.

TECHNICAL PAPERS

PhD Thesis, 1970, "Models of Regional Waste Water Transportation".

1971, Chapter 8, Waste Water Conveyance - "Models of Regional Water Quality Management", Thomas, Dorfman and Jacoby.

EDWARD A. McBEAN

EDUCATION	University of British Columbia, Vancouver, British Columbia B.A.Sc., Civil Engineering, 1968 Massachusetts Institute of Technology, Cambridge, Massachusetts S.M., Water Resource Systems Analysis, 1970
PROFESSIONAL AFFILIATIONS	Engineering Institute of Canada - Associate Member American Geophysical Union - Associate Member
PROFESSIONAL HISTORY	
Jun 1970 - Present	Engineer, The Acres Group. Responsible for mathematical systems analysis to investigate plans for the development of the Saint John River Basin, New Brunswick. The project involved the construction of a mathematical optimization model and a simulation model to determine water quality levels given various alternative development schemes.
Sep 1968 - Jun 1970	Research Assistant, Massachusetts Institute of Technology. Research, working with Associate Professor E. Perkins, primarily concerned with the numerical and hydrologic characteristics of water surface profile computations. The results have been incorporated into the subsystem HYDRA of ICES (Integrated Civil Engineering System). Seminar investigations (Sep 1969-Feb 1970) to test the effectiveness of the proposed multiple objective analysis of the "Procedures for Evaluation of Water and Related Land Resource Projects" of the U.S. Water Resources Council.
May 1968 - Sep 1968	Engineer, International Power and Engineering Consultants. Responsible for the development of the computer system to examine the effects of the Columbia River Treaty on the operation of the proposed Canadian Dams. The project involved consideration of the sizing of power installations and the formulation of operating rules for Mica Creek, Duncan, and Arrow Dams,under the constraints of the Treaty and the load curve of the power system.
TECHNICAL PAPERS	"Computational Algorithms for Backwater Profiles" To be published (with F. E. Perkins). "Error Growth Characteristics in Backwater Computations" To be published (with F. E. Perkins). "Error Criteria in Water Surface Profile Computations" Hydrodynamics Laboratory Report No. 124, June 1970 (with F. E. Perkins). "Error Criteria in Water Surface Profile Computations" S.M. Thesis, Massachusetts Institute of Technology, June 1970. "Multiple Objective Redesign of the Big Walnut Project" Water Resources Council, Massachusetts Institute of Technology, Co-operative Agreement WRC-69-3, February 1970 (with D. C. Major et al).

I.W. McCaig

EDUCATION	University of Glasgow, Glasgow, Scotland BSc (Honours), Civil Engineering, 1943 Harvard University, Cambridge, U.S.A. S.M. Systems and Environmental Engineering, 1970
PROFESSIONAL AFFILIATIONS	Association of Professional Engineers of the Province of Ontario - Member Operations Research Society of America - Member Engineering Institute of Canada - Member American Society of Mechanical Engineers - Member American Society of Civil Engineers - Member Institution of Civil Engineers, United Kingdom - Fellow International Association for Hydraulic Research - Member American Water Resources Association - Member American Geophysical Union - Member
PROFESSIONAL HISTORY	
1970 - Present	Director, Acres Limited and H.G. Acres Limited Special Internal Consultant, Acres Consulting Services Limited Responsible for development of systems and environmental engineering in Acres, and quality control of the company's water resource and hydro-electric engineering.
1969 - 1970	Leave of Absence for post-graduate studies at Harvard University.
1967 - 1969	Director and Senior Vice President, H.G. Acres and Company Limited Chief Engineer in charge of special projects and laterly Chief Engineer and Manager of Engineering responsible for all engineering departments in H.G. Acres parent office in Niagara Falls.

1964 - 1966	Director, Acres Limited. President, Acres of British Columbia Limited.
1960 - 1964	Director and Vice President, H.G. Acres and Company Limited. Final responsibility for the electrical, hydraulic and mechanical engineering aspects of all of the company's projects. Member of the Board of Engineers for the Northumberland Strait Crossing Project.
1958 - 1960	Head, Hydraulic Department, H.G. Acres and Company Limited. Responsible for the administration of the department and for the hydraulic engineering for all of the company's projects with the duties including the direction of the company's hydraulic laboratories.
1946 - 1952	Engineer, Babtie, Shaw and Morton, Consulting Engineers, Glasgow, Scotland. Detailed designs for 12 miles of aqueducts, four miles of tunnel, the tailrace tunnel and channel and an access road eight miles long for the Glen Shira Hydroelectric Development (44,000 hp), Scotland. Civil engineering surveys, designs and specifications for various features of the Glen Shira Hydroelectric Development.
1943 - 1946	Junior Scientific Officer, Marine Aircraft Experimental Establishment, Ministry of Aircraft Production, United Kingdom. Research work relating to the hydrodynamics of seaplanes.
TECHNICAL PAPERS	"Air Pollution and Urban Design" Air Pollution Control Association, Ontario Section Meeting, Honey Harbour, Ontario, September 1968 (with Denison and Hobson).

TECHNICAL PAPERS (cont'd)

"A Mathematical Model for Transient Free Surface Flow in Nonhomogeneous or Anisotropic Porous Media"
Water Resources Research, Volume 4 No. 3, September 1968 (with Szabo).

"Computer Makes a Reality of the Total Systems Approach"
Canadian Consulting Engineer, February 1967.

"Intensity of Cavitation Attack Related to Fluid Properties"
Symposium on Testing Techniques in Ship Cavitation Research, Norway, 1967 (with Leith).

"Water Resources and Requirements of Western Canada"
Canadian Institute of Mining and Metallurgy, Calgary Branch Meeting, Calgary, Alberta, October 1965 (with Patterson).

"Rockfill Cofferdam Problems"
EIC Regional Technical Conference, Regina, Sask., May 1965 (with MacDonald).

"Measurements of Auto-Oscillation in a Hydroelectric Supply Tunnel and Penstock System"
ASME Journal of Basic Engineering, Series D, December 1963 (with Abbott and Gibson).

"Some Measurements of Auto-Oscillation Initiated by Valve Characteristics"
International Association for Hydraulic Research, Proceedings, Tenth Congress, London, England, 1963 (with Gibson).

"Hydrologic Simulation of a River Basin - An Aid in Flood Control Planning"
The Engineering Journal, June 1963 (with Gardiner and Jonker).

"Design of Steel-Lined Pressure Tunnels for Hydro-electric Developments"
Indian Journal of Power and River Valley Development, Special Number of Analysis and Design in Hydraulic Structures, December 1962 (with Folberth).

TECHNICAL PAPERS (cont'd)

"Selection of Dyke Freeboard and Spillway Capacity for Grand Rapids Generating Station"
The Engineering Journal, November 1962 (with Jonker and Hamilton).

"Buckling Resistance of Steel Liners for Circular Pressure Tunnels"
Water Power, July 1962 (with Folberth).

"Surges in Air Vents Adjacent to Emergency Gates"
ASME Journal of Basic Engineering, Series D, December 1961 (with Jonker).

"Underground Power Plants in Canada"
ASCE Proceedings, Journal of the Power Division, June 1958 (with Simpson and McQueen).

"Application of Computer Model Studies to Problems Involving Hydraulic Transients"
ASME Transactions, 1959 and Journal of Basic Engineering, Series D, December 1959 (with Jonker).

"Photography and Electronics as Tools in Hydraulic Experimental Work"
The Engineering Journal, December 1959 (with Gent).

"Spillway Capacity and Flood Flows"
Department of Northern Affairs and National Resources, Resource Branch, Proceedings of Symposium No. 1, Spillway Design Floods, November 1959 (with Erickson).

"Investigations into the Fatigue Failure of a Steel Conduit Liner" ASCE Annual Convention, Washington, D.C., October 1959.

"Complexities of Manifold Flow"
Washington State Institute of Technology, Second Hydraulics Conference - The Hydraulics of Nuclear and Fossil Fuel Plants, October 1959 (with McNown).

"Friction Losses in Large Diameter Concrete-Lined Hydraulic Tunnels"
ASCE Convention, Washington, D.C., October 1959 (with Clinch).

"Prevention of Ice Formation on Low Level Reservoir Outlets"
International Association for Hydraulic Research, Proceedings, Eighth Congress, Montreal, Quebec, 1959 (with Haydock).

TECHNICAL PAPERS (cont'd)

"Design of Large Pressure Conduits in Rock"
ASCE Proceedings, Journal of the Power Division, December 1957 (with Patterson and Clinch).

"Hydraulic Design and Model Testing of the Intake for the Bersimis - Lac Casse Hydroelectric Development"
International Association for Hydraulic Research, Proceedings, Seventh Congress, Lisbon, Portugal, 1957.

OSKAR T. SIGVALDASON

EDUCATION

University of Manitoba, Winnipeg, Manitoba
B.Sc., Civil Engineering, 1959
Imperial College of Science and Technology, University of London, London, England
D.I.C., Concrete Structures and Technology, 1962
University of London, London, England
Ph.D., Failure Characteristics of Concrete, 1965
Harvard University, Cambridge, Massachusetts
Special Studies, Environmental Sciences, 1969-1970

PROFESSIONAL AFFILIATIONS

Association of Professional Engineers of the Province of Ontario - Member
Engineering Institute of Canada - Member
American Institute of Aeronautics and Astronautics - Member
American Society of Civil Engineers - Member
American Society for Testing and Materials - Member
American Concrete Institute - Member

PROFESSIONAL HISTORY

1970 - Head, Applied Mechanics Department, Niagara Falls Office, H. G. Acres Limited.

Responsible for the formulation, development and use of operations research methodology (linear programming type) for the screening process required in the selection and sizing of reservoirs, power plants and diversion canals for a massive multibasin hydroelectric power development.

Responsible for the development, testing and use of simulation and mathematical type computer programming models for a study of the effects of water quality management on sociologic and economic development, with particular reference to the Saint John River Basin, New Brunswick.

1969 - 1970 Research Fellow, Harvard Corporation Appointee, Environmental Sciences Department, Division of Engineering and Applied Physics, Harvard University, Cambridge, Massachusetts.

1968 - 1970 Member, Executive Committee, GE 400 Users Association.

Participation in the promotion of liaison among all parties associated with the use of the General Electric 400 series of digital computers.

1967 - 1969 Head, Applied Mechanics Department, Niagara Falls Office, H. G. Acres Limited.

Responsible for the investigation and study of specific engineering and technical problems, particularly where the solutions involve the use of analogues, experimental or computer techniques, or the extensive use of mathematics.

Supervision of the development of mathematical models for continuum mechanics, particularly in the fields of rock and soil mechanics, structural mechanics and dynamics, and groundwater analysis.

Responsible for the development and application of digital computer programs for general engineering purposes.

Participation in the development and use of mathematical modelling techniques for a study of the effects of water quality management on sociologic and economic development with particular reference to the Saint John River Basin, New Brunswick. The work principally involved the interplay between the study group (engineers, economists, sociologists) and the client in the interpretation of the use of the models.

Development of a general computer program for the structural analysis of rigid frames by the stiffness matrix method.

1965 - 1966 Engineer, H. G. Acres & Company Limited.

Supervision of the development of digital computer programs for the routine solution of general civil engineering problems.

Responsible for the co-ordination of the civil engineering for the intake and the access bridges of the Portage Mountain Hydroelectric Development.

Structural engineering designs for Habitat, Expo '67, Montreal, Quebec.

Investigations, using model piles, of the resistance to lateral load of piles in rockfill for the design of the Northumberland Strait Crossing, New Brunswick-Prince Edward Island.

1961 - 1965 Postgraduate student.

1960 - 1961 Structural Engineer, Brown and Root Limited, Engineers and Contractors, Calgary, Alberta.

Structural designs for industrial buildings and equipment foundations.

1959 Field Engineer, Haddin, Davis and Brown Company Limited, Calgary, Alberta.

Field investigations and construction supervision for municipal works.

TECHNICAL PAPERS "Finite Element Applications to Singularity Problems" (in preparation).

"In Situ and Induced Stresses at the Churchill Falls Underground Powerhouse"
The Second Congress, International Society for Rock Mechanics, Belgrade, Yugoslavia, September 1970 (with R. Benson and T. W. Kierans).

"Stress Analyses of Underground Openings in Rock Using the Finite Element Method"
EIC Annual Conference, Halifax, Nova Scotia, May 1968 (with R. Benson and M. V. Thompson).

"The Influence of Testing Machine Characteristics Upon the Cube and Cylinder Strength of Concrete"
Cement and Concrete Association, United Kingdom, Magazine of Concrete Research, December 1966.

"Spherical Seating Characteristics"
The Engineer, May 1966.

"The Testing Technique Required to Achieve the Correct State of Stress in Concrete Specimens"
The Physical Society and Society of Physics, Symposium on The Physics of Testing Concrete, London, England, January 1966.

"Specimen and Testing Machine Characteristics and Their Effect on the Mode of Deformation, Failure and Strength of Materials"
Institution of Mechanical Engineers, Symposium on Testing Machine Design, Manchester, England, September 1965.

"The Influence of the Testing Machine on the Compressive Strength of Concrete"
Cement and Concrete Association, Symposium on Concrete Quality, London, England, November 1964.

MICHAEL V. THOMPSON

EDUCATION

University of Toronto, Toronto, Ontario
B.A.Sc., Civil Engineering, 1961
M.A.Sc., Civil Engineering/Structures, 1966

PROFESSIONAL AFFILIATIONS

GE 400 Users Association, Software Subcommittee - Member

PROFESSIONAL HISTORY

1966 -

Staff Consultant, Computers, and
Senior Engineer, Applied Mechanics, The Acres Group.

Responsible for the co-ordination, within The Acres Group, of the development and application of computer software for scientific and engineering purposes.

Responsible for a configuration study of hardware for a computer utility to serve a multi-interest group located in Toronto, Ontario, and for the preparation of specification targets for hardware suppliers and the supervision of benchmark testing of hardware proposed for the computer utility.

Co-ordination of the development and use of simulation and mathematical type computer programming models for a study of the effects of water quality management on sociologic and economic development with particular reference to the Saint John River Basin, New Brunswick.

Development of Monte Carlo type dynamic computer programming techniques for the establishment of the most economic operating rules for the Kaptai Reservoir, East Pakistan. The programs have accommodation for constraints covering navigation, electric power generation, and the effects of flooding on upstream and downstream crop yields.

Development of a Monte Carlo type computer simulation program for probability assessments of the failure to meet energy demands by an electric power system in the New England States.

Participation in the preliminary analyses, development and use of computer systems, employing the finite element method, for various engineering computations, including:

Analysis of groundwater characteristics, and analyses of two-dimensional frames for the design of a prestressed concrete tunnel, Tunnel Crossing, Welland Canal, Welland, Ontario

Optimization of the excavations required in a narrow gorge to change the shape of a proposed earthfill dam in such a manner as to reduce the arching effects that promote piping failures, Lower Notch Power Project, Ontario

Definition of the stresses and displacements in the masses surrounding underground openings in rock, Churchill Falls Power Project, Labrador, Newfoundland

Participation in the development and testing of computer programs for streamflow synthesis using random techniques, reservoir simulations and snowmelt runoff calculations, Churchill Falls Power Project, Labrador, Newfoundland.

Development of various plotting programs for the graphical presentation of the results of computer programs.

Preliminary analysis and development of a computer program for the computation of the stresses in gravity dam structures, of simple or complex shape, resulting from any combination of forces.

Analysis of various engineering calculations, and preparation of programs for their performance by digital computer, including:

The calculation of the quantities of the different materials in reservoir dykes of varying heights

The calculation of the section properties of complex shapes

The analysis of beams of composite construction

The summation and documentation of concrete reinforcing bar requirements

Structural designs for the intake trashracks, intake bulkhead gates and intake service gates, Kettle Rapids Hydroelectric Development, Manitoba.

Analysis of the nature of the failure, during a severe spring storm, of approximately 200 feet of the outboard wall of a harbour entrance pier, Hamilton, Ontario.

1964 - 1966 Instructor, University of Toronto, Toronto, Ontario.

Tutor in applied mathematics for problem-solving laboratory sessions.

Presentation of lectures in statics and dynamics to first-year engineering students.

1961 - 1964 Flight Lieutenant, Royal Canadian Air Force.

TECHNICAL PAPERS

"The Engineer and the Computer - Mutual Development in the 70's"
EIC Regional Conference, Peterborough, Ontario, April, 1970.

"Stress Analyses of Underground Openings in Rock Using the Finite Element Method"
EIC Annual Conference, Halifax, Nova Scotia, May 1968 (with R. Benson and O. T. Sigvaldason).

"Moire Movement Determination in a Flat Slab"
University of Toronto Thesis Library, 1966.

E. E. TRELOAR

EDUCATION	University of New South Wales, Australia B.Sc., Mathematics, 1964 B.Com., Applied Statistics, 1967 M.Com., Economics, 1968
PROFESSIONAL AFFILIATIONS	New South Wales Statistical Society, Australia – Member
PROFESSIONAL HISTORY	
1971 –	Economist/Statistician, Hedlin, Menzies & Associates Ltd.
1968 – 1970	Consultant Economist/Statistician, Crooks, Michell, Peacock & Stewart, Engineers, Architects and Planners, Australia

Assignment:
United Nations/Singapore, Urban Renewal Development Project.

Responsible for design and execution of the following large-scale sample surveys for the Singapore Project:
- Origin/Destination Traffic Survey
- Commercial Vehicle Survey
- Screenline/Cordon Surveys
- Public Housing Tenants Survey
- Retail Establishment Survey
- Household Expenditure Survey
- Central Area Sociological Survey
- Office Space Demand Survey
- Community Centre Survey

Planned and supervised a number of demographic and associated studies including:
- Population Projections
- Work Force Projections
- Household Projections
- Housing Need Projections
- Motor Vehicle Population Projections

Developed linear programming models for use in concept plan development. These models were designed to optimize worker/employment distributions, and determine optimal scheduling priorities for urban renewal projects.

Conducted Modal Split and Trip Generation Analyses of traffic data assembled on the Singapore Project.

Provided computer and statistical expertise in a major (sociological) study of the satisfaction with housing of tenants in high-density public housing estates.

Developed a method, utilizing numerical surface techniques, for computing dredging volumes from data generated by Decca navigational equipment.

Conducted an economic feasibility study of a proposed cement plant in Queensland, Australia.

1967 Lecturer, Department of Economic Statistics, University of Sydney, Australia.

Consultant Activities:

Designed and supervised a 3- state sample survey of over-award payments in Metal Trades in Australia.

Conducted a study into the brand-switching behaviour of purchasers of consumer nondurables (food), using stochastic process theory.

1966 Part-time lecturer/tutor, Universities of Sydney and New South Wales, Australia.

Consultant Activities:

Study of traffic congestion in the marshalling yards of a ready-mix concrete firm.

Design and execution of a sample survey of New South Wales taxi industry.

Study of sales projection techniques for a major distributor of heavy earth-moving equipment.

COMPUTER EXPERIENCE

Hardware: Mainly IBM/360 series

Languages: FORTRAN IV (F)
COBOL (F)
ASSEMBLER (E)
OS/360 JCL

Extensive experience in use of IBM SSP/360 and IBM MPS/360 packages, and the development of special application programs for scientific use.

Some experience in systems programming.

PUBLICATIONS

A Semi-Markovian Analysis of Consumer Coffee Purchasing Behaviour, Australian UNESCO Conference on Mathematics in the Social Sciences. Sydney, Australia, 1968.

Planning Models: Contributions from the Singapore Project, co-author with R.S. Skeates. Forthcoming in Journal of Royal Australian Planning Institute.

Satisfaction with Housing: A Methodological and Substantive Approach, Malayan Economic Review, October 1970. Co-author with J.S. Western and S.H.K. Yeh.

A Transportation and other Infrastructure Cost Minimization Approach to the Scheduling of Development Priorities for Urban Development Projects, Co-author with R.S. Skeates. Forthcoming at Fifth International Symposium on the Theory of Traffic Flow and Transportation, Berkeley, California, 1971.

APPENDIX 'B' - modelling projects

ACRES PROJECT NO. 1272C .. Digital Computer Study of Agricultural Adjustment Possibilities

LOCATION ..... Province of Prince Edward Island

CLIENT ..... Government of Prince Edward Island
Department of Agriculture
Agriculture Rehabilitation and Development Administration

DATE 1966

DESCRIPTION ..... Preparation of data and use of a linear programming package to study, by digital computer methods, possible adjustments to the macro-agricultural production of the Island, and to determine:

1 - The optimum mix of possible activities to obtain the maximum net revenue

2 - The net income for agriculture with indications of the costs involved in the pursuit of alternative, i.e., nonoptimal plans

3 - The resources required to achieve the optimum activity plan and the economic value of the limiting resources

The principal part of the work involved the collection and processing of the data concerning the initial assertions covering possible production activities and their unit costs, and the limitations imposed by available resources, marketing possibilities and net profits associated with each possible production activity.

ACRED PROJECT 1416 Railway Crossing Study
System Evaluation

LOCATION ..... Welland Canal, Ontario

CLIENT ..... The St. Lawrence Seaway Authority

DATE 1967

DESCRIPTION ..... The primary purpose of the study was to define the number and location of canal railway crossings, but it was recognized early in the study that these factors were interdependent with the possible railway networks using the crossings. The approach adopted, therefore, considered integral railway systems which comprised both crossings and associated rail networks.

The system capital costs were estimated for all crossings and track and amortized at six per cent interest over forty years. The forty-year period was estimated by the St. Lawrence Seaway Authority as being the probable useful life of the crossing facilities in the light of historical changes to previous Welland Canals.

The operating performance of the various systems was obtained by simulation using a Train Performance Simulator Program in conjunction with the consultant's GE-415 computer. A system analysis program devised by the consultants was used to assign through railway traffic to the system and to give the annual system operating costs on the basis of train miles and train hours.

DESCRIPTION (Cont'd) .... The existing railway system was similarly analyzed to establish its performance and level of service. The feasible systems were assessed using the existing system as a measure of performance and level of service to ensure that the future systems considered gave an overall performance better than, or at least equal to, that of the existing system. The study was based primarily on through traffic since it proved impossible to obtain sufficiently detailed and accurate data on service movements. Supplementary studies based on the same approach could, however, be carried out if this data becomes available at a later date. The effect on operating cost of various rates of growth of traffic was also studied.

The total cost of capital plus interest was added to the forty-year operating cost to give the sum total outlay implied by each system. This parameter, together with other pertinent factors, was used to evaluate the systems and to select the recommended schemes.

ACRES PROJECT 1616A System Studies

LOCATION ..... Thailand

CLIENT ..... Electricity Generating Authority of Thailand (EGAT)

DATE 1967

DESCRIPTION ..... Comprehensive studies of the electric power generating and transmission system of the EGAT, of the present and probable future load of the system, and of the possible sources, both hydro and thermal, of additional generating capacity to determine the means for making optimum use of water resources and to establish a program for the future development of the system.

The studies involved the development and use of a digital computer simulation model of the system and its possible development. The simulation also integrated into the study the effects of water requirements by the irrigated areas supplied by each of the Ping and Nan Rivers, and the effect of the confluence of these two rivers as the Chao Phya River.

ACRES PROJECT	2098	Electric Power System Development Planning
LOCATION		The New England States, U.S.A.
CLIENT		H. Zinder and Associates Incorporated for the New England Regional Commission (a federal/state economic planning group)
DATE		1969 - 1970
DESCRIPTION		Study of the existing electric power generation and transmission facilities in the New England States, and preparation of a general development plan for these systems covering the period from 1970 to 1990 when the load of the 67,000-square mile area served by them is expected to grow from 10,000 to 50,000 Mw.

The study considered committed developments to 1976, the restraints imposed by preservation of environmental quality, the possibility of importing power, the use of fossil and nuclear fuels, the contribution by standard and pumped storage type, hydroelectric power source, optimum system operating schedule.

Simulation programs provided by the Westinghouse Corporation and constructed by the consultant were used to assess sequenced system capacity, with various sizes and types of generation equipment, to meet the time variant load demand. The use of Monte Carlo methods allowed the consultant to simulate probable outages in generating units which when convoluted with load demand probability produced a system reliability curve.

ACRES PROJECT	2073	General Consulting Services Kaptai Reservoir Operating Rules
LOCATION		East Pakistan
CLIENT		The East Pakistan Water and Power Development Authority (EPWAPDA)
DATE		1970
DESCRIPTION		The consultant conducted a study of the operating procedures for the Kaptai Reservoir in the Chittagong district of East Pakistan as part of the assistance provided to EPWAPDA at both the management and technical levels.

The construction and operation of Kaptai Reservoir and hydroelectric plant apparently caused increased flooding in two large irrigation areas downstream of the dam. Several crop losses were being incurred and the authorities wished to reduce flooding by improvement of the reservoir operating rules.

A mathematical programming model was developed to assist in formulating an improved policy. The system objectives within the model minimized the losses due to:

Loss of generated hydroelectric energy as compared to that presently produced.

Losses due to crop damage downstream.

Losses due to crop damage in the reservoir area.

The model used dynamic programming, historical flows and the structural components as they existed. The operating policy of the reservoirs was determined.

ACRES PROJECT	P2161	Economic Study of Nickel Mine
LOCATION		Thunder Bay District
CLIENT		Great Lakes Nickel Company
DATE		1970
DESCRIPTION		The financial analysis of a proposed nickel mine was performed with the aid of a financial simulation program. Changes in tax structures for mining, project financing and schedule expected price of ore and various recovery rates could be studied within the model of the physical and financial aspects of this project. The basic structure of this model was, however, simple. It calculated physical throughputs and worked out the losses and revenues that result. These calculations lead on to taxes, and the repayment of loans or other finance. The simulation was advanced year by year to the time horizon specified. Selected output indicated cash flow, equity, taxes paid, etc. The model significantly reduced the time to evaluate a great many schemes and financial situations.

ACRES PROJECT	2306	Development of Engineering of Economic Water Quality Simulation Models
ASSISTANT CONSULTANTS		META Systems Inc., and James F. MacLaren Limited
LOCATION		Saint John River, New Brunswick
CLIENT		Government of Canada Department of Energy, Mines and Resources Policy and Planning Branch
DATE		1970 - 1971
DESCRIPTION		This study is at present being completed for the Department of Energy, Mines and Resources of the Canadian Federal Government, to examine the feasibility of using sophisticated mathematical modelling techniques in the planning and management of the water resources of river basins in Canada. The study is being carried out by a group of companies, both in the United States and Canada, under the direction of H.G. Acres Limited. The Saint John River Basin was selected as an example for the study, and contains a wide variety of river types, reservoirs, and an extensive pollution problem with significant effects on the fish life in the river. The river basin is further complicated in that it includes portions of Maine in U.S.A., New Brunswick and Quebec in Canada, and part of the length of the main stem forms the U.S.A./Canada border. The study includes the building of two computer models for the basin, one to optimize the treatment levels for the different polluters under various political and technical constraints, and another to simulate the detailed behaviour of the oxygen level and waste loads in the river.

DESCRIPTION
(cont'd)

A major part of the study is to determine the usefulness of the models for supplying information directly applicable to decision making at all levels of government, and in determiningthe speed, flexibility and data requirements necessary when the models are used for these purposes. The models themselves can include explicit consideration of the hydrology and hydraulics, as well as the chemistry of the system, the waste treatment cost functions at all potential treatment sites, and the benefit function for water quality either in dollars or on a weighted scale.

Methods will be demonstrated for examining the extra treatment cost involved in applying different social and political constraints on the cost of treatment at various locations, or the levels of water quality.

Interfacing the model to other models will be studied, particularly with respect to regional socio-economic models covering the river basin.

Methods of using models to assist basin management and possible forms of enforcing various water quality control schemes are typical points that form part of the study.

This complete project is being carried out by a multidisciplinary team including specialists in numerical mathematics, fish biologies, fluid mechanics, waste treatment, socioeconomics, agreous chemistry and hydrology.

ACRES PROJECT	2707	Review of Hydro Quebec Studies Ruper, Broadback and Nottaway Rivers
LOCATION		Watersheds Draining into Hudson's and James Bays
CLIENT		Hydro Quebec
DATE		1970 - 1971
DESCRIPTION		The economic feasibility of developing several watersheds in various sequences and combinations on the James Bay regiona of the Province of Quebec for the purpose of hydroelectric generation was investigated using a combination of conventional and operations research techniques. A linear programming model was utilized in a screening process to select and size reservoirs, power plants and diversion canals. The LP model had an objective function which mathematically represented net benefits accruing to the developer over a period of ten years. The value of energy was defined exogeneously to and system sensitivety to these changes was noted. Representative hydrology for the entire period in monthly or seasonal flows was included within the constraint equations. Reservoir storage curves and rating curves for hydraulic structures were approximated by piece-wise linear functions. These models were developed and used, and the project completed in less than four months.

CACC / CCAC
87285

STRUCTURING OF A MODEL OF DATA TRANSMISSION NETWORKS IN CANADA

P
91
C655
S866
1971

DATE DUE
DATE DE RETOUR

JUL 1 5 1986			

LOWE-MARTIN No. 1137