

REMOTE SENSING CONSULTING PROJECTS

CARRIED OUT BY

PHILIP A. LAPP LIMITED

MARCH, 1984

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Listed below are some typical consulting projects relating to the broad field of remote sensing carried out by PHILIP A. LAPP LIMITED. This selection of projects shows the range and depth of our remote sensing knowledge and experience.

FUNCTIONAL SPECIFICATION FOR AN AIRBORNE IMAGING  
MICROWAVE RADIOMETER FOR ICE RECONNAISSANCE (AIMR)

This specification establishes the functional requirements for an AIMR, an adaptation for ground use, and an associated Ice Centre Playback Analyser. The AIMR is primarily intended for use as part of a remote sensing package to be carried in turbo-prop aircraft undertaking ice reconnaissance patrols in the Canadian Arctic, Great Lakes, St. Lawrence Gulf and Eastern Seaboard regions. Produced for the Atmospheric Environment Service of Environment Canada in 1984.

A REVIEW OF REMOTE SENSING TECHNOLOGY,  
SENSOR TECHNOLOGIES AND THEIR APPLICATIONS

A 1983 survey of the functions and purposes of various sensors, technologies involved, platforms and applications, state-of-the-art and development trends.

REPORT OF THE SURVEYS AND MAPPING  
STRATEGIC PLANNING GROUP

This study group, chaired by Dr. Philip A. Lapp in 1983, focussed on issues relating to the geodetic and topographical mapping core programs of EMR's Surveys and Mapping Branch. The study group met with users of topographic maps and geodetic data across Canada to determine their needs and to make recommendations that will form the basis of SMB's strategic plan.

EVALUATION OF EMR REMOTE SENSING ACTIVITIES

An evaluation, based on a national survey, of EMR's remote sensing activity which is administered by the Canada Centre for Remote Sensing. This major report focussed on two issues for analysis: Landsat and CCRS's technology transfer activities.

APPLICATION OF SPACE AND REMOTE SENSING TECHNOLOGY  
TO THE VERIFICATION OF WEAPONS SYSTEMS  
FOR USE IN OUTER SPACE

This study presented an overview analysis of the effectiveness of space technology and remote sensing applied to arms control verification of anti-satellite weapon systems. The study team suggested the possible configuration, roles and tactics of such a spacecraft and outlined the capabilities of the Canadian space industry in the production of a first-generation Surveillance and Verification System. Carried out in 1983 for the Arms Control and Disarmament Division of the Department of External Affairs.

### SPACE STATION USER STUDY

A major study carried out in 1983 for NRC through their contractors, Spar Aerospace, to ascertain likely Canadian applications for a permanent low earth orbit space station planned for launch by NASA in the early 1990's. The work carried out by PHILIP A. LAPP LIMITED involved a detailed study of the requirements for Canadian applications for such a station, within a wide range of Canadian industries, coast to coast. Remote sensing was one of seven subject groupings within which proposals were examined. The objective was to provide NRC with sufficient information to allow a decision to be made on whether or not Canada should participate in this international venture.

### RADARSAT USER REQUIREMENT STUDY

An Ice and Ocean User Requirement Definition Study for RADARSAT was carried out for the Department of Energy, Mines and Resources during 1981 and 1982. Tasks in this study included the determination and validation of the user requirements; development of data presentation products; trade-off analysis of appropriate platform, sensor and communications mixes; policy alternatives for consideration by the Government in respect of levels and types of service to users; plan for phasing in services as aircraft and satellite platforms are put into place; comprehensive benefit and value analysis of RADARSAT data capabilities in respect of various instrumentation options and of interdependencies with planned satellites including ESA, U.S. and Japanese programs to determine the options most appropriate to Canadian ice/ocean information requirements.

PROGRAM EVALUATION OF THE  
SURVEYING AND MAPPING ACTIVITY, EMR

A 1981 review and assessment of the S & M activity for the Department of Energy, Mines and Resources, based on the responses to a questionnaire.

CONSULTANT STUDY ON THE REMOTE SENSING INDUSTRY

A report to the Task Force on the Future of the Ontario Centre for Remote Sensing. This 1981 study investigated private industry perceptions of OCRS and assessed the future prospects of the remote sensing industry in Ontario.

DESIGN SPECIFICATION FOR THE CCRS  
BOTTOM ECHO RECORDER SUBSYSTEM

Carried out for the Canada Centre for Remote Sensing in 1980, this design specification detailed the hardware and software design requirements of the new Bottom Echo Recorder Subsystem (BERS) to be developed under contract to the CCRS. The purpose of the BERS is to form part of the CCRS MK III Airborne LIDAR Bathymeter System; the primary functions of BERS are to control the MK III System and to acquire data from various instruments within MK III and record these data on magnetic tape to facilitate post-flight analysis.

TECHNOLOGY, APPLICATIONS AND USER STUDY OF  
AERIAL HYDROGRAPHY AND ASSOCIATED TECHNIQUES

The status, development and performance of the Canadian Aerial Hydrography System (which provides an airborne method of making accurate water depth and associated position measurements) were described in this 1981 report. The results of an investigation and analysis of potential applications were presented. Potential users of aerial hydrography and spin-off applications such as topographic surveys were identified.

AERIAL HYDROGRAPHY PILOT PROJECT

Carried out in 1979-1980 for the Canadian Hydrographic Service, this project was devoted to the development and evaluation of a prototype airborne system for the remote measurement of shallow water depths. Specific objectives of the project were to continue development of the CCRS photo bathymetry system, and by integration of this system with the CCRS laser bathymeter, produce a fully operative hybrid system prototype; to assess the performance capabilities and limitations of the system through the acquisition, reduction and analysis of flight trial data; to estimate the cost and time benefits which could be realized through the use of the system in production survey work; and to initiate transfer of the aerial hydrography technology to the private sector.

ICARUS (INERTIALLY-CONTROLLED AIRCRAFT  
TRACK RECOVERY AND UPDATING SYSTEM)

This report describes the structure and operation of the software component of ICARUS, developed for the Canada Centre for Remote Sensing for post-mission reduction of multisensor navigation data. The ICARUS software package consists of two segments: a process control segment which provides user interface to the package and a data processing segment which processes inertial and auxiliary sensor data sets to generate minimum-error time-histories of aircraft flight profile parameters. Results from two flight trials demonstrated the performance capabilities of the system for various sensor configurations.

THE IDENTIFICATION OF OPPORTUNITIES FOR THE  
U.K. IN THE DEVELOPMENT OF MARINE POLLUTION  
SENSORS. TASK A: STATE OF THE ART REVIEW  
(NORTH AMERICA)

For this major study carried out in 1979 for the Shipping and Marine Technology Requirements Board in the Department of Industry, U.K., the Company acted as the North American subcontractor providing: the input on the "state-of-the-art" of water pollution sensor development in Canada and the U.S.A.; an inventory of major organizations engaged in pollution sensor development in Canada; and a list of companies or organizations interested in joint collaboration on new or modified products. A major portion of the report consisted of a catalogue of North American water pollution sensors with relevant performance data summaries.

REPORT OF THE INTERDEPARTMENTAL STUDY GROUP  
ON OCEAN INFORMATION SYSTEMS

This study group, chaired by Dr. Philip A. Lapp on behalf of the Ministry of State for Science and Technology, included representatives from all federal departments with responsibilities for ocean management operations, technology development and policy formulation. The group assembled an inventory of and made recommendations relating to ocean data needs and systems in the areas of resource management, protection of the marine environment, development and control of navigation, defence, ocean service activities and international ocean management.

REPORT OF THE TASK FORCE ON NATIONAL SURVEYING AND MAPPING

This Task Force, chaired by Dr. Philip A. Lapp, was established in 1977 to review surveying and mapping activities within the Department of Energy, Mines and Resources. The study investigated current and future needs in order to establish federal government responsibilities and to analyze the relevance of S & M objectives, practices and resources.



RESOLVING AMBIGUITIES IN INTERPRETING THE  
THERMAL SIGNATURE OF ICE AND WATER IN  
AERIAL THERMOGRAMS OF FLAT ROOFS

Carried out in 1978 for the Canada Centre for Remote Sensing, this project encompassed two principal activities. First, a set of contact and radiant temperature measurements were made on wet and dry parts of a roof, and the results related to airborne thermal infrared signatures taken at the same time, to test a procedure for deriving a true temperature map over dry, wet and frozen regions of a roof. Second, aerial thermographs taken for a number of sites were analyzed for heat loss and results compared to heat analyses done for the same sites in 1977, to assess how much heat-loss analysis of roofs with wet patches would be improved if the correct temperature was known over the entire surface.

THE ASSESSMENT OF HEAT LOSS FROM BUILDINGS  
BY MEANS OF AERIAL THERMOGRAPHY

A project conducted for the Canada Centre for Remote Sensing in 1977 by PHILIP A. LAPP LIMITED, the Ontario Centre for Remote Sensing and the Nova Scotia Research Foundation. This pilot study determined the value of aerial thermography for qualitative identification of heat loss in a cross-section of industrial/commercial/institutional sites in Prince Edward Island. Intended to serve as the forerunner of a comprehensive and systematic survey of all such sites in P.E.I. and Nova Scotia.

SATELLITES AND SOVEREIGNTY

Report of the Interdepartmental Task Force on Surveillance Satellites (1976), led by Dr. Philip A. Lapp. Included discussions of the role and place of satellites among alternative sensor platforms, departmental surveillance requirements, and capabilities of satellite systems. The report examined options open to Canada in terms of research and development implications, cost and schedule impact, industrial involvement and benefits, and international participation.

CODS USER SURVEY AND COST BENEFIT ANALYSIS

Following interviews with 70 potential user agencies and the performance of 3 major cost benefit studies, this report developed 20 recommendations designed to extend the Canadian Ocean Data System user liaison program, forming the basis for a continuing marketing and applications engineering activity. Considered in the optimal data generation system was a wide range of sensors on a variety of platforms, including satellites, ships, aircraft and buoys. This study was commissioned by Hermes Electronics Ltd. in 1976.

THE ROLE OF REMOTE SENSING IN THE  
MONITORING OF WATER AND EFFLUENT QUALITY

The objectives of this 1976 study were to a) assess the status and potential application of remote sensing to water and effluent quality monitoring, including both technical and economic considerations, b) to identify promising areas for research and development of new sensors and techniques, and c) to recommend options for the integration of remote sensing into operational systems of the Department of the Environment.

AN INVESTIGATION OF SYSTEMS FOR THE  
SURVEILLANCE AND MONITORING OF OIL SPILLS AT BEAUFORT SEA

A study undertaken for the Canada Centre for Remote Sensing as part of the Beaufort Sea Project in 1975. PHILIP A. LAPP LIMITED brought together a team of scientists and engineers to consider and propose a viable and feasible system, incorporating remote sensing and other technologies, to detect and monitor oil spills in the Beaufort Sea. This investigation involved a scientific and technical assessment of remote sensing instruments including hardware specifications, software, operator skills, data acquisition, data handling and interpretation, and the interface with command and control operations.

AN ASSESSMENT OF THE CAPABILITIES  
OF ONTARIO INDUSTRY IN REMOTE SENSING

Carried out for the Ministry of Natural Resources, this study assessed the capability of Ontario industry, in 1974 and in five years' time, to perform part or all of the work of the Ontario Centre for Remote Sensing.

A REVIEW OF ACCOMMODATION REQUIREMENTS FOR THE  
REMOTE SENSING COMPLEX OF THE DEPARTMENT OF  
ENERGY, MINES AND RESOURCES

A review and assessment of options for meeting the accommodation requirements for the EMR Remote Sensing Complex. Carried out for CCRS Management in 1974.

THE IDENTIFICATION OF REQUIREMENTS CRITICAL TO  
OPERATIONS ON AND BELOW ICE-COVERED WATERS

A 1974 study directed toward the implementation of the portion of the Oceans Policy relating to Canadian achievement of world-recognized excellence in operating on and below ice-covered waters. Two workshops were held - one devoted to commercial activities in the Arctic (petroleum operators and transportation industry), the other focussed on Arctic waters support services (governmental activities and fishing industry). Recommendations for improved levels of remote sensing of ice conditions were identified under the program grouping of ice forecasting as a support service for Arctic transportation. Prepared on behalf of the Ministry of State for Science and Technology.

A PROPOSED CROP INFORMATION SYSTEM  
USING REMOTELY SENSED DATA

A study undertaken for the Canada Centre for Remote Sensing in 1974 to investigate crop information sources, to interview agencies using available crop information, to review current and potential remote sensing imagery systems, and to postulate a crop information system integrating remotely sensed data as an additional input.

INDUSTRIAL INVOLVEMENT IN THE AIRBORNE PROGRAM  
OF THE CANADA CENTRE FOR REMOTE SENSING

A working document, prepared in 1974 for the Task Force on Industrial Involvement in the CCRS Airborne Program, to assist in the development of overall plans and policies and to indicate the major implications of industrial involvement in the Program (which encompasses the acquisition of remotely sensed data from airborne platforms and the subsequent ground processing and application of these data).

MARKET ASSESSMENT OF THE LASER FLUOROMETER SYSTEM

PHILIP A. LAPP LIMITED was contracted in 1973 to conduct a market survey among potential users and to advise the Department of the Environment on the future development of the remote sensing laser fluorometer. The recommendations defined the optimum mechanism for transferring the technology to Canadian industry.

A STUDY OF THE RESEARCH AND DEVELOPMENT NEEDS FOR  
AIRBORNE SENSING SYSTEMS WITHIN THE  
DEPARTMENT OF THE ENVIRONMENT

Undertaken for the Working Group on the DoE Research Flight Facilities Needs in 1973. An assessment of the viable options open to the Department to satisfy its needs for airborne sensing, including an estimate of costs, evaluation of the quality of service to DoE, and recommendations regarding the organization required for the management and operation of a research flight facility (funding, scheduling, information services, location, etc.).

OBSERVABLES AND PARAMETERS OF REMOTE SENSING

A 1971 report of the Sensor Working Group to the Inter-departmental Committee on Resource Satellites and Remote Airborne Sensing for Canada. Using a modelling approach, the study defined how various activities associated with remote sensing fit into the resource and environmental management process. Dr. Philip A. Lapp chaired the Sensor Working Group of the Canadian Advisory Committee on Remote Sensing from 1970 to 1976.

ADDENDUM TO REMOTE SENSING CONSULTING PROJECTS  
CARRIED OUT BY PHILIP A. LAPP LIMITED  
SEPTEMBER, 1989

MARKET EVALUATION STUDY FOR COMPUTER MAP DATA BASE  
FOR ONTARIO

An evaluation of the market for a computerized map data base of Ontario was undertaken to examine the case for replacing the current conventional OBM program with a computerized OBM mapping program. The study was carried out in 1987 for the Ontario Ministry of Natural Resources.

The study determined the use of computerized topographic data in resource management, land use and administration. The anticipated demand and benefits were assessed. The issues of standards, research and development, systems architecture, and the supply and demand for expertise and services were also addressed. Dr. Lapp was the Program Director.

RADARSAT: A COMMERCIALY FINANCED GOVERNMENT PROGRAM

The purpose of the study was to determine the extent to which commercial financing could be attracted to the Radarsat remote sensing satellite project.

The study involved a technical review aimed at simplifying and scaling down the spacecraft, and the commissioning of independent market assessments. Philip A. Lapp Limited was retained by Spar Aerospace to review available market data and to provide projections used to evaluate the commercial potential of the Radarsat programs. The study was carried out in 1986 for Energy, Mines and Resources Canada.

RADARSAT COST RECOVERY OPTIONS

The study was commissioned to identify the ways and means of achieving full or partial cost recovery for the RADARSAT satellite, and to assess the feasibility and desirability of these ways and means. The project was carried out in 1986 for the RADARSAT Project Office. Philip A. Lapp's services were retained by Price Waterhouse.

The study was based on a review of existing assessment studies, and on interviews with officials of RADARSAT, EOSAT Corporation in the US, and potential users. It concluded that RADARSAT could achieve revenues of at least \$24 million annually, and recommended private sector involvement in the marketing and distribution of satellite data.

INVESTIGATION INTO THE REQUIREMENTS  
FOR THE SUPPLY AND DEMAND  
FOR SATELLITE MICROWAVE RADIOMETER DATA FOR AES

This study was carried out in 1985 for the Atmospheric Environment Service of Environment Canada. It examined the potential for microwave radiometry in terms of AES user requirements, sources of satellite microwave data and products, options for processing and distribution, regulatory and policy aspects, and financial implications.

The study involved interviews within several parts of AES, including CMC. The study recommended that AES move towards the integration of satellite radiometry data into the operational forecast system.

FUNCTIONAL SPECIFICATION  
FOR AN AIRBORNE IMAGING MICROWAVE RADIOMETER  
FOR ICE RECONNAISSANCE (AIMR)

The AIMR was designed as part of a remote sensing package to be used for ice reconnaissance. This specification established the essential features and operating conditions for a prototype system including an AIMR, an adaptation for ground use, and an associated Ice Centre Playback Analyser.

The specification was developed through consultation with users, suppliers of current radiometer designs, owners of ice reconnaissance aircraft, ice forecasters, and engineering and ice reconnaissance operations staff. It was carried out in 1984 for the Atmospheric Environment Service of Environment Canada.



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