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A Role for Private Enterprise in Remote Sensing from Space?*

Private enterprise should have responsibility for data acquisition and data management.

Introduction

Recent technical, institutional, and economic events have produced a critical decision time frame for the Landsat remote sensing system. In particular, the role of government versus private initiative is being seriously debated. Uppermost in the minds of companies who have followed the development of Landsat remote sensing as a possible business venture is the question: Is there a role for private enterprise in remote sensing from space?

Any role private enterprise would assume in remote sensing from space would primarily be related to the ultimate profitability of the involvement. There is, however, a "benefit-to-mankind" overtone to remote sensing of natural resources which private enterprise acknowledges and will want to accommodate in any business plans.

In order for significant profit to be realized by private enterprise from remote sensing from space, an earth-observing satellite system must evolve from experimentation and research to an operational mode. In the following paragraphs, the question of private enterprise's part in effecting an operational remote sensing system and the potential profit and benefits to be realized from such a role will be examined.

Abstract: *In order for significant profit to be realized by private enterprise from remote sensing from space, an earth-observatory system must evolve from an experimental to an operational mode. A number of technical, legal-institutional, and economic factors impact the rate and effectiveness of the transition. The impetus for change appears to be intimately tied to the investment and involvement of private enterprise. Throughout the transition, institutional responsibility for various parts of the system should move from the federal government to private enterprise. In an operational mode, private enterprise should have responsibility for data acquisition (including the space segment where appropriate) and data management (except permanent archiving) with a shared responsibility for data analysis.*

Whereas the terms "remote sensing from space" and "Landsat remote sensing" are often used interchangeably, it is important to note that the former term as used in this paper refers not only to the Landsat series of satellites and related ground facilities but includes other earth-observing multispectral satellite systems such as certain oceanic and meteorological satellite systems.

Future of Landsat Remote Sensing

In a remote sensing system as sophisticated as Landsat, many factors impact its progression from an experimental to an operational mode. These can be conveniently

* Presented at the Annual Meeting of the American Association for the Advancement of Science, Denver, Colorado, February 25, 1977.

Photogrammetric Engineering and Remote Sensing,
Vol. 44, No. 2, February 1978, pp. 171-175.

grouped into (1) technical factors, (2) legal/institutional factors, and (3) economic factors.

Figure 1 lists possibly the most visible and interesting factors affecting the future of Landsat. This list is not intended to be exhaustive, but rather indicative of the complexity and interrelation of the decisions and events required to bring it into an operational mode. For illustrative purposes, one of the factors in each group will be discussed, although no one factor operates independently.

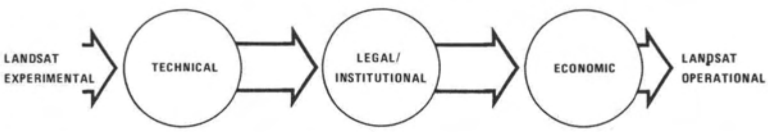
TECHNICAL FACTOR: MATURITY OF REMOTE SENSING APPLICATIONS

Useful and beneficial remote sensing applications of Landsat data appear to be the terms most often used in justifying the requirements for an operational Landsat. Useful and beneficial remote sensing applications imply a certain data demand which has been variously translated into cost-benefit numbers. This is essential and appropriate if the system under scrutiny is intended only as a government-subsidized program and the terms of reference are for the general welfare and good of the people, but few intelligent business investment decisions are based on such considerations.

Private enterprise is most interested in the maturity of a remote sensing application, defined as an application requiring repetitive remote sensing data and sufficient user need and willingness to pay for the data. In these rather stringent terms, there are presently only a few remote sensing applications able to meet the test of maturity.

There appear to be a number of remote sensing applications that today partially meet such a maturity test, for example, dam inventorying by assessing surface water distribution. This is an ideal use of Landsat 1 and 2 multispectral scanner (MSS) data that, when combined with selected surface parameters, yields highly accurate inventory tabulations. This remote sensing application fails the maturity test by (1) not demanding a repetitive data supply, and (2) being sponsored by a user who is largely unwilling to pay for the services. The latter situation is indicative of a lack of marketing of the technology in order to generate a user recognition of the cost effectiveness of the service. In other words, the application may be technically mature and have a corresponding need, but due to inadequate technology transfer relative to the applications possibility, a user will neither understand nor be willing to pay for the service.

An operational Landsat remote sensing system, in order to be financially viable, requires a basic set of technically mature applications with the related repetitive data requirements and user comprehension. This basic set appears to be evolving into the discipline areas of agricultural production, water resources management, land-use planning and management, and geological exploration and mineral resources management. Each application is at a different point in its maturation with the earliest area expected to fully mature in the early 1980s.



TECHNICAL FACTORS	LEGAL/INSTITUTIONAL FACTORS	ECONOMIC FACTORS
MATURITY OF REMOTE SENSING APPLICATIONS	WHITE HOUSE PRIORITY	TECHNOLOGY TRANSFER/ TECHNOLOGY DIFFUSION
MULTI-SOURCE ENVIRONMENTAL DATA INTEGRATION	CONGRESSIONAL ACTION	LANDSAT D FUNDING
DIGITAL PROCESSING TECHNIQUES	EARTH RESOURCE OBSERVATORY SATELLITE (EROS) MANDATE	EROS FUNDING
THEMATIC MAPPER DEVELOPMENT	NASA-OFFICE OF APPLICATIONS MANDATE	NASA FUNDING
SPACE SHUTTLE SCHEDULE	DOMESTIC/INTERNATIONAL REGULATION	PRIVATE INVESTMENT
TELEMETRY & DATA RELAY SATELLITE SYSTEM SCHEDULE	PRIVATE INITIATIVE	MARKET STIMULATION
MASTER DATA PROCESSOR-EROS DIGITAL SYSTEM SCHEDULE	FOREIGN AGREEMENTS	FOREIGN INVESTMENT
MASS DATA STORAGE-RETRIEVAL TECHNOLOGY	UNITED NATIONS ACTION	USER DEMAND

FIG. 1. Factors affecting the future of the Landsat system.

LEGAL/INSTITUTIONAL FACTOR: WHITE HOUSE PRIORITIES

A new President is largely an unknown in consideration of an operational Landsat remote sensing system. President Carter's most direct influence will likely be through fiscal year 1978 and future budgets in support of a Landsat-D satellite and related ground facilities. There are good reasons to believe that President Carter will favor remote sensing from space and encourage the evolution of the Landsat remote sensing system from the present experimental through the transitional mode. Among those reasons are:

- President Carter has shown an appreciation for natural resources management and environmental problems in a number of his campaign speeches as well as in several statements to the American Institute for Aeronautics and Astronautics.
- He has demonstrated in Georgia as Governor that a Regional Planning Structure for Land Planners is not only a feasible but also a workable approach. Data requirements for regional planning are directly related to a Landsat remote sensing system.

At the present time, the Office of Management and Budget (OMB) is considering the Landsat-D for FY 1978 funding. About October 1977, a decision will be reached whether or not to go ahead with Landsat-D. It is widely known that OMB is looking for a tangible expression by private enterprise before agreeing to the funding of Landsat-D. If this is the case, industry must move rapidly to make known that there is a need for program continuity.

ECONOMIC FACTOR: TECHNOLOGY TRANSFER/TECHNOLOGY DIFFUSION

Technology transfer and/or technology diffusion are the terms used to describe the process of moving developed technology into the market place. The degree of sophistication and the actual or perceived user need for the technology are factors which determine the rate of transfer or diffusion.

NASA has traditionally been the center for public space technology research and development. It is within their charter to insure that technology is made available to the private sector; thus, NASA has established technology transfer offices to facilitate this activity. At the same time, NASA has funded principal investigators, established Applications Systems Verification Tests (ASVT), set up regional applications programs administered by field centers (e.g., working with Intralab), and provided limited training programs to push developed Landsat technology to the user.

The Department of Interior has likewise established Applications Assistance Branches within the Earth Resources Observation Satellite (EROS) program to deal with technology transfer.

The federal government has been reasonably successful within time and budget constraints in selling developed technology. Nevertheless, the use and demand today for Landsat data are highly fragmented and not well developed.

It is generally believed that a much broader market and therefore greater Landsat data usage could be tapped with an aggressive market development program in conjunction with technology transfer/technology diffusion programs. Private enterprise has traditionally had the responsibility to conduct market and sales programs for consumable technology products and services, notwithstanding such efforts as NASA's Technology Utilization Program. But what is most needed here is an imaginative, aggressive market development program to bring out the dormant market for Landsat data which in turn would stimulate more applications development, thus requiring more Landsat data. The stimulus, obviously, must come from private enterprise.

Private Enterprise Versus Federal Government Role

The impetus for moving a Landsat remote sensing system from an experimental to an operational mode appears to be intimately tied to the investment and involvement of private enterprise. The level of investment and involvement by private enterprise will in turn have significant impact on the rate of transition. This is not to say that government should totally remove itself from the Landsat remote sensing program, because the success of operational implementation is still dependent on a joint private/federal relationship.

This shared responsibility is particularly important when the complexity of the Landsat remote sensing system is examined. If a Landsat remote sensing system for convenience is considered to be comprised of three basic parts: (1) data acquisition, (2) data management, and (3) data analysis (Figure 2), the institutional responsibility for various parts changes as the system moves from an experimental to an operational mode.

Traditionally, private enterprise and the federal government are each able to function more effectively and efficiently in certain

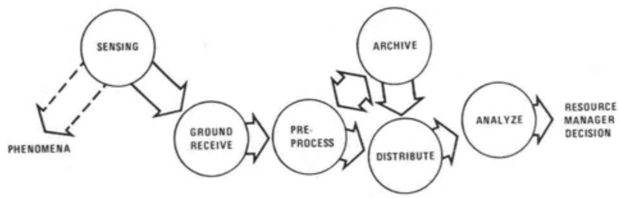


FIG. 2. Components of Landsat remote sensing system.

roles. From one private entrepreneur's viewpoint in an evolving Landsat remote sensing system, these functions can be characterized as shown in Figure 3.

In all three modes, experimental, transition, and operational, the analysis of the data is a shared responsibility involving not only private enterprise and federal government, but state and local governments, universities, and any group or individual wishing to use or apply the data. As the system becomes operational, more and more of the federal government's data analysis may likely be contracted to industry on a service basis since the constraints on manpower are, and will continue to be, severe in line elements of the federal government. This is a cause/effect situation rather than a legitimate transition of responsibility.

Likewise, in all three modes the federal government will continue to have the responsibility to provide a master data archive. This does not preclude private enterprise from the establishment of special archives, possibly as early as in a transition mode, but the federal government must insure the retention of a permanent data record.

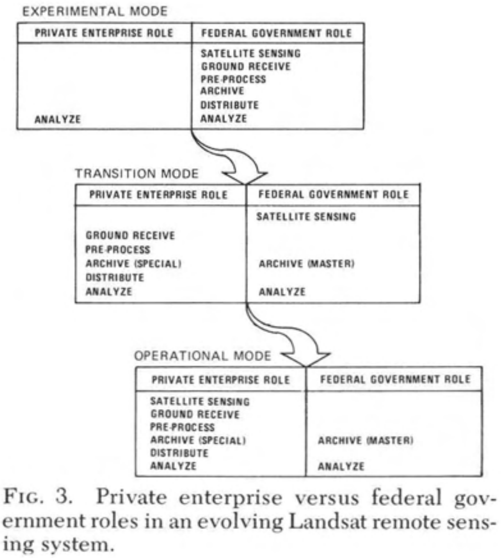


FIG. 3. Private enterprise versus federal government roles in an evolving Landsat remote sensing system.

The transfer of responsibility in the transition mode comes in the data management part with private enterprise stepping into a processing and distribution role. This is a role to which private enterprise can bring certain capabilities to bear that the federal government cannot. For example, data product sales are directly related to the marketing of the products, which is traditionally a commercial function and one industry is geared to perform. Nonetheless, the federal government is in fact providing some marketing service with NASA's technology transfer programs. The transfer of technology in this manner is useful and important and should continue throughout the transition mode; however, industry should accept the prime responsibility for promoting and marketing the data product.

Not so clear is the role private enterprise should have in direct reception of data from government resource-sensing satellites during the transition mode. It is a well established business practice that once a sale is made the sale includes a commitment to deliver both in quality and in timeliness a specified product. Without direct access to the satellite data, private enterprise involved in the data management role may find it impossible to satisfy normal product delivery commitments. With the development, installation, and successful operation of advanced satellite data processors as, for example, the Master Data Processor (MDP) at NASA's Goddard Space Flight Center, the scheduling problem may be less critical; having the federal government continue to receive the data directly and pass it rapidly through the system may be acceptable.

Very clear is the need for the federal government to retain responsibility for the space segment of the system through the transition mode. Most commentators, both private and public, have determined that the market does not exist today, and is not likely to exist for several years, that would justify the private investment in multispectral observatories.

In an operational mode, the principal change would be the transfer of responsibility for the space segment to private enterprise. When in time this occurs is dependent on the maturity of the applications market, likely to occur in the 1980s. At that time, dedicated satellites could be developed and launched and operated by industry, not unlike the communications satellite with data and information services available for all on non-discriminatory access and economic terms.

It is important to note that, beginning in the operational mode time frame, NASA should continue to pursue an aggressive earth resources research and development program comparable to the Nimbus satellite program which supports the operational NOAA weather satellites.

Conclusions

The question of whether or not there is a profitable role for private enterprise in remote sensing from space has been partially answered in the positive. There are substantial arguments that show remote sensing from space will not achieve operational status without industry involvement and investment. The question of whether that involvement and investment will return a profit will depend on intelligent initiatives by private enterprise and a mature cooperation between the private and public participants.

At this point in the maturation of the Landsat remote sensing system, the remote sensing community must guard against the possibility of becoming entrapped in an Alphonse-and-Gaston dilemma. OMB sometimes indicates that without significant industry involvement and investment there will not be a "guaranteed" future space segment. Private enterprise responds that, without government insuring the space segment through the next-generation satellites, there is insufficient market justification for significant investment. Congress emphatically indicates that there is inadequate movement on the part of both government and industry toward an operational system and introduces legislation suggesting the establishment of a "chosen entity."

It is in this critical crossroads decision time frame that private enterprise initiative could force the system into a transition mode by becoming involved and risking sufficient capital to develop a future business in operational remote sensing from space. This action also would demonstrate private enterprise's belief that resource remote sensing data is potentially beneficial to all mankind and should be made operationally available at the earliest possible time.

Call for Papers

International Symposium on Interaction of Marine Geodesy and Ocean Dynamics

Miami/Virginia Key, Florida October 10-12, 1978

The Symposium, sponsored by the Battelle Columbus Laboratories, the University of Miami's Rosenstiel School of Marine and Atmospheric Science, the Atlantic Oceanographic and Meteorological Laboratories of NOAA, the International Association of Physical Sciences for the Oceans, the American Geophysical Union, the Marine Technology Society, and the International Association of Geodesy, will cover the following topics:

- Nonperiodic aspects of ocean positioning: geoid, tsunamis, sea floor spreading, plate tectonics, etc.
- Dynamic aspects of ocean positioning—I: long period and quasi-geostrophic period (more than 48 hours).
- Dynamic aspects of ocean positioning—II: tidal/inertial period and sea swell period (less than 48 hours).
- Metrology/instrumentation.
- Applications: ocean surveys/mapping, navigation.
- Workshop on ocean tides.

Those wishing to present papers should send an abstract, not exceeding 250 words, by March 24, 1978, to

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