STATEMENT OF

DR. ARTURO SILVESTRINI
PRESIDENT AND CHIEF EXECUTIVE OFFICER
EARTH OBSERVATION SATELLITE COMPANY

SUBMITTED FOR THE HEARING ON

THE LANDSAT PROGRAM: MANAGEMENT, FUNDING, AND POLICY DECISIONS

BEFORE

THE COMMITTEE ON
SCIENCE, SPACE, AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES

26 NOVEMBER 1991

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INTRODUCTORY COMMENTS

Thank you Mr. Chairman and Members of the Committee. It is a pleasure to appear before the Committee on behalf of EOSAT to share with you our views on the National Land Remote-Sensing Policy Act of 1991 (HR 3614) and the future of the Landsat commercialization process.

Let me begin by stating EOSAT's appreciation for the long-standing interest that the Committee has shown in the Landsat program. Had you not shown such strong support over the years, it is doubtful that there still would be a Landsat program for us to discuss the future of today. Moreover, the introduction of HR 3614 demonstrates that the Committee is aware that the future of America's land remote-sensing program must be guided by current circumstances rather than those that prevailed in the early 1980s. We are especially pleased that HR 3614 recognizes the urgency of beginning work on Landsat 7.

Like HR 3614, EOSAT is committed to maintaining America's technological lead in land remote-sensing. For this reason, we are eager to work with the Committee and the other individuals and organizations represented here today to ensure that the bill is backed by a careful analysis of the history of the Landsat program and of the current circumstances in which commercialization is taking place. We are confident such cooperation will lead to a bill that ensures retention not only of America's technological superiority in land remote-sensing, but also of its commercial competitiveness.

COMMERCIALIZATION IS A PROCESS

Central to the analysis that I will present today is a recognition that the Land Remote-Sensing Commercialization Act of 1984 (PL 98-365) established a phased commercialization process designed to gradually transfer Landsat to the private sector while ensuring data continuity for 6 years beyond the practical demise of Landsat 5 with two additional satellites, Landsats 6 and

- Expansion of the product line.

  In order to tailor products to the needs of users, EOSAT has expanded the digital product line beyond the single computer compatible tape (CCT) format that was on Landsat's shelf in 1985. These new formats include floppy disks and, most recently, 8mm cartridges that hold as much data as ten CCTs. Other EOSAT marketing innovations include "floating" scenes that enable customers to set the boundaries for a scene or subscene that bridge the boundaries of standard scenes and thus reduce the number of scenes that must be purchased to cover a desired geographic location.

- Technical support, training, and other services to support current users and encourage wider use of Landsat data.

  EOSAT distributes nearly 60,000 technical and application user notes worldwide each year to assist in the education of the remote-sensing community. EOSAT also holds applications and training seminars (on such topics as global change research) in North America, Europe, and the Third World. In addition, all of our customers receive personal contact and assistance in applications and training through our sales and support staff. EOSAT has 7 regional sales managers to support the North American market and 30 representatives in 25 countries outside North America. This marketing staff is backed up by an applications/training office and a 10-person customer service office. The results of these support services and market development efforts are reflected in my next point:

- Expansion of the market with lessened dependence on purchases by the federal government.

  EOSAT's marketing efforts have tripled the number of users worldwide purchasing Landsat data. In the last 18 months, over 100 first-time users have been added in North America alone. This market expansion has reduced EOSAT's dependence on sales to the federal government. While the federal government accounted for 60.4 percent of EOSAT's revenues from data sales in 1986, it accounted for only 44.2 percent in 1990. The federal government will always remain a key segment of EOSAT's market, but the viability of the commercialization process depends on market expansions like the one already realized.

- Private investments in support of Landsat.

  EOSAT has invested in private facilities that are preparing the way for full commercial operations. In August of this year, we began work on the new ground station in Norman, Oklahoma. EOSAT and its parent companies also provided approximately 14 percent of the construction costs of Landsat 6, thus ensuring that the satellite would be delivered at a fixed cost to the government.

- Responsiveness to national security needs.

  The usefulness of Landsat data for U.S. forces and allies in the Persian Gulf war demonstrated that commercialization of Landsat is fully compatible with our national defense needs.

economic competitiveness of the Landsat system. EOSAT believes that these goals can be most effectively achieved by a continuation of the public/private cooperation that is the basis of the commercialization process. Commercialization remains the best course to ensure that Landsat does not become a burden to taxpayers and thus a victim of budget austerity as it almost did in 1989. The commercialization process, of course, is aimed at relieving the federal government of all financial responsibility for Landsat, and the cost savings already effected by EOSAT are the first fruits of this process. Next year EOSAT will pick up an even larger share of the burden when it assumes responsibility for the operating costs of Landsat 6.

More than cost savings, however, commercialization is also the best means to ensure broad use of Landsat data and retention of America's technological lead in land remote-sensing. As a commercial entity, EOSAT has a direct interest in providing services, products, and technical advice that educate users to the potential usefulness of the data and respond to their specific needs. HR 3614 recognizes the ability of the private sector to carry out these functions more effectively than the government and thus mandates that "commercial marketing and distribution of land remote-sensing data ... remain exclusively the function of the private sector." Government agencies are no less in need of such support and market development, however, than are private businesses. Thus EOSAT believes that the language of HR 3614 should reflect the essentially commercial nature of purchasing and procurement transactions of government agencies.

Despite this general consensus that commercial marketing and distribution remains the best way to ensure the broad use of Landsat data and apportion the costs fairly among those who directly benefit from the system, legitimate questions have been raised regarding the short-term compatibility of Landsat commercialization with the public good. These questions center on data availability and access and the preservation of America's technological leadership in land remote-sensing. We believe that a careful examination of the impact of commercialization can lay these concerns to rest.

Data Availability

Data availability is a function of data acquisition policy and can be viewed from two perspectives:

1) What and how much data did we collect in the past (i.e. what is in the archives) and

2) What and how much data are we collecting now (i.e. what are current acquisition rates and policies).

Researchers have been dismayed to discover that Landsat archives do not have full global coverage and fear that an insufficient number of data scenes are being collected under current acquisition policies. Archiving policies of the federal government antedate commercialization and the existence of EOSAT, but are important to look at since the establishment of a baseline will help us recognize what is the result of commercialization and what is not.

Contents of Archives

The absence of full global coverage in Landsat data archives reflects the data acquisition and archiving policies of the various government agencies responsible for Landsat since its inception. During the years of government operation, acquisition policy focused on coverage of the lower 48 states: U.S. Government agencies neither sought nor were instructed to systematically collect and archive global data sets. (The international ground stations, of course, did collect and archive data of interest to themselves.) These policies, or lack thereof, long antedate Landsat commercialization, so it is clear that the commercialization process played no role in our collective failure to anticipate the needs of global change research.

investment. Thus after assuming control of Landsat marketing in September 1985, EOSAT immediately cut prices on digital data.

Under these circumstances, commercial pricing is an approximation of a free-market price, which is the normal mechanism that a market economy uses to prevent wasteful use of resources. It is only an approximation, however, since all satellite land remote-sensing systems are currently subsidized by their home governments. Such subsidies are not necessarily wasteful, but when governments bypass the normal mechanism to prevent waste, they must do so with great care. Thus in modifying Landsat's traditional nondiscriminatory pricing policy, as does HR 3614, we must first discern the nature of the problem we seek to resolve, avoid subsidizing uneconomical uses of data, and prevent the unintended creation or heightening of other barriers to access.

Causes of the Declining Sales to Academia

Since declining purchases of Landsat data by academia stands at the heart of debate over commercial pricing and access, this trend deserves particular attention. A year-by-year analysis makes it difficult to blame commercial pricing for this decline, which largely occurred before the introduction of commercial prices for digital products by the National Oceanic and Atmospheric Administration (NOAA) in 1983 and for photo products by EOSAT in 1985. Thus other causes must be considered.

Our analysis, presented in Appendix II (see especially Charts 1 through 4), of the number and type of items purchased by academic institutions leads to several tentative conclusions. First, purchases are highly dependent on federal grants. Second, practitioners of photo analysis appear to be especially sensitive to subsidies, price, and the availability of grant money. Unable to afford or unwilling to make upfront investments in computer hardware, they also appear unable to pay the production costs associated with generating photo products. Third, digital users, having made investments in hardware, appear to have been less affected by the ending of NASA's research and grant programs and by the introduction of commercial prices. Either they have had alternate funding sources or have been willing to spend their own money to buy data to utilize existing hardware investments. At the same time, however, their purchases have not been stimulated by price reductions. The relatively flat digital sales figures would indicate that new academic users are not entering the market despite significant reductions in hardware costs. This probably reflects a lack of funding from both federal and state agencies during the fiscally tight 1980s for the purchase of both computer processing equipment and data. Finally, the analysis suggests that the commercialization process itself has not caused sharp reductions in the researchers' access to data compared to the 1970s.

Ways of Stimulating Research

The conclusions derived from purchases of Landsat data by academic institutions can help us shape HR 3614 so that it effectively achieves its goal of facilitating researchers' access to Landsat data in general and global change research in particular. The inclusion of a research grant program would seem to be fundamental. Researchers conduct research on a given topic because some institution or government agency believes such research to be important and is providing funding, not simply because data sets are cheap. Moreover, a grant program based on peer review of the importance and relevance of the proposed research is probably a more cost-effective use of federal research dollars than is subsidizing data production, as the government did with photo products through 1985.

Our effort to stimulate research must also address four specific weaknesses of HR 3614. First, international cooperation has long been a cornerstone of the Landsat program, but as currently worded, HR 3614 includes no provisions to improve the access to Landsat data of researchers outside the United States.

and use Landsat data because it enables them to carry out their respective missions in a more cost-effective manner than other alternative sources of information.

Since EOSAT believes that government agencies will buy Landsat products when they are convinced of their economic utility, we see inadequate product awareness and questions centering on rights of use as the main barriers limiting use by government agencies. I have already discussed the market education, training, and support services offered by EOSAT and aimed at market development, so I would like to address the issue of rights of use.

In order to protect its market, EOSAT requires customers to sign a trade secret agreement preventing release of the raw data sold to each customer. The practical impact of this agreement on government agencies has been to limit their ability to share the data with other, related agencies. To obtain the same data, each agency has had to make its own purchase. Thus the need for multiple purchases of the same data, not the price per se, has been the stumbling block. State government agencies and the Department of Defense have been particularly affected by this. HR 3614 is thus on the right track with its authorization for government agencies to share or sell their unenhanced data for noncommercial use. Care must be taken, however, that "noncommercial use" and "unenhanced data" are defined in a way that is neither too broad nor too narrow. If these terms are defined too broadly, government agencies could be prohibited, for example, from selling to commercial entities maps derived from unenhanced Landsat data. If they are defined too narrowly, government agencies and other nonprofit institutions could compete unfairly with the value-added industry by commercially selling enhanced data products.

EOSAT is already actively addressing the problem of government agency access identified by HR 3614. We have, for example, introduced a Statewide Coverage Program to eliminate the need for duplicative purchases by state agencies. Under this program, a state buys coverage of the entire state, and all state agencies can then utilize the data for state-authorized programs. So far, ten states have purchased statewide coverage and six other states have purchases pending. We believe that the improved access to data by the agencies in these states will promote use not only in those states, but in the other 34 states as well when counterpart agencies see the demonstrated utility of Landsat data to their respective missions. Moreover, most states using Landsat data rely on local universities to process the data. Thus the Statewide Coverage Program has the added advantage of providing data to universities for teaching and research purposes.

EOSAT has proposed an even more extensive support program for the Department of Defense, which would include upgrades at the Norman, Oklahoma, Ground Station and more liberal data-use policies.

Role of the Value-Added Sector

The important role of the value-added firms in promoting data use should not be overlooked. Although EOSAT does provide customer support services and technical support, we sell only unenhanced data. While advances in computer technology have placed computer analysis and manipulation of data within reach of many data users, the value-added sector still plays a key role in research applications and development of software and other products.

As I have stated above, HR 3614's language regarding "noncommercial use" and "unenhanced data" must be very carefully drafted to avoid creating unfair competition for this dynamic sector of the remote-sensing industry. As currently worded, the proposed bill prohibits the commercial use only of *unenhanced* data sold to nonprofit entities. This suggests that a nonprofit institution could purchase unenhanced data from EOSAT, process the data, and sell the resulting *enhanced* data as a commercial product in direct competition with the value-added companies. If the bill contains no safeguards against this possibility, private firms will not be able to compete against the nonprofit institutions and will be driven out of business. As important as

the lure of improving Landsat's competitive position with experimental sensors that might delay the launch. Because Landsat is an operational system on which many users depend, use of it to demonstrate and prove new technology must not interfere with operational users.

- Incorporate advanced sensors into Landsat 7.

  While we believe that the Landsat-6 design incorporates significant advances improving Landsat's competitiveness, and that risky technology should be avoided, EOSAT sees the possibility of including some advanced sensors on Landsat 7. The nature of such sensors will obviously be determined by discussions among the various interested parties, especially NASA and the Department of Defense, to define the needs of users. We will keep the Committee apprised of progress on this issue.

- Institute a technology demonstration program.

  EOSAT believes that technological advances will play a key role in the ultimate success of Landsat commercialization. Many of the pessimistic appraisals of commercialization assume that Landsat satellites will continue to resemble the large satellites that have characterized space technology to this point. While it is too soon to make a generational change for Landsat 7, technological advances hold great promise for future follow-on systems. The type of technology demonstration program mandated by HR 3614 is fully consistent with the research role assigned the federal government in support of Landsat commercialization under PL 98-365.

Competitiveness of the Landsat System

International competitiveness depends not only on technology but on consistent government policies that foster new industries. The American public is not well served when government-financed technological research and development efforts become the basis for the commercial success of foreign companies. EOSAT is confident of Landsat's ability to compete technologically against foreign land remote-sensing systems, including SPOT. We are also confident that these hearings and the discussion of the Landsat program they have engendered will lead to policies that foster a competitive, commercial remote-sensing industry in the United States.

Landsat vs. SPOT

EOSAT's 1984 commercialization proposal foresaw that the Landsat system (i.e. Landsats 4 and 5) for which we were competing, and which we hoped to inherit from NOAA, would not be fully competitive with the about-to-be-launched SPOT system with its 10-meter resolution and stereoscopic capabilities. Thus our early sales projections and marketing plans fully anticipated the strong growth that SPOT has achieved. Such rapid growth is typical when a new technology is introduced to meet needs unsatisfied by existing technology—we expect equally strong enthusiasm in the market for Landsat 6's 15-meter panchromatic band. What we did not anticipate is that so many years would pass before America would be able to launch its response to SPOT, i.e. the Enhanced Thematic Mapper on Landsat 6. Currently, the launch of Landsat 6 is expected in 1992.

Given the long delay in the launch of Landsat 6, what is surprising is not that worldwide SPOT revenues have managed to edge out worldwide Landsat revenues, but that the Landsat system has remained so highly competitive years beyond its design life. Contrary to other published statistics, Landsat's competitiveness can be readily confirmed by examining worldwide revenue figures for the two systems (see Appendix II).

APPENDIX I

ANALYSIS OF DECLINING LANDSAT SALES TO ACADEMIA

Methodological Problems of EROS Records on Landsat Sales

The following analysis of declining Landsat sales to academic institutions is based on information from the Eros Data Center. Three important limitations imposed by EROS's records should be noted:

1) The EROS Data Center records "items" distributed, not scenes.

For photo products, an item is one frame. One multispectral scene can generate one black-and-white photo (or frame) for each band (for an MSS data scene, four; for a TM data scene, seven). Multiple color photos can also be generated from one scene by selecting any three bands or three sets of ratios between bands. For digital data, an item is one computer compatible tape (CCT). EROS ships a complete MSS data scene on one CCT, but a TM scene is broken into quadrants and shipped as four CCTs. The relationship between scene and item is also confused by the sale of data in units less than a full data scene (i.e. 31,450 square kilometers)—customers can buy subscenes, quarter scenes, and mini-scenes rather than full scenes. These purchases are logged in EROS records according to the number of photos or CCTs (i.e. items) needed to fill the order.

2) FY 1976 comprised 15 months.

EROS data series are recorded by fiscal year. In 1976 the federal government shifted from a July/June fiscal year to an October/September fiscal year. To accomplish this, FY 1976 was lengthened by 3 months. Thus the unusually high item distribution in 1976 is partly the result of the length of FY 1976.

3) Only direct sales to academic institutions are recorded.

The figures kept by EROS tend to understate academia's access to Landsat data because EROS records only direct sales to academic institutions. EOSAT knows, however, that under our Statewide Coverage Programs, eleven of the sixteen states that have purchased statewide coverage or are planning such purchases rely on local universities to process the data. As a result these universities have data for educational purposes and research projects. Such academic access, which is not reflected in EROS's distribution figures, will increase as more states take advantage of the Statewide Coverage Program.

> NASA's technological interests, which did not always match the needs of the potential users. ...
>
> The operational bureaus of the Department of Agriculture were not impressed with the results of LACIE and did not adopt the system for predicting yields developed in the project. The Department chose not to adopt the LACIE system because it had not been designed to suit the needs of an agency and because of concerns about the costs of the LACIE system.[2]

Given the scale of LACIE, the ending of the program clearly would have led to decreases in university purchases funded by the project.

NASA's University Grants Program, which existed from 1972 to 1982, had a different impact on academic purchases of Landsat data:

> [Under the University Grants Program in applied remote-sensing,] earth science and natural resources faculty in universities around the nation were awarded renewable grants-in-aid to serve in their states as focal points for educating and rallying the user community. The objective of the program was for NASA to provide seed money to stimulate and inspire state and local government agencies' use of satellite data. ...
>
> ... Few of the project demonstrations resulted in the adoption of satellite techniques on an operational basis.[3]

From this brief description, and even without considering yearly funding levels of the NASA grant program, we can readily understand the reasons sales levels were not sustained over the long run:

- Over-enthusiasm on the part of some investigators resulted in setting unrealistic goals and hence promising more than the technology could provide; and the ancillary situation where agency personnel, once stimulated, quickly oversubscribed to actual vs potential technical capabilities. Results seldom matched expectations.
- Coarse spatial resolution and spectral coverage of then existing systems presented a mismatch between what could be delivered by way of a reliable and replicable product, on the one hand, and what was needed to fulfill mandated requirements on the other;
- Data delivery and distribution problems frequently led to project delays, inefficient use of agency personnel in the field, and sometimes to project abortion if it were one that was highly sensitive to timing. Agencies sometimes felt that they had become research assistants to the university or that they were seduced into additional work having no foreseeable pay-off;
- Failure, in general, of project scientists to be knowledgeable about or concerned with, the social, political, legal, and economic constraints hindering the adoption of new technology. This is not to malign the integrity of these professionals but, rather, to emphasize that the program was designed and implemented as a technical awareness program to increase the number of users. It was not designed to solve their local institutional, political, and economic issues;

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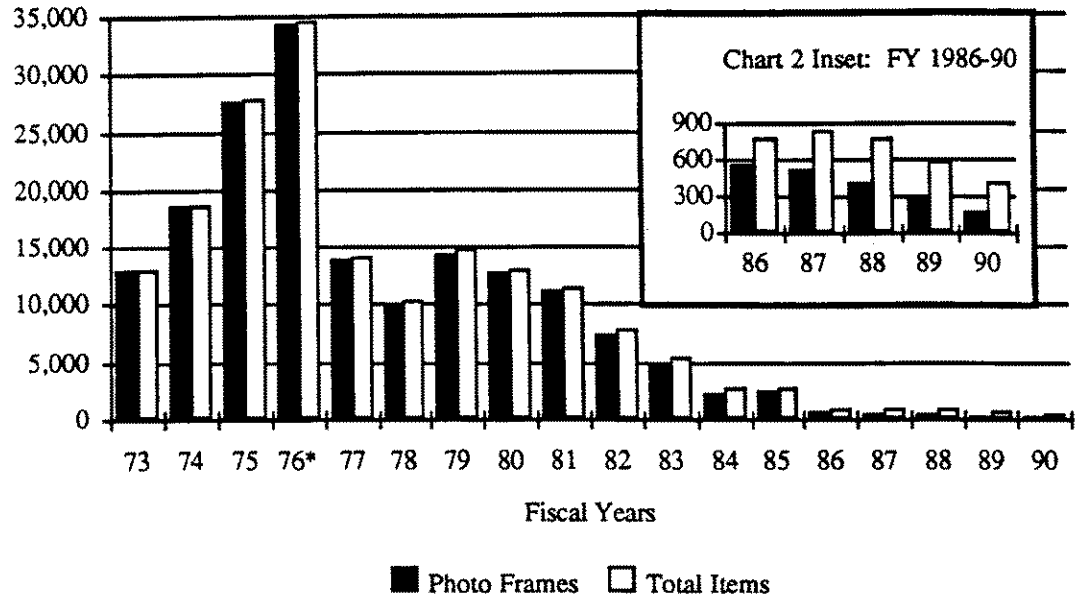
[2]Pamela E. Mack, *Viewing the Earth: The Social Construction of the Landsat Satellite System* (Cambridge, Mass.: MIT Press, 1990), pp. 151 and 155.

[3]Stanley A. Morain and Pitt G. Thome, *America's Earth Observing Industry: Perspectives on Commercial Remote Sensing* (Hong Kong: Geocarto International Centre, 1990), pp. 17-18.

Chart 2
Purchases of Landsat Items† by Academia Fiscal Years 1973-1990
Photo Frames vs. Total Items



†See discussion of "item" vs. "scene" on page 13 of this paper.
*15-month fiscal year reflecting the shift from July/June to Oct./Sept. fiscal year.

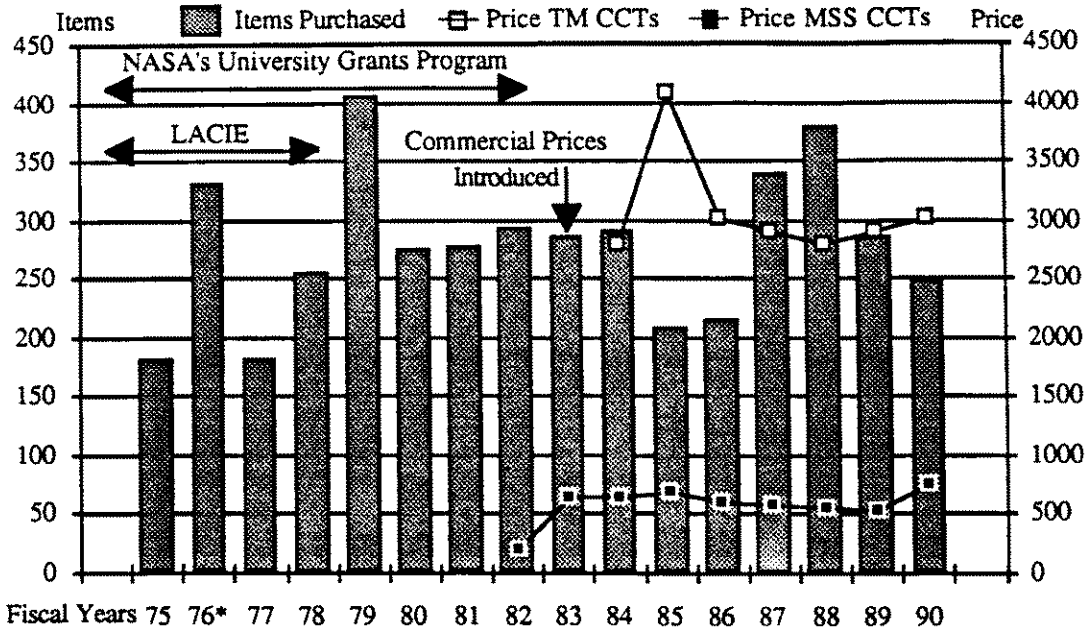
Source: EROS Data Center. "Annual Report of Landsat Data Services, FY 1990."

Chart 2 disaggregates the information from Chart 1 and shows the number of photo frames purchased by academic institutions compared to their total purchases of Landsat items. Through 1985 their purchases are overwhelmingly dominated by photo products. Even allowing for the inflation in the number of items purchased caused by the number of photo frames that can be generated by one data scene, we can infer some useful conclusions from this situation. Photo analysis can be taught and practiced with very low investments in equipment. Digital analysis in the 1970s, however, required investments in computer hardware on the order of $.5 million.[6] Most academic institutions using Landsat data apparently did not or could not make such investments. Their demand for data declined even during the years of the NASA grant program, and dropped sharply when that program ended. The introduction of unsubsidized prices for photo products in late 1985 contributed to another sharp decline in the already low number of photo items purchased.[7] Without impugning the merits of research performed through photo analysis, one can note that digital analysis using a computer is far more versatile. With hardware costs significantly

[6]Ibid., p. 144.

[7]Production of a photo product requires the processing of the underlying digital data in order to produce a transparency. During the years the government operated Landsat, this production cost was absorbed by the government, and the customer was charged only for the cost of reproducing a print from the transparency. Since late 1985, customers pay the full cost of generating and printing the photo.

Chart 4
Purchases of Landsat Digital Items† by Academia
Fiscal Years 1974-1990
with
Overlay of Constant Dollar Prices‡ for TM CCTs and MSS CCTs
Fiscal Years 1982-1990



†See discussion of "item" vs. "scene" on page 13 of this paper.
‡1982/84=100.
*15-month fiscal year reflecting the shift from July/June to Oct./Sept. fiscal year.

Source: EROS Data Center. "Annual Report of Landsat Data Services, FY 1990."

Chart 4 shows sales of digital items to academic institutions. Unlike sales of photo products, sales of digital items have not been strongly affected by the end of the NASA grant program,by the introduction of commercial prices in 1983, or price reductions made by EOSAT in late 1985. It is too early, however, to say whether the reduction of prices for MSS data older than 2 years to the cost of reproduction and transmission that occurred in 1990 is stimulating purchases by academic institutions.

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