1976

CHRONOLOGY OF EVENTS

- Sept. 21, 1966 - Secretary of the Interior announced the establishment of the Earth Resources Observation Satellite (EROS) Program. (The name of the program was later changed to Earth Resources Observation Systems Program)
- Oct. 21, 1966 - Interior Under Secretary Luce provided specifications to NASA for the first Earth Resources Survey Satellite to meet needs of Interior and other resource agencies.
- July 12, 1967 - Memo from Under Secretary Luce to Assistant Secretaries and bureau heads establishing the EROS Program.
- FY 1969 - NASA obtained approval and funds to start the Earth Resources Technology Satellites (ERTS) A and B.
- FY 1969 - First EROS Program direct appropriations.
- Dec. 10, 1970 - USGS requested permission to distribute NASA aircraft and ERTS imagery to the general public.
- FY 1971 - Interior appropriation bill provided $4.9 million including ". . . an increase of $300,000 for development of a central data reception center." OMB impounded $3.0 million of the signed appropriation which effectively delayed beginning the EROS Data Center and adversely affected USDI coordination with NASA, whose Earth Resources Program was not cut.
- October 1971 - EROS Data Center prepared for initial operation at temporary location at Sioux Falls, South Dakota.

- Mar. 9, 1972 - NASA accepted USGS offer to distribute experimental aircraft and space acquired imagery.
- 1972 - Initial sale of data from the EROS Data Center in temporary location.
- July 22, 1972 - ERTS-1 launched from Western Test Range.
- July 25, 1972 - EROS Data Center began receiving, processing, and distributing ERTS images.
- 1973 - Interior requested funding (with agreement from NASA, Agriculture, Commerce) for FY 74 to initiate ERTS-C. Request was not approved.
- August 1973 - Official dedication of EROS Data Center at new facility north of Sioux Falls, South Dakota.
- January 1974 - Operation of EROS Data Center in new facility.
- FY 1974 - Congressional authorization to NASA for ERTS-C.
- FY 1975 Budget approved for NASA funding of ERTS-C (Presidential Decision).
- January 1975 - Name of ERTS changed to Landsat.
- January 23, 1975 - Launch of Landsat-2.
- 1974-1976 - Joint NASA-Interior technical planning of advanced Landsat data distribution system to improve quality and reduce time.
- Spring 1975 - FY 1976 approval and funding of NASA portion of advanced digital data processing system.
- Fall 1975 - FY 1977 Interior request for digital system denied by OMB.

° Fall 1975 - FY 1976 Interior request for increase denied.

° December 1975 - FY 1976 & Transitional Quarter Congressional add-on of $2.5 million to initiate Interior portion of digital data processing system.

° February 5, 1976 - Senator Moss question, "What Federal institution arrangements does your agency suggest for an operational Landsat capability? Included in the response should be arrangements to insure continuity of data as well as validation of the operational concept."

° March 1976 - Letters from Administrator of NASA to Secretaries of Interior, Commerce, Agriculture, and Chief, Corps of Engineers relative to:

- Support of agencies for follow-on Landsat system with FY 1978 new start
- Concept of Interagency Decision Team and Interagency Decision Team Working Group.

DEFINITIONS

° Approved Landsat program is the current funded program that consists of Landsat-1 and -2 that are in orbit and were launched on July 21, 1972, and January 22, 1975, and Landsat-C that is scheduled for launch late in CY 1977.

° Landsat Follow-on program is the program that is being defined and justified at the present time. (Budgetary approval in FY 78 will be required if a data gap of several years in the early 1980's is to be avoided.)

° Space Segment is the portion of the system that consists of spacecraft, imaging systems, launch and checkout of spacecraft, operation of spacecraft in orbit, data acquisition, and initial data processing. (NASA plans to assume responsibility for this portion of the program during the early 1980's.)

° Ground Segment is the portion of the program that provides for data storage, reformatting for specific users, and data distribution. This is an area where Interior is the leader at the present time. DOI's position is that a multiagency funding approach will be necessary for Interior to continue this role in future Landsat programs. This is a major issue for consideration by the Interagency Decision Team.

COST RECOVERY

International considerations

EROS Data Center pricing policy goals are based on recovery of the cost of materials, labor, certain computer support services, and amortization of equipment to produce the data products. Current prices are the same for data products from Landsat and similar format products from aircraft.

Foreign Landsat reception stations and data distribution organizations have complained about the low prices from the EROS Data Center. These complaints have become stronger since NASA has informed the foreign stations that the U. S. will charge $200,000 a year for their participation in the program. The cost of data from foreign sources will be even higher if the cost of reimbursing the U. S. is passed on to purchasers of data.

Operators of some foreign stations would like the EROS Data Center to refer all orders and requests for information for foreign data within their areas of coverage to them. This would be a violation of the Freedom of Information Act. The EROS Data Center is willing to inform customers of the availability of data from foreign sources, but plans to fill valid orders when the data requested are part of the EROS Data Center's holdings.

The EROS Program plans to increase the price of Landsat data in October 1976. Comparably sized aircraft and satellite photographic products will no longer have the same prices; this will make it possible to recover more of the true operating costs related to satellite data preparation and distribution. An additional price increase will occur in January 1978 when the Landsat digital processing capabilities become available and the quality of the data is markedly improved.

Full or partial recovery of costs

Recovery of the costs for the total system will require either a very large volume or a very high price during the first few years of the Landsat follow-on program. Partial recovery rather than total recovery may be the most realistic approach.

Standard prices

The Government organizations that sell Landsat data are Interior through the EROS Data Center, Agriculture through the ASCS laboratories, and Commerce through a contractor to NOAA. The volume of sales through Commerce and Agriculture has been small (about 10%) compared to data sales by Interior.

The price of photographic Landsat data from each of these sources has been adjusted to be equivalent to comparably sized aircraft products. This has led to prices that are too low for Landsat data. Interior will probably increase the price for

Landsat data in October 1976 and separate the price of Landsat data from the aircraft photographs. At the present time, Interior and Commerce prices are the same except for the size of products or when special enhancements for water features are required. Prices charged by NOAA are lower than those charged by Interior or Commerce. Preliminary discussions with ASCS and NOAA indicate that they will consider similar price increases. A uniform price policy for Landsat photographic products needs to be agreed to and implemented as soon as possible.

INTERAGENCY COORDINATION--TECHNICAL PLANS

Technical plans between Interior and NASA have been closely coordinated for a number of years. Examples are:

The basic specifications for Landsat-1 and -2 were developed by the Departments of Interior and Agriculture and submitted to NASA by Interior Under Secretary Charles F. Luce on October 21, 1966.

Interior was a major participant with NASA and other agencies in evaluating proposals for Landsat-1 (ERTS-1) and in formulating the investigative program that resulted from these proposals.

Technical plans for an all-digital data processing system at NASA-Goddard Space Flight Center and the EROS Data Center were worked out in detail between the NASA and EROS Program offices.

Initially, the EROS Program planned a direct reception capability for Landsat at the EROS Data Center. Subsequent decisions in the early 1970's by the Federal Communications Commission to license companies to provide domestic communications satellite (DOMSAT) services within the United States and successful implementation of these capabilities led to reconsideration of the most effective approach to rapid data availability at the EROS Data Center. The present concept is for NASA to use DOMSAT capabilities to transmit raw data received from Landsat at their Fairbanks, Alaska, and Goldstone, California, stations to Goddard Space Flight Center (GSFC). These data would receive initial

processing along with directly received data at GSFC. The initially processed data (including radiometric corrections and coefficients for geometric corrections) would be transmitted to the EROS Data Center by DOMSAT for storage and further processing into formats compatible with user needs. The advantage of using DOMSAT is that data could be moved rapidly and be available to the user within 2 to 7 days after acquisition rather than the 6 to 10 weeks that is customary at the present time. Use of DOMSAT would also make it possible to process and distribute Alaska data rapidly. NASA is in the process of implementing the first steps toward a DOMSAT capability between Fairbanks, Alaska, and GSFC. Initially this communications link will be used for meteorological data but can be upgraded for Landsat. Multiagency participation in implementing a DOMSAT capability is essential. The method of funding and schedule for implementation need early consideration by the IDT.

Current discussions with USDA indicate that the planned EROS Digital Image Processing System (EDIPS) could satisfy most of the Large Area Crop Inventory Experiment (LACIE) processing requirements. The time requirements for LACIE would require the use of a DOMSAT data transmission system because fully processed Landsat data must be available to the LACIE program within 2-5 days after acquisition.

NASA technical plans for the Landsat follow-on program were presented to Interior and other agencies in late 1975. A number of technical factors did not appear appropriate to scientists within the Department of the Interior. A summary of these concerns was transmitted to NASA on February 25, 1976. Subsequent studies and re-evaluations by NASA are resolving most of the areas of concern.

RAPID DATA AVAILABILITY

Background

"Quick look" is the capability to rapidly (within 24-48 hours) process Landsat data and provide it to the users. These data do not receive the full processing applied to standard Landsat products but are of good enough quality to permit use for a number of time-critical purposes. A quick-look capability can be available at the EROS Data Center through combining the capabilities of the EROS Digital Image Processing System (EDIPS) and a Domestic Communications Satellite (DOMSAT) data link. The cost of adding DOMSAT to EDIPS will be $1 to $1.3 million for the first year and $600 K recurring costs. A DOMSAT communications link would also speed up the data throughput for standard products.

Needs and lack of U. S. capabilities

Canada constructed a "quick look" capability at their Landsat reception station at Prince Albert, Saskatchewan. Other nations that have constructed or are planning Landsat reception stations have included this capability. The United States is the only nation with Landsat reception stations that cannot provide "quick look" data.

Some areas of the U. S. can be covered from the Canadian "quick-look" facility. For example, the USGS obtained Canadian data to study the Susquehanna River flooding in 1975, and Chevron Oil Company acquired

Canadian data over the eastern part of the Beaufort Sea to support their over-ice seismic surveys during the late winter and spring of 1976. As Chevron and other petroleum exploration companies work farther to the west in the Beaufort Sea, they will be out of reception range of the Canadian station.

Examples of applications where "quick look" data are needed include:

1. Measurement of areal extent of snow for timely prediction of runoff in hydroelectric catchments,
2. Measurement of areal extent of snow for timely prediction of flood hazards associated with rapid melting of snowpacks,
3. Rapid identification and mapping of areal extent of floods,
4. Rapid regional assessment of range grass conditions,
5. Timely crop inventory to supplement slow conventional crop reporting techniques,
6. Direct observation of marine oil spills and waste dumps and observing the movement of these features,
7. Observation and location of sea ice and open water in the U. S. Arctic as aids to navigation and oil exploration.

Use of Domestic Communications Satellites

Transportation of data by aircraft introduces several days' delay in the availability of data to users. This has not been a significant factor in the past because processing facilities at the Goddard Space

Flight Center (GSFC) required more time than was used for transportation. The new Master Data Processor at GSFC and the EROS Digital Image Processing System at the EROS Data Center (EDC) will be able to process data much more rapidly. These systems will be in operation in January 1978. At that time the 7 to 10 days used in air transport will be the major factor in time delays between data acquisition and delivery.

Domestic Communications Satellites (DOMSAT) are capable of rapid transmission of Landsat data from Fairbanks, Alaska, and Goldstone, California, to GSFC. The same satellite transponder can be time-shared for retransmission of data that has been processed at GSFC to the EROS Data Center. A capability would also be available to select particular portions of the data at the EROS Data Center, format the data according to user requirements, and retransmit the data to these users through DOMSAT. An example of this type of service would be to support the Department of Agriculture Large Area Crop Inventory Experiment (LACIE). Technical discussions between USDA, USDI, and NASA are exploring the possibility of meeting USDA requirements through this approach.

Implementation of a Domestic Communications Satellite capability, with Interior as one of the participants, is critical to decisions that must be made by the Department of Agriculture. If Interior participates in the DOMSAT capability, Agriculture may choose to use Interior's processing capabilities to accomplish their mission. This would assure

a large volume of data production that would be a significant factor in covering Interior cost of operation and equipment amortization. If Interior does not participate in the DOMSAT data transmission, Agriculture will be forced to duplicate many of the capabilities that are being implemented at the EROS Data Center.

Methods of solving the problems of funding DOMSAT data transmission and the role of Interior in participating in the use of DOMSAT capabilities need immediate attention by the Interagency Decision Team.

ROLE OF EDC IN THE CURRENT LANDSAT PROGRAM AND FOLLOW-ON SYSTEM

Background

In 1972, following the launch of Landsat-1 (formerly ERTS-1), the following organizations were involved in data distribution:

NASA - direct distribution to principal investigators,

Interior/EROS - sale of data to Interior-related users and general public,

Agriculture/ASCS - sale of data to agricultural users,

Commerce/NOAA - sale of data to oceanographic and meteorological users.

In 1975, NASA terminated their direct distribution of data to principal investigators and provided funding to EROS, ASCS, and NOAA to provide imagery data to investigators. In addition the EROS Data Center provides all computer compatible tapes of Landsat, and Skylab data and film copies of aircraft imagery to NASA principal investigators.

The dollar value of data produced by the EROS Data Center has had the following history:

FY	Aircraft	Spacecraft	Total
1973	$144,676	$ 229,642	$ 374,318
1974	237,332	599,415	836,747
1975	566,806	1,043,036	1,609,842
1976 (est)	920,000	1,860,000	2,780,000

The volume of business in NOAA and ASCS for space data has been small.

Current status

Plans for an all-digital data processing system were presented by NASA and Interior at an Interagency Decision Team Working Group meeting during the fall of 1975. Reactions by other agencies were:

Agriculture - uncertain of method of operation but wanted high density digital data for direct input to Large Area Crop Inventory Experiment (LACIE).

NOAA - planned to obtain photographic data with special processing from Interior for reproduction and sale to oceanographic and meteorological community.

Corps of Engineers - planned to use high density digital data.

Near-term future 1978 - 1980

The EROS Data Center is the only facility that will be equipped to accept the NASA-produced high density digital tape, screen the data for quality, reformat the data into a variety of products, and distribute the data to users by January 1978.

Agriculture is discussing the possibility of using the EROS Data Center capability to avoid duplication of a similar capability in their own agency. This appears to be possible if rapid data distribution systems using Domestic Communications Satellites (DOMSAT) are implemented at EDC.

Corps of Engineers could make arrangements with the EROS Data Center for selection of the portions of data that are of interest to the Corps. Present plans, however, are to receive all the data directly from NASA through the DOMSAT link.

NOAA will probably use enhanced photographic data. NOAA is considering alternatives that include purchase of enhanced master photographic transparencies from Interior and making copies for their customers or accepting orders for data but having the copies produced by the EROS Data Center.

The EROS Data Center has been growing in technical capability, volume of data available, volume of data reproduced, and complexity of processing tasks that can be accomplished.

Other agencies are recognizing these accomplishments and starting to depend on the EROS Data Center to serve their program needs. This avoids the necessity for duplication of capabilities.

The degree of dependency of other agencies will depend on the ability of the EROS Data Center to satisfy their specific needs.

Service to other agencies tends to be rather large in volume and predictable. This type of service improves the efficiency of operations at the EROS Data Center and forms an indirect method for interagency support of the Interior activity through the sale of data.

Future in the early 1980's

Introduction of the Thematic Mapper (TM) will require significant upgrading of the capabilities at the EROS Data Center, if this facility is to continue to serve in the roles that are developing.

The cost of these improvements will be at least $10 million and may be significantly higher.

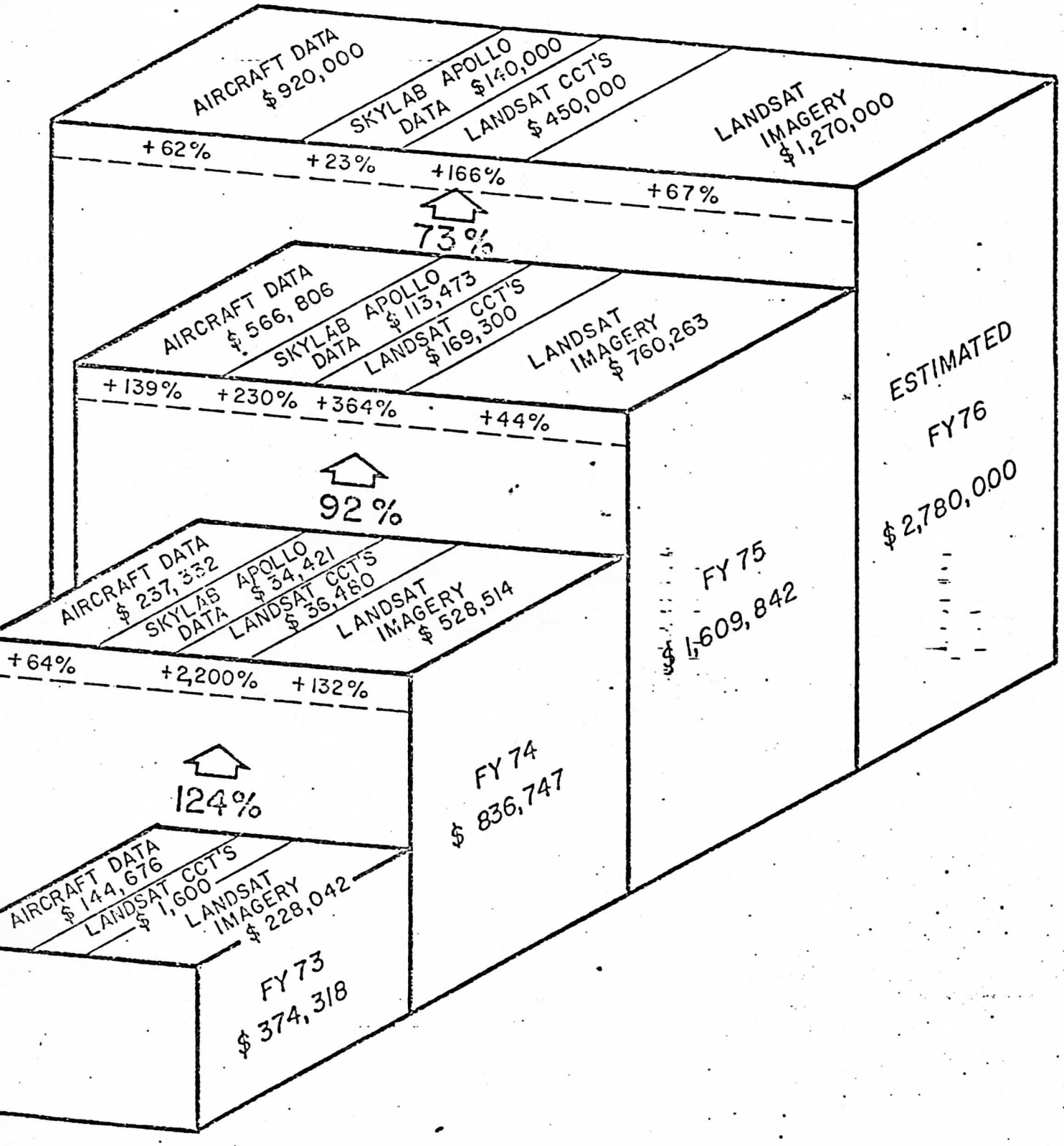
Since the TM is an experimental system, NASA is planning to budget for the hardware required for these improvements provided Interior will assume responsibility for operation of the system.

Interior can expect major budgetary impacts from this transition to TM data processing such as equipment rental and/or purchase, facilities to house equipment, recurring operating expenses, and initial low volumes of data requests that may limit ability to recover full costs of operation. NASA and/or multiagency funding support will be required for EDC involvement in activities related to the Thematic Mapper.

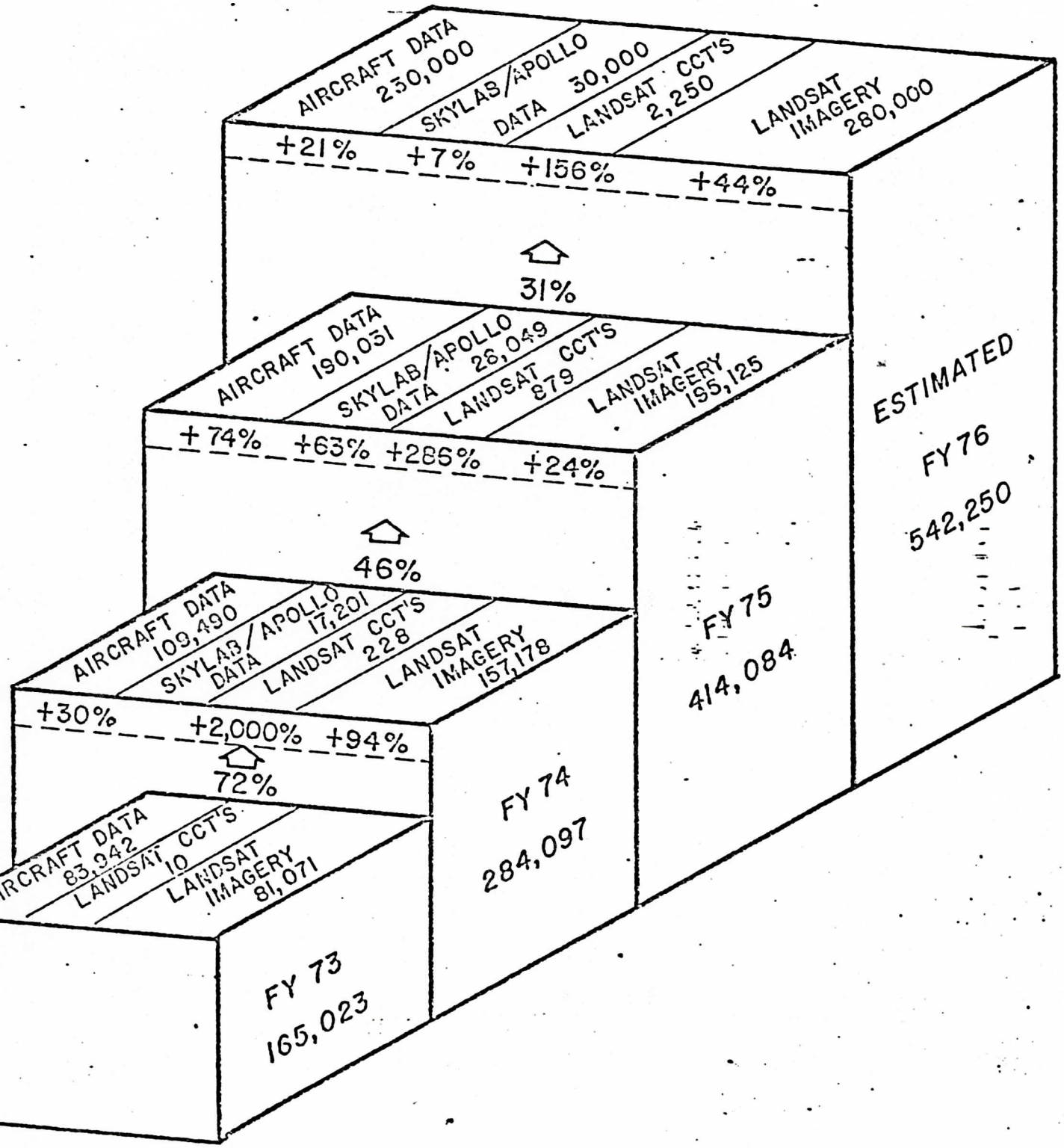
Conclusion

The EROS Data Center has emerged as the leader in processing and distribution of satellite data. This trend can continue through the early 1980's only if EDC receives substantial multiagency support including NASA funding. The ability of the EROS Data Center to satisfy interagency requirements during the next 2 to 6 years will be directly related to strong interagency support for this facility.

EDC DATA DEMAND (DOLLARS)



EDC DATA DEMAND (FRAMES)



LANDSAT IMAGES

Figure 1. Standard Landsat image, Needles, California, area, scale: 1:1,000,000

Figure 2. Digitally enhanced Landsat image, Needles, California, area, scale 1:1,000,000 (Rectangle shows target area enlarged on Figures 3 and 4)

Figure 3. Standard Landsat image, enlargement of target area shown in Figure 2, scale 1:250,000

Figure 4. Digitally enhanced Landsat image, enlargement of target area, scale 1:250,000