

N O T I C E

THIS DOCUMENT HAS BEEN REPRODUCED FROM
MICROFICHE. ALTHOUGH IT IS RECOGNIZED THAT
CERTAIN PORTIONS ARE ILLEGIBLE, IT IS BEING RELEASED
IN THE INTEREST OF MAKING AVAILABLE AS MUCH
INFORMATION AS POSSIBLE

Spr

(NASA-TM-82207) PRIVATE SECTOR INVOLVEMENT
IN CIVIL SPACE REMOTE SENSING. VOLUME 2:
APPENDICES (National Aeronautics and Space
Administration) 123 p HC A06/MF A01

N80-33846

Unclas
CSCL 05B G3/43 35220

PRIVATE SECTOR INVOLVEMENT
IN CIVIL SPACE REMOTE SENSING

June 15, 1979.

Prepared by
An Interagency Task Force
National Aeronautics and Space Administration
Department of Commerce/
National Oceanic and Atmospheric Administration
Department of Interior
Department of Agriculture
Department of Defense
Environmental Protection Agency
U.S. Army Corps of Engineers
Department of State

Volume 2—Appendices



PRIVATE SECTOR INVOLVEMENT
IN CIVIL SPACE REMOTE SENSING

TABLE OF CONTENTS

Volume 1 - Report

Summary of Report on Private Sector Involvement in Civil Space Remote Sensing

Section I	Introduction
Section II	Private Sector Views
Section III	Market Description
Section IV	Policy Issues
Section V	Financial Considerations
Section VI	Options for Private Investment and Participation
Section VII	Recommended Plan of Action

Volume 2 - Appendices

Appendix 1	Excerpts from PD/NSC-42, October 1, 1978, and Dr. Press' Memo, December 20, 1978 Relative to Private Sector Involvement In Civil Space Remote Sensing
Appendix 2	Excerpts from U.S. Space Policy Statements Relative to Private Sector Involvement In Civil Space Remote Sensing Excerpts from U.S. Space Policy Statements Relative to PSIS
Appendix 3	Private Sector Interactions
Appendix 4	<i>Commerce Business Daily</i> and <i>Federal Register</i> Announcements
Appendix 5	Private Sector Views
Appendix 6	State and Local Government Views
Appendix 7	Market Analysis
Appendix 8	Economic Feasibility Report

APPENDIX I

Excerpts from PD/NSC-42, Oct. 10, 1978, and Dr. Press' Memo, Dec. 20, 1978, Relative to PSIS

The following paragraph from PD/NSC-42, October 10, 1978, subject: Civil and Further National Space Policy applies.

"5. *Private Sector Involvement.* Under the joint chairmanship of Commerce and NASA, along with other appropriate agencies, a plan of action will be prepared by February 1, 1979, on how to encourage private investment and direct participation in the establishment and operations of civil remote sensing systems. NASA and Commerce jointly will be the contacts for the private sector on this matter and will analyze proposals received before submitting to the Policy Review Committee (Space) for consideration and action. (U)"

The following text from a memo, dated December 20, 1978, from Dr. Frank Press, Director OSTP to Dr. Robert A. Frosch, Administrator, NASA, subject: Schedule for PD/NSC-42 applies.

"In your letter of November 28, 1978, you state that the private sector involvement study and the integrated remote sensing system study should be amalgamated. I agree with your recommendation. To make the amalgamated efforts more useful, however, they should be completed by June 15, 1979, rather than February 1, 1979, and August 1, 1979, as stated in PD/NSC-42."

APPENDIX 2

Excerpts from U.S. Space Policy Statements Relative to PSIS

From The White House Fact Sheet on U.S. Civil Space Policy, October 10, 1978:

- Emphasize space applications that will bring important benefits to our understanding of earth resources, climate, weather, pollution and agriculture, and provide for the private sector to take an increasing responsibility in remote sensing and other applications.
- Assure American scientific and technological leadership in space for the security and welfare of the nation and continue R&D necessary to provide the basis for later programmatic decisions.
- Demonstrate advanced technological capabilities in open and imaginative ways having benefit for developing as well as developed countries.

Remote Sensing Systems. Since 1972 the United States has conducted experimental civil remote sensing through LANDSAT satellites. There are many successful applications and users, including Federal departments, other nations, a number of states, and a growing number of commercial organizations. The United States will continue to provide data from the developmental LANDSAT program for all classes of users. Operational uses of data from the experimental system will continue to be made by public, private, and international users. Specific details and configurations of the LANDSAT system and its management and organizational factors will evolve over the next several years to arrive at the appropriate technology mix, test organizational arrangements, and develop the potential to involve the private sector.

Integrated Remote Sensing System. A comprehensive plan covering expected technical, programmatic, private sector, and institutional arrangements for remote sensing will be explored. NASA will chair an interagency task force to examine options for integrating current and future systems into an integrated national system. Emphasis will be placed on defining and meeting user requirements. This task force will complete its review prior to the FY 1981 budget cycle.

The Private Sector. Along with other appropriate agencies, NASA and Commerce will prepare a plan of action on how to encourage private investment and direct participation in civil remote sensing systems. NASA and Commerce will be the contacts for the private sector on this matter and will analyze proposals received before submitting to the Policy Review Committee (Space) for consideration and action.

From the 1969 Presidential statement at the United Nations:

“. . . we have determined to take actions with regard to earth resource satellites . . . (which) will be dedicated to produce information not only for the United States but also for the world community.”

From the Secretary of State's statement at the Fourth Ministerial Meeting of the United Nations Conference on Trade and Development in 1976:

“. . . we are prepared to cooperate with developing countries in establishing centers, training personnel and, where possible, adapting our civilian satellite programs to their needs.”

The *United Nations Outer Space Committee* in 1975 noted with satisfaction the growing number of stations set up for direct reception and distribution of Landsat data and encouraged other countries in areas not already covered to work together on a regional basis for the establishment of such stations. The Committee also concluded that future studies on global and regional data distribution centers should be conducted in the light of such advantages as “maximum international cooperation” and “dissemination of all data and information to all countries on an equal and nondiscriminatory basis.”

APPENDIX 3

PRIVATE SECTOR INTERACTIONS

Companies Visited

Bank of America
*BDM Corporation
Chase Manhattan Bank
Citibank
*Communications Satellite Corporation
Daedalus Enterprises, Incorporated
*Earthsatellite Corporation
Environmental Research Institute of Michigan
ESL Incorporated
Fairchild Space and Electronics Company
Ford Aerospace and Communications, Incorporated
*General Electric Company
Geosat, Incorporated
Geo Source Incorporated
*Hughes Aircraft Company
Merrill, Lynch, Pierce, Fenner and Smith, Incorporated
Ocean Data Systems Incorporated
Ocean Routes Incorporated
Salomon Brothers
Siescom Delta Incorporated
Technicolor Graphic Services Corporation
Texas Instruments Incorporated
Western Geophysical Incorporated

Discussions with Representatives of:

Battelle Columbus Laboratories
Cargill Incorporated
Chevron Incorporated
Computer Sciences Corporation
Control Data Corporation
ECON Incorporated
Exxon Company USA
Gulf Oil Corporation
Martin Marietta
Metrics, Incorporated
Phillips Petroleum Company
Rockwell International
Satellite Business System
*Terra Mar

*Submitted substantive written response to Commerce Business Daily Announcement.

Texas Gulf Incorporated
Texaco Incorporated
The Bendix Corporation
The Superior Oil Company
TRW Incorporated
University of Maryland
Western Union Telegraph Company
*World Space Center

Discussions with Individuals

Dr. John DeNoyer
Mr. Charles Mathews
Mr. Willis Shapley

Written Responses to Commerce Business Daily Announcement (No Discussions)

*Dames and Moore
*Goodyear Aerospace Corporation
Pickering Research Corporation
*RCA Corporation
*Technological Graphic Services, Incorporated

Miscellaneous Inquiries

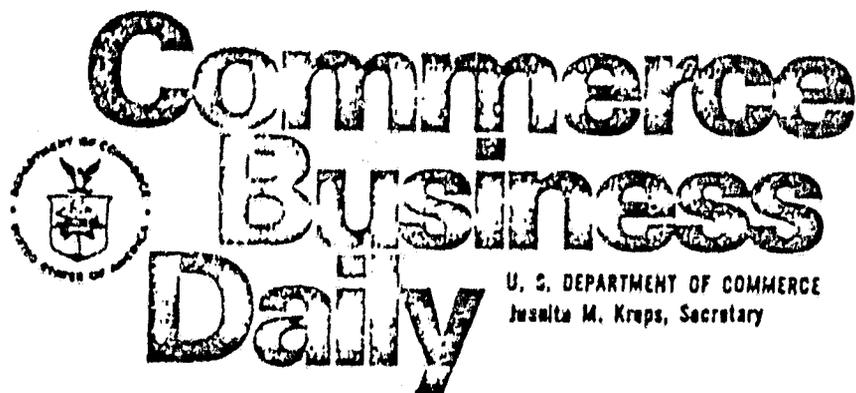
Eleven requests from various companies and individuals for more information in response to Commerce Business Daily Announcement.

*Submitted substantive written response to Commerce Business Daily Announcement.

APPENDIX 4

COMMERCE BUSINESS DAILY AND FEDERAL REGISTER ANNOUNCEMENTS

FRIDAY, FEBRUARY 2, 1979



*A daily list of U.S. Government
procurement invitations, contract
awards, subcontracting leads,
sales of surplus property and
foreign business opportunities*

A Experimental, Developmental, Test and Research Work (includes both basic and applied research).

A -- REMOTE SENSING FROM SPACE The Federal government has been investing in the development of systems for remote sensing from space for the past several years. It is now interested in determining how to increase the involvement of the private sector in such activities. At the request of the President, an Interagency Task Force co-chaired by NASA and the Department of Commerce is developing a plan of action on how to encourage private investments and direct participation in civil systems for remote sensing of the earth from space. This plan of action will be submitted to the Space Policy Review Committee (SPRC) for consideration and action. Expressions of interest in such systems may be extended to include sensing of the oceans and/or atmosphere, if desired. Interest may involve the ownership and/or operation of the total system or any segment of it, e.g., spacecraft, space-to-ground communications links, data processing, data dissemination and storage, analytical services, etc. The views of interested parties are solicited for consideration in developing recommendations for a plan of action. The information desired includes: 1. Incentives believed required from the Federal government, if any. Actions recommended to the government to attract greater private participation and investment in this field. 2. Desirable institutional or corporate arrangements. 3. Desirable and undesirable government regulation, if any. 4. A description of the remote sensing system of choice and its capabilities; including area of coverage, resolution, sensor frequency bands, frequency of coverage. 5. Preferred, proposed, or required data products, both as to type and quantity. 6. Estimate of the markets for and uses of data products; overall market size as well as markets of special interest to you (both domestic and foreign); market growth potential. 7. Estimates of the private investment deemed necessary for the level of involvement envisioned, the availability of investment capital. 8. Consideration in possible foreign competition and its effects. 9. Time frame in which private participation is considered feasible. 10. Any other information or views you believe should be considered. This information will also be used in a study of possible integration of Remote Sensing Systems chaired by NASA. The Co-chairmen of the Interagency Task Force are A. Frutkin, Code L, NASA Headquarters, Washington, DC 20546, 202/755-3972 and W. Eskrite, NOAA, Code OA1, Bldg 5, Room 826, 6010 Executive Blvd., Rockville, MD 20852, 301/443-8620. Submissions will be considered up to 15 Mar 79. Queries may be addressed to any of the above (031)

E.Z. Gray, Code L, NASA Headquarters, Washington, DC 20546,
Tel: 202/755-8433

ORIGINAL PAGE IS
OF POOR QUALITY

[7510-01-M]

(NASA Notice 79-19)

REMOTE SENSING FROM SPACE

Increased Involvement with Private Sector

The Federal government has been conducting research and development of systems for remote sensing from space for the past several years. Remote sensing from space involves taking photo-like images and obtaining data on the earth and its environment from orbiting spacecraft. The government is now interested in determining how to increase the involvement of the private sector in such activities. At the request of the President, an Interagency Task Force co-chaired by NASA and the Department of Commerce is developing a plan of action on how to encourage private investments and direct participation in

10146

civil systems for remote sensing of the earth from space. This plan of action will be submitted to the Space Policy Review Committee (SPRC) for consideration and action. Expressions of interest in such systems may be extended to include sensing of the oceans and/or atmosphere, if desired. Interest may involve the ownership and/or operation of the total system or any segment of it, e.g., spacecraft, space-to-ground communications links, data processing, data dissemination and storage, analytical services, etc.

The views of interested parties are solicited for consideration in developing recommendations for a plan of action. The information desired includes:

1. Incentives believed required from the Federal government, if any. Actions recommended to the government to attract greater private participation and investment in this field.
2. Desirable institutional or corporate arrangements.
3. Desirable and undesirable government regulation, if any.
4. A description of the remote sensing system of choice and its capabilities, including area of coverage, resolution, sensor frequency bands, frequency of coverage.
5. Preferred, proposed, or required data products, both as to type and quantity.
6. Estimate of the markets for and uses of data products; overall market size as well as markets of special interest to you (both domestic and foreign); market growth potential.
7. Estimates of the private investment deemed necessary for the level of involvement envisioned, the availability of investment capital.
8. Consideration of possible foreign competition and its effects.
9. Time frame in which private participation is considered feasible.
10. Any other information or views you believe should be considered.

This information will also be used in a study of possible integration of Remote Sensing Systems chaired by NASA.

The Co-chairs of the Interagency Task Force are Mr. A. W. Frutkin, Code L, NASA Headquarters, Washington, DC 20546, telephone: (202) 755-3972 and Mr. W. Eskite, NOAA, Code OAI, Bldg. 5, Room 826, 6010 Executive Blvd., Rockville, MD 20852, telephone: (301) 443-8680.

Submissions will be considered up to March 15, 1979, and should be addressed to Mr. E. Z. Gray, Code L, NASA Headquarters, Washington, DC 20546, telephone: (202) 755-8433.

Queries may be addressed to any of the above.

ROBERT A. FROSCHE,
Administrator.

(FR Doc. 79-5086 Filed 2-15-79; 8:45 am)

ORIGINAL PAGE IS
OF POOR QUALITY

APPENDIX 5

PRIVATE SECTOR VIEWS

SUMMARY

Elements of the private sector concerned with remote sensing systems are positively interested in investment in and management of all or parts of these systems. This interest, however, is conditioned by the belief that substantial revenue through government purchases of services must be a continuing mainstay of such a market and by their concern that government not compete with or excessively regulate private operations.

In the earth resources sensing field, only one or two private spokesmen consider the time ripe for such ownership, but all wish the door kept open. They would prefer more time to allow the market for remote sensing services, products, and equipment to develop and to be better understood. They have not yet defined precisely the performance and technical characteristics of an operational earth sensing system to their own satisfaction. They would expect a regulatory framework to be imposed on a private venture for any necessary security considerations and international concerns to assure equitable access and to protect against pirating of data. They generally support the current open data policy of the U.S., and they believe the "politics" of remote sensing should be managed so as to preserve global markets for U.S. firms.

The environmental sensing program is regarded to be mature and well-defined and to represent a continuing market almost entirely dominated by the federal government. There is some interest to take over some of the existing well-defined satellite system elements of the program, with claimed cost savings to the government.

Ocean sensing systems are considered to be in the research and development phase, and private investment is accordingly thought to be premature.

* * *

It was central to the study approach to obtain a validated understanding of the views of the private sector. To this end, interviews were conducted with over 50 firms involved in spacecraft and ground equipment manufacture, data manipulation and analysis, training, operations, finance, and data use (see attached list). Views were also sought formally by announcements in *Commerce Business Daily* and the *Federal Register*.

It should be noted, however, that private sector thinking on these matters was, with a few exceptions, not greatly advanced at the start of this study. Accordingly, the views reported here may be expected to change, possibly quite rapidly, in response to currently proposed legislation and, indeed, to the stimulus of government interest evidenced by this study.

As of the first quarter of 1979, the private sector appeared to hold the following views:

Readiness for Investment

Most spokesmen do not consider that the private sector is quite ready to embark on major investments or risks in the space or ground segments of earth resources remote sensing systems. The primary reason given is that the market outlook is not sufficiently understood, defined or developed. At the same time, the private sector is strongly agreed that its present unreadiness should not operate to foreclose its eventual participation and that "the door should be kept open." A few companies indicated they would probably accelerate the preparation of proposals for participation if their competitors or government actions, such as legislation, pressed the issue. Indeed, this already appears to be occurring with indications of at least one proposal for private investment in and operation of a segment of an earth resource sensing system.

In the environmental sensing field, another company is considering a proposal for a private investment/risk venture which applies to a portion of one of the segments of the current operational systems. The government could lease some of the services it now requires for that segment.

Market Evaluation

General—With few exceptions, the experienced and involved private sector spokesmen consider the future market for earth sensing products and services to be promising but exceedingly difficult to assess. Parts of this market, notably in the fields of geology and mineral resources, are relatively mature with many of the benefits demonstrated. Other uses, such as in the agricultural fields, have not been sufficiently demonstrated in an operational setting to encourage routine use. There is general agreement that the potential benefits to the nation are great from both social and economic standpoints, but it is not clear how these benefits convert into equivalent markets. The mix of public and economic interest is thought to justify both continued government support (through market or effective subsidy) and eventual private operation.

Current Market—The present sales of data and services in the earth sensing area are perceived to fall far short of the levels which would be required to pay off the real cost of a total operating system, even if data prices were increased by significant multiples. Many feel that the potential market is so undefined, unidentified and unaware that meaningful market surveys for Landsat-type system are not feasible at this time. A more defined current market prospect is asserted for a stereo satellite system by a group of interested users, premised on the belief that there is significant demand by the mineral and petroleum industries for world-wide stereoscopic imagery usable with Landsat data. They project a commercial market which would reimburse 50% of the program costs, the remainder to be covered by government.

No firm proposal for private funding of such a program has yet been evidenced.

Limits to Data Needs--Some users, particularly those concerned with very large geographical areas, and also those interested in smaller features but located at various places around the globe, recognize that satellite remote sensing of the Landsat type can best meet their needs. For many others, satellites provide a useful tool in identifying features that should be more closely examined by other remote sensing techniques (aircraft or helicopter-mounted-sensing devices of various sorts) or by ground base measurements. Still other users have information requirements that cannot *quite* be met by present satellite systems because of limitations on scale, or accuracy, or repeat cycles, or the exact characteristics measured by the satellite, yet they try to use Landsat data because it is available, and because they cannot afford the aircraft and other approaches.

For still other users, the applicability of Landsat data in meeting their information needs has been demonstrated in government R&D programs, but the satellite data has not been available in a timely and dependable fashion so that they can conduct their own tests or begin to incorporate the technology into their routine operations. These are the "real time" users.

Most firms cannot now assess the relative needs for repetitive as against nonrepetitive use of Landsat data. They consider this one key to determining the market potential. They are concerned over the possibility that some users, as the minerals industries, may satisfy their long-term data requirements in the first three to five years, then decrease their data purchases unless new sensing capabilities are introduced. A further concern is awareness that most users will fulfill only a part of their data requirements from satellites and can apply only a part of their budgets for this data.

Foreign Competition--The companies which have studied this question with respect to earth resources satellites are concerned that future foreign systems, especially if subsidized by their governments, may divide and undercut the available market. (The foreign component of the market is itself generally regarded as important.) They also believe that the foreign stations which have direct access to U.S. Landsat satellites should be required to pay a valid price for that access and be prohibited from undercutting U.S. data sales prices. User spokesmen would prefer to buy data from U.S. sources but will meet their requirements whenever they can, hopefully, from the lowest price source. Some firms believe that a government decision on an operational system is needed without delay to maintain U.S. technological leadership and forestall loss of the user market to foreign competition by default.

Services and Equipment Markets--The suppliers of analytical services and processed data for earth sensing systems are generally optimistic regarding market growth, provided that the government assures continuity of space sector operation, directly or indirectly, and does not offer competing services. Some manufacturers of ground equipment, however, are not optimistic of the

market unless the U.S. government introduces the international agreements that require some or all parts of the ground stations be bought from the U.S. firms.

The Government Market--Perhaps the most important private sector conviction is that the federal government is now and will continue to make up the largest share of the market for each sensing data and services. Indeed, one company felt the government must provide 75% of the market share to make private investment attractive. However, the private sector feels it cannot gain sufficient information of future government needs for data and service. State and local government use of data is regarded as important in the public interest, but the private sector generally considers that the federal government will have to contribute much of the funding necessary for such applications; this use potential is considered effectively a part of the overall federal government market.

For environmental sensing systems also, the federal government is perceived to be the primary customer, although direct access by other private users is projected by one firm. One or two firms express some interest in supplying the services of the currently operational systems under some form of agreement with the federal government.

System Considerations

General--There are differing opinions within the private sector with respect to the definition of earth sensing systems appropriate for an operational venture. In part, this reflects the private sector's recognized and natural uncertainty, at this early stage, as to markets and user requirements. In part, it reflects emphasis upon different user groups. Those firms which believe that the federal government, with its interests in renewable resources, will be their major user, tend to think in terms of some version of the Landsat system including the Thematic Mapper. Those who believe the oil and minerals community to be a ready and expandable market emphasize a stereo capability with sensing capability different from the Landsat system. For some applications there is great interest in improving the system resolution to ten meters which some believe will meet user requirements and also be acceptable politically.

With respect to environmental sensing systems, there was general agreement that government requirements have defined the characteristics of these operational systems and will continue to do so in the future.

Landsats C and D--In the interest of keeping system and user costs down and in order to maintain continuity with the established data base, some firms believe a version of the Landsat system, carrying a Multi-Spectral Scanner, may be sufficient. Others think that the more advanced Thematic Mapper on Landsat D, with thermal band and higher resolution, will be a minimum capability to satisfy a wide range of users.

Integrated Systems—At the time of this study, the private sector had not in general given serious consideration to the alternatives represented by a possible combination of civil and military remote sensing systems or by a possible combination of land, weather and ocean sensing systems. Nor did thought appear to have been given to "piggy backing" commercial systems on government satellites now or in the future. On the other hand, no aerospace firm doubted the ability of private contractors to operate combined systems and meet security constraints as necessary under appropriate government controls. At the same time, some firms expressed the view that systems would be simpler, cheaper and more viable, commercially and politically, if classified military requirements were kept separate and system complexity minimized. In any event, many firms, while wishing to improve existing resolution somewhat, were concerned that making very high resolution data products available to the public could create international policy issues affecting the viability of earth sensing markets. Also, some firms felt that the greater the integration of systems into a single system, and the greater the resultant regulation, the less opportunity there would be for innovative risk taking in private sector investment.

Data Policies

National Policy—Most private sector spokesmen strongly support the current federal government policy with respect to the open and nondiscriminatory availability of data from civil remote earth sensing systems. They would extend it from the experimental Landsat era to an operational one. Reasons given are that this posture would minimize domestic and international political reactions that could complicate market development, it serves the purpose of U.S. commercial access to a global market, and it increases our opportunity to compete with foreign systems. These spokesmen would preserve direct foreign access to U.S. earth sensing satellites but only at realistic prices.

Somewhat fewer interested private firms believe that departure from the policy of open access to data could greatly strengthen the private sector market. Particularly with the minerals and oil industry users in mind, they suggest that, if data could be provided "exclusively" to a user, the price for the data could be increased dramatically and produce greater revenue. They are not clear on whether this means that given data could be sold only once or how this would affect total sales.

Data Pricing—Except for state and local government users, there seemed to be widespread agreement of users and analytical services companies that the present prices of data at the EDC center should be raised several times without seriously impacting its usage in order to create a more competitive environment. It was pointed out data prices are only a few percent of the cost of data analysis procedures or services.

Data Resale and "Copyright"—In the interest of building a market which would support a commercial earth sensing system, however, the private sector would wish to develop legal protections against duplication and resale of data by unauthorized sources. This would be done by copyright restrictions, contractual provisions, or similar devices. It was suggested by a firm that such restrictions on certain data might have to be extended in time, from six months' protection to five years'.

Privacy—There is some recognition that the collection of high-resolution data (ten meters or better, instantaneous field-of-view), even domestically, could raise questions of privacy, personal or corporate. No solutions were suggested, and it would seem this is a question to be left, by consensus, to the development of court doctrine.

Government vs. Private Roles

General—The private sector sees some problems in sorting out the relationships between the federal government, other nations and the enterprisers in a future operational earth resource sensing venture and differ in their expectations that solutions can be found. The more optimistic firms point to the fact that the fabrication of the space segment is now contracted to private industry in both civil and military programs, that ground equipments are handled in the same way and that many analytic services are already provided through the private sector (for earth sensing but largely by the government in environmental sensing). They stress that private enterprise motivations are likely to offer more aggressive market development and cost-benefit ratios.

Systems Responsibility—Opinions in the private sector vary widely as to whether it should seek all or any part of an operational remote sensing system. Some firms believe federal agencies should and would continue to operate the space and ground segments while private enterprise would take over all else. But others see no reason to exclude the space segment. The issue appears actually to turn on the experience of the particular firm. A major spacecraft manufacturer thinks in terms of private sector operation of the spacecraft and ground systems and making its profit in good part on the basis of a government market for services. A more broadly-based firm prefers an initial arrangement in which the government operates the space segment of an earth sensing system while private interests receive, process and market the data; the space segment would serve in some measure as a subsidy by the government—which is seen as amply justified by the continuing and large public service benefits provided. In the end, industry would not exclude itself from any aspect of a remote sensing system operation, assuming an acceptable return on investment.

Responsibility for R&D—It is universally agreed that the government should continue to conduct research and development programs in remote sensing systems development and applications even after private operations are established. One suggested that the R&D on sensors utilize operational

satellites owned by private interests and so provide a greater business base for the private operation and at the same time might cut government costs.

Government Regulation—The prospect of government regulation is everywhere regarded as inevitable, sometimes even desirable. Users tend to desire government regulation to a greater degree than potential system operators in order to assure their equitable access to data and avoid conflicts of interest or special advantage for a private system operator.

In general, the private sector anticipates controls on such matters, for example, as the maximum resolution of data that might be collected or distributed publicly, on the nondiscriminatory availability of data, on unauthorized duplication of data and on any security aspects, especially in a combined civil-military system.

Government Competition—It is universally desired that the government discontinue any practices or services which would compete with the private sector in an operational mode (see below).

Current Issues

General—The private sector especially those providing analytical services for earth sensing data, widely believes that federal agencies are now engaged in various practices which compete with it or otherwise discourage the development of the market and the private sector's interests in it.

Extent of Data Processing—Some service firms which manipulate data obtained from government sources and provide equipments and data analysis, believe that the government should make data available with only minimum preprocessing corrections made, leaving the maximum scope for the industry to perform additional processing services. This group feels that NASA and EROS Data Center (EDC) now do more than is necessary and that this even impedes certain proprietary processes worked out by industry which require data at an earlier stage of processing. Other firms stress that NASA and EDC are providing a reasonable level of processing, but the standards for this processing should be published and adhered to so that private firms can build their markets on a stable base.

Users of information derived from the data do not uniformly support this view. To minimize the need for them to pay for additional processing and analysis, some users would like EDC to continue to provide them data with geometric and radiometric corrections, optimized to exploit the dynamic range of the film used for the photographic products provided and for the extraction of information through digital data processing.

Free Data and Assistance—Some private sector spokesmen object to the free provision of data and other assistance by government agencies to various portions of the market, especially the states, counties and cities and the universities for purposes other than research and training. They consider that this assistance deters development of an economic market. Others recognize

that this practice is intended to help in developing user interest and recognition—and so a market—but all argue that this development is best carried out by involving the private sector.

High Cost Patterns—Major firms which have given most study to operational earth sensing ventures consider that present remote sensing programs, perhaps because of their R&D nature, include costs for facilities and operations at EDC and GSFC which are higher than those that would be required for a commercial system. Collateral duties, such as R&D, training, archiving and public service functions, now performed at these facilities or in the Landsat program, would be provided in an operational system only if supported by the government.

Commitment and Continuity—Industry considers that the federal government has not made an unequivocal commitment to an operational earth sensing system, the President's statement regarding the continuity of earth resources data notwithstanding. They believe that continuity of government *user* interest in particular is essential to motivate greater interest and initiative by the private sector in anticipation of an opportunity for transition to a private system.

International Aspects

As noted, private spokesmen are aware of the significant proportion of current earth sensing data collected for foreign use and the much larger proportion covering overseas geography for foreign and domestic use. To preserve a global market for U.S. firms, they recommend continuation of an open data policy, nondiscriminatory access, continuation of the arrangements with foreign ground stations for direct data reception under terms requiring them to pay a real economic price for access to U.S. satellite and preventing them from undercutting U.S. data prices. In some discussions, the feeling was expressed that it might be wise to avoid or minimize any linkage between U.S. civil and military systems on the ground that a different approach would cause political reactions abroad and compromise the market. Similarly, there was some concern that very high resolution data products could cause adverse reactions in the international market. There were also questions raised regarding the impact of TDRSS on foreign ground stations.

Possible Private Ventures

General—A few studies have been made by the private sector of possible initiatives for significant investment and participation in a space remote sensing operation. Major organizations examining the subject in some degree are in the user community, system operations and the aerospace industry. In addition, one or more major financial institutions are now exploring funding approaches to the problem.

Public Corporation/Chosen Instrument—One firm, involved in space system operations, has expressed publicly its desire to be selected as a "chosen instrument" based on the precedent established by the federal government in the organization of space communications. This would entail the corporation's ownership, management and operation of a system, with some public representation. The federal government would be expected to contract for services amounting to 75% of the revenue requirements so as to make a viable market.

Among the arguments cited for this approach are that it proved successful in the communications case, that the firm possesses experience in systems operation and international relationships, and that it avoids conflicts of interest that might arise if a major aerospace manufacturer were to operate the system.

Virtually all other potential private sector competitors contacted oppose this arrangement on the ground that it eliminates competition.

Special Market Orientation—A study by an organization representing roughly 100 foreign and domestic companies, predominantly in the oil and minerals field, argues that there is a sufficient market for stereo data from space to provide 50% of the funds necessary to establish and operate a remote sensing system. Further, it is said, this system would require no government support if subscribing users could have exclusive access to data.

Leased Services—One aerospace firm envisions an arrangement for one part of the environmental sensing satellite systems, the geostationary satellite systems, patterned on the Navy/LEASAT communications program in which a private firm provides the investment and operating funds required, develops and owns a system designed to meet Navy requirements, then leases services to the Navy. The Navy leases a major portion of the system capabilities and has no obligation if the services are not forthcoming. The system operator retains the remainder of the system to market to other users. This is similar to NASA's TDRSS program but differs somewhat in the measure of risk undertaken by the government in recognition of the more advanced technology applied in the TDRSS case. A specific proposal has not yet been made, so the details of this proposition are unknown at this time.

It is argued, based on the experiences in these communications programs, that the advantages of this approach are that it relieves the government of raising capital and reduces its cost, defers system costs until services become available, smooths out program budget cycles, transfers the major technical and operational risks to the private sector and motivates the private sector to find ways to extend the life of the system and develop broader markets. All of these factors could ultimately reduce cost to the government but are speculative and must await the receipt of a specific proposal. However, the approach is under consideration only for the environmental sensing area, not yet for earth sensing where the risks are considered much greater.

Ground Segment Venture—Another firm suggests an approach in which the private sector would raise the capital necessary to develop and operate a

segment of the ground system with government providing the space segment and continuity of data requirements. The basis for revenue would rest on recognition of a mix of public and private market interests.

Private Financing—No financial institution contacted had, at the outset of this study, been approached by the private sector in connection with any scheme or proposal for funding a private venture in remote sensing. Without benefit of serious examination, all felt that such a venture would have to be considered high risk unless there is a government-guaranteed market; it would therefore have to have the possibility of paying itself out in the very short term, say five to seven years, with a high rate of return. However, one institution has, since the initiation of this study, been exploring the feasibility of private financing of the government's remote sensing programs.

General Conclusions

With only one or two firms now seriously contemplating possible initiatives, the general consensus of the private sector is that the government should commit to support long-term remote sensing programs because of the public interest and economic potential, drop services performable by industry and invite private industry's investment, ownership, development and operation to the maximum extent possible. The private sector is not reluctant to assume that responsibility if the government will provide the market support to make this an acceptable risk, and they believe it will be cost effective to the government.

APPENDIX 6

EXECUTIVE OFFICE OF THE PRESIDENT OFFICE OF SCIENCE AND TECHNOLOGY POLICY

WASHINGTON, D.C. 20500

June 1, 1979

MEMORANDUM

TO: NASA/Arnold W. Frutkin, Associate Administrator for External
Affairs

FROM: ISETAP/Governor Richard D. Lamm, Chairman, Natural Resource
and Environment Task Force

SUBJECT: Private Sector Involvement Study

Attached, you will find a paper summarizing the views of state and local governments regarding the involvement of the private sector in satellite remote sensing.

This paper is being forwarded to you for inclusion in the report of the Private Sector Involvement Study. The National Governors' Association, the Council of State Planning Agencies, the Earth Resources Data Council, and the National Conference of State Legislatures' remote sensing project assisted ISETAP in the preparation of this paper.

Attachment

STATE AND LOCAL GOVERNMENT VIEWS

Market

Seven States are considered to have independent, on-going operational Landsat analysis and application capability. Twelve States have completed (or nearly completed) demonstration projects and are close to deciding the applicability of Landsat to their on-going data requirements. Sixteen States are in the early phases of demonstration programs.

Ten States have purchased, budgeted, or ordered analysis equipment. Over \$9 million of State funds and nearly 380 person-years of staff time have been invested in Landsat technology. Nearly \$8.5 million in State controlled, Federally provided funds have also been invested by the States. Seventy-six local governments and regional agencies in 29 States and the District of Columbia have utilized Landsat data.

It is estimated that in 1978, the States spent around \$5 million on Landsat. State and local governments are currently acquiring around \$50,000 per year in data. It is projected that in 1985, State and local governments will expend \$12 million on space remote sensing and around \$20 million per year by 1990.

Due to the rapidly evolving and developmental nature of Landsat and related technology, the involvement of private firms is important, since many smaller data users do not want to make large capital outlays for equipment in the face of a rapidly expanding technology. However, at the same time, it should be emphasized that the vast majority of States are planning to develop their own internal Landsat data analysis capabilities and will not rely heavily on the private sector for these services. The States consider this the most rational and cost effective approach to their use of Landsat. With the exception of specialized interactive data processing equipment, most States have the necessary data processing equipment and can develop the application discipline knowledge to be able to effectively develop and integrate an in-house Landsat data processing system. From a cost point of view, the repetitive and the multi-purpose nature of Landsat use makes it significantly more economical to develop an in-house capability than to contract for services every time a need for the use of Landsat arises.

In evaluating the use of private industry, it is important to differentiate between State and substate user organizations. Although it is probably a smaller market, there is more of a tendency for substate users to rely upon private industry since these organizations normally have substantially less internal technical capability and would not accrue as many advantages from multi-purpose uses.

Landsat information is normally used as a part of internally developed and operated geobased information systems. In addition, a successful Landsat

project requires an integrated approach between ground truth collection and Landsat data processing. Private industries involved in providing services are often staffed by technical people who are not generally knowledgeable of State problems and applications and are not knowledgeable of the physiography and earth resources of the States to which they are providing services.

Based on experience with private industry, State and local officials view the following functions as comprising the most appropriate roles for private industry at this time:

- Provision of specialized equipment and software to the States;
- Provision of analysis services and Landsat products to local governments;
- Provision of specialized or unique product or service lines which State agencies and facilities would not be able to provide;
- Consultation on systems design and development.

Configuration of System

The overwhelming need of State and local governments is for the Federal government to make a firm commitment to assure Landsat-type data continuity and compatibility. The spatial resolution and spectral region of Landsat-D will satisfy many of the requirements of State and local governments. Greater than 30m² resolution is needed for some particularly urban applications. Stereo coverage will be useful. There is also a demand for other sensors such as the active microwave. Data delivery within 7-14 days of satellite overflights is needed for most applications and within 1-2 days for some important applications.

Institutional

Due to the public service nature of satellite remote sensing, it is recommended that the system be Federally owned and operated for at least the near term. The States major concern, particularly in regards to the ground segment, is that a privately operated system could tend to develop standardized products in response to the needs of large, aggregated markets and reduce or eliminate marginal products for limited markets in an attempt to improve efficiency and profitability. Although this approach would provide very efficient and responsive service to the large markets, it may reduce the amount of very useful service to a wide range of users, such as State and local governments. State and local governments also feel that they can have more influence on the Federal government as operator of the system than they could on a private firm.

State and local governments believe that the involvement of the commercial sector is, to a large extent, determined by the interest and willingness of private industry to participate in the system. It should be the policy of the U.S. government to define and to foster opportunities for maximum participation of private industry in satellite remote sensing as both contractor and entrepreneur.

If the private sector would at some time desire to own or operate the Landsat system, the Federal government would have to, of course, play a continuing role in assuring unbiased and open data acquisition and dissemination practices.

Economics

The social and economic values of Landsat to State and local governments are difficult or impossible to quantify. The utility of remote sensing systems resides in a complex mix of direct benefits and subtle, but more important, less direct benefits of improved information for decision making and natural resource management.

The benefits of satellite remote sensing are largely nonquantifiable, particularly at this early stage of application. However, this current lack of quantifiable benefits does not outweigh the preponderance of international, national, State, regional, and local evidence that a continuing Landsat type system should be established. State and local governments view the establishment and operation of satellite remote sensing as a public service in the same context as census, cartographic, geological, and meteorological data which are provided as a public service of the Federal government. Due to this diffused and interdependent nature of benefits resulting from Landsat use, State and local governments strongly feel that the major portion of the cost of the Landsat system should be paid by the Federal government.

In establishing a pricing policy, the States feel that no attempt should be made to recover the research and development costs of the experimental earth resources programs (including Landsat-D) nor the major costs associated with an operational system. It is recommended that the price of Landsat data be limited to the cost of the data reproduction and distribution and all data acquisition, processing, and storing should be considered Federal data expenses. A five-fold increase in the cost of Landsat data would greatly decrease State and local government use of Landsat.

State and local governments recommend that the Federal government should make a strong commitment to a systematic and on-going technology transfer program, as a public service to help State, regional, and local agencies develop the capability for using Landsat.

The key elements of the needed technology transfer program are:

- User awareness and comprehensive training;
- Technical assistance and consultation;
- Continued research, demonstration, and validation;
- Communication with and among users (user networks);
- Development and dissemination of software.

One particularly important aspect of technology transfer is demonstration and validation projects. State and local governments are strictly operational. They do not have funds for R&D or to adapt new technologies. Therefore, the States require low cost, relatively low risk demonstration opportunities be-

fore they are able to commit State funds for new concepts. State and local users continually stress the importance of having the opportunity for "hands on" demonstration projects, tailored to meet their needs and conducted over test sites of their choosing. Such custom demonstrations are seen as the only realistic way to acquaint users with the technology and its applications in an operational setting, to overcome their reservations about its effectiveness, and to instill the confidence required to develop an on-going program. If the Federal government provides the opportunity for a validation effort, a State can then more easily provide funds for the operational use of the concept.

The NASA RAP and ASVT programs are critically needed for effective technology transfer. These programs help States gain a basic working knowledge of Landsat after which, if they find the technology applicable to their needs, they can contract with private industry for on-going operations or develop an alternate operational structure. The RAP and ASVT programs thus should be viewed as developing a potential market for private industry.

It is important that private industry not be viewed as a significant agent for technology transfer to State and local governments. The basic organizational imperatives of industry and State and local government result in the private sector (as an entrepreneur) being unsuited to provide technology transfer. After all, it is not in the interest of private firms to truly transfer technology since such an action would eliminate subsequent opportunities for business.

APPENDIX 7

MARKET ANALYSIS

GENERAL APPROACH—Market Assessment Through 1990

An analysis was conducted of the current and potential future markets for space-based remote sensing systems and related activities necessary for collecting and using data concerning the earth and the atmosphere. The purpose of the analysis was to provide a market basis for evaluating the viability of private investment in such systems. The time period of interest was from the present through 1990.

Estimates of the magnitude and nature of the current data sales and projected market were obtained from the EROS Data Center, USDA, NOAA and NASA; Federal agency members of the PSIS Interagency Task Force; representatives of private industries and user organizations involved in remote sensing or related activities; and where available, existing market data from previous studies. Projections of the market were based on integration of the data acquired from the above sources and estimates of the future by experienced users and suppliers of remote sensing services and equipment.

CURRENT MARKET PERCEPTION—Four Major Application Areas in Various Stages of Development

Remote sensing from space has developed in four major application areas: (a) sensing of environment/meteorology; (b) sensing of the earth's land surface; (c) sensing of the oceans; and (d) sensing for general scientific research and knowledge. Each area is currently in a different stage of development and presents different prospects for private sector involvement.

The environmental (meteorological) sensing market is well established and is predominantly represented by the Federal Government, particularly NOAA and DoD. In remote sensing of earth resources, the market is in an earlier stage of development and is extremely diversified consisting primarily of a variety of Federal agencies, foreign users and some state and local governments in the renewable resources area, and private sector users in non-renewable and geologic resources applications. Remote sensing for specialized ocean applications has only recently entered the R&D phase with Seasat. Based on the experience to date, the oceans market will consist of the Federal Government (NOAA and DoD) and private organizations such as offshore oil, gas and mining, marine transportation and fisheries. In the scientific research area, there is a well established, but limited market normally funded by the Federal Government which involves universities, some Federal R&D centers and scientists associated with various non-profit or science-oriented for profit firms. The research market is normally ad hoc in nature, closely associated with the specific purpose of the satellite, and generally not of long-term significance to private industry in terms of investment.

FUTURE INTEREST IN REMOTE SENSING— Estimated 43 U.S. Satellite Launches thru 1990

There is a significant interest in remote sensing systems from space on a global scale. This interest reflects the general perception that remotely sensed data benefits both public and private users by providing a source of totally new and incremental information which existing sources are incapable of providing; and/or a source of information which is a capable substitute for existing data sources resulting in a cost savings. Both of these characteristics are increasingly attractive to private entrepreneurs striving to offer a new service or conduct their businesses in a more cost-effective manner.

The interest and perceived benefit to be accrued by remote sensing is reflected in an estimated 43 U.S. satellites which may be launched thru 1990. These include approximately 19 meteorological satellites, 4 in the Landsat series, 2 Stereosats, 2 or 3 NOSS and 12 other research and development satellites. In addition, there will be at least 10 and perhaps as many as 23 launches of foreign remote sensing satellites over the same 12 year period.

Although it is quite possible that not all of these satellite programs will actually be funded, the extent and diversity of the activities being considered represent a major confidence in the future development of space-based remote sensing. These planned governmental activities also represent a substantial basis for a growing and diversified market for private industry.

POTENTIAL BUSINESS AREAS—There are Three Major System Areas (segments) with Potential for Private Investment

The range of activities/functions associated with remote sensing are represented by three major business areas (segments), each involving a different kind of potential market:

- ***Space Segment***—includes design, fabrication, checkout, preparation for launch of the spacecraft and its instruments, control and operation of spacecraft and instruments, tracking and data acquisition. Presently, this market is primarily supported by the Federal Government on a contractual basis and represents the greatest dollar volume (approximately \$1.2 to 1.5B) thru 1990.
- ***Ground Data-Handling Segment***—includes data reception, geometric, radiometric and atmospheric correction, integration with orbital data decoding, archiving and dissemination. The ground segment market is also primarily supported by the Federal Government and will generally be limited in the foreseeable future to only a few industrial participants.
- ***Analytical Services Segment***—includes the activities and hardware and software systems that convert processed remote sensing data into useful management information for decision-making by user organizations. The analytical services market is comprised of a variety of private sector and non-profit organizations and has the potential of becoming the largest long-term market for industry.

The relationships among these segments vary with application area and have an inherent impact on the nature and degree of involvement by private industry. For example, in meteorology, the user communities were well established, aggregated and characterized by a close and more direct one-to-one institutional relationship between the three segments. In contrast, the earth resources remote sensing programs are characterized by a diverse, geographically diffused user community and equally diversified requirements. This diversification creates a requirement for flexibility, particularly in the analytical services segment for a variety of customized services and products.

Currently, the private sector is involved in all three system segments or business areas. In the space and ground data-handling segments, private industry's involvement is solely as a contractor to the Federal Government for the design and construction of spacecraft, sensors, ground data handling equipment and software, and as an on-site support contractor providing a broad range of operations and analysis support in satellite launch and control of spacecraft and in tracking and acquisition. However, in the analytical services area, there is a growing amount of competitive business in the field of providing equipment and services for the analysis of remotely sensed data and products to the ultimate users.

LANDSAT MARKET

A. Present Landsat Data Market—Total of 273,508 Frames at an Estimated Dollar Volume of \$4,846,105 for 1978

Since the initiation of the Landsat program, data has been available at generally reproduction costs at the EROS Data Center (EDC), USDA, and NOAA in the U.S., and from foreign stations. In addition, until recently, the NASA Goddard Space Flight Center (GSFC) has distributed data free of cost to user organizations involved in cooperative technology transfer projects such as the Large Area Crop Inventory Experiment (LACIE).

To provide a baseline for the market analysis, a survey was conducted of all Landsat data distributed in 1978. This survey showed that the Landsat data market in 1978 was a total of 273,508 frames at an estimated dollar market volume of \$4,846,105. The approximate dollar volume of sales assumes that the data available free-of-charge from GSFC would be sold at a price comparable to EDC. The breakdown of the Landsat data market by user sector is as follows:

<u>Sector</u>	<u>Dollar Volume of Market</u>	<u>% of Market</u>
• Federal Government	\$2,550,876	52%
• Private Industry	579,950	12%
• Foreign	1,340,539	27%
• Other e.g., Universities and State and Local Governments	374,770	9%
	<u>\$4,846,105</u>	

Most Landsat applications are currently in a demonstration and verification phase. The Federal Government is presently the largest and most diversified market with prime applications by USDI, USDA and CoE in water resources management, land cover inventory, crop yield forecasting, forestry and rangeland management. The overwhelming majority of industry applications to date and for some time in the future will be in mineral and petroleum exploration. However, in the long term, the private market is estimated to equal the Federal market in size and diversity with important new applications in renewable resource areas such as timber inventory, environmental impact evaluations and siting and routing. A slowly, but continually expanding market (particularly with the availability of higher resolution data) is expected among state and local governments. The most important and widespread state and local Landsat application will continue to be the generation of land cover data which are integrated and combined with supplemental information such as economic, demographic and ownership data to develop geobased resource information system and satisfy the growing information needs of increased state and Federal natural resources legislation such as the EPA 208 Areawise Planning and Waste Treatment Program. States receive

approximately \$14.5 billion in Federal assistance grants to implement such legislation; it is anticipated that an increasing amount of these Federal funds will be used for data collection, including remote sensing. The foreign market, particularly among the developing nations, is presently very active and attractive to U.S. industries involved in the provision of remote sensing related services and equipment. A recent study has indicated that more than 75 nations have used Landsat data in various natural resources and base mapping applications with emphasis on land suitability evaluation for economic development, agriculture and forestry. Rapid growth is expected in the foreign Landsat market.

B. Data Cost Sensitivity—Data Market is Generally Inelastic to Price

Presently, the cost of remotely sensed data products is a very small fraction (some 2% to 5%) of the user's total cost of carrying out the application. So long as this is true, it seems that the data market will be generally inelastic to price. However, it is important to realize that sensitivity to cost varies with the user sector. Generally, the private industry market segment is likely to be the most insensitive to price. A general consensus among mineral and petroleum companies is that a price increase up to ten-fold would be tolerated with little market impact. The continued use would be justified due to the large benefit accrued as a result of Landsat data use, as well as the fact that data cost would still be a proportionately small fraction of the total data use costs.

Government agencies and, in particular, state and local users, are likely to be the most sensitive to data price levels. Most state officials feel that a five-fold price increase may have a moderate to significant impact on data use. State organizations will probably opt for the least expensive equipment and will choose to establish their own data analysis capabilities and will depend on external service organizations, primarily for the provision of specialized Landsat equipment and software. Although cost sensitivity will be more variable among Federal users, a number of Federal agencies state that their data use will be directly affected by price increases of five-fold due to overall fixed agency budget constraints.

C. Present Services and Equipment Market—Estimated at \$32 to \$44M for 1978

There is a growing market for the provision of analytical services and equipment. It is estimated that presently there are approximately 70 to 80 organizations which have entered the service and equipment supplier market. No single organization has dominant share of the market. Most are for-profit businesses, some are private not-for-profit organizations, others are university-affiliated. The present services and equipment suppliers market has been estimated on the basis of previous surveys and data acquired during this study to be between \$32 to 44 million in 1978 with the following breakdown:

ANNUAL
DOLLAR MARKET

MARKET ACTIVITY DESCRIPTION

\$14 to 18M

Data Analysis Services—manual and computer implemented analysis, interpretation and conversion of Landsat data into information products (statistical, graphical and textual) to be used for operational decision-making.

\$4 to 6M

Special Purpose, Enhanced Imagery Products—Implementation of any of a number of optical and digital enhancement techniques designed to produce a superior Landsat image for visual interpretation.

\$12 to 16M

Data Analysis Equipment—Optically or computer oriented equipment designed for the processing, analysis and interpretation of Landsat data into information useful for decision-making.

\$2 to 4M

Computer Data Analysis Packages—Computer programs designated for the processing, analysis and classification of Landsat data for a particular purpose or thematic extraction.

\$32 to 44M Total Market

D. Forecasts of Total Future Landsat Market—Estimated for “Low” and “High” Level Markets for 1985 and 1990

A forecast of the future data, services and equipment market was made on the basis of the present market developments/events which may impact the future market, and estimates concerning market growth rate made by user organizations and private industries. Some of the future developments identified as having a positive market impact are: (a) commitment to Landsat data continuity in the President's Space Policy; (b) consistent Congressional pressure to transition Landsat into an operational system; (c) planned launch of the improved Landsat-D; (d) operation of improved, all-digital data distribution system; (e) launch of complementary satellites providing geologic data; (f) launch of foreign earth resources satellites; (g) establishment of worldwide network of ground stations; (h) development of vastly improved data analysis/extraction programs; (i) development of increasingly low-cost equipments and analysis programs; (j) increasing integrated use of remote sensing data with conventional information in Federal, state and local geobased information systems; and (k) improvements in overall data management capabilities. Based on these developments and using the 1978 market as a baseline, “high” and “low” market forecasts were made for 1985 and 1990.

Baseline Present Market (1978)

Data	\$ 5M
Equipment and Services	38M
Total	<u>\$43M</u>

Future Worldwide Market Forecasts

	<u>1985</u> (low to high)	<u>1990</u> (low to high)
Data	\$13 to 31M	\$20 to 71M
Equipment and Services	97 to 115M	150 to 276M
Totals	<u>\$110 to 146M</u>	<u>\$170 to 347M</u>

The "high" end of the market estimates reflect the more aggressive/optimistic assumptions made by industry and user organizations while the "low" end represents the conservative opinions. The specific estimates provided were reduced for clarity to two basic assumptions consisting of annual market growth and data cost increases. These assumptions are as follows:

Low Market Assumptions

- Constant 5% annual market growth for imagery and 10% growth for CCT's thru 1990.
- Two-fold price increase for CCT's and no price increase for imagery in 1980.

High Market Assumptions

- 5% annual growth for imagery and 10% growth for CCT's until 1983; starting with 1983 double to 10% annual growth for imagery and 20% growth for CCT's (primarily due to impact of Landsat-D).
- Four-fold price increase for CCT's and two-fold price increase for imagery in 1980.

METEOROLOGY MARKET—\$83M in 1980 and \$90M in 1985, Essentially all Supported by the Federal Government

Weather forecasting is a clear responsibility of a single Federal agency, NOAA. Typically, NOAA sets system requirements, develops continuity plans, gains funding for modernizations, keeps the spacecraft and ground systems functioning and delivers support to users. The development and procurement of spacecraft and launch support capabilities, as requested by NOAA, are NASA functions. Research and development leading to applications improvements are prime concerns of NASA.

NOAA budget allocated to satellite remote sensing will be \$83.3M in 1980, and approximately \$90M in 1985. Most of these expenditures are for equipment purchases. Historically, the opportunity for private investment in meteorological satellites has not been given significant consideration with the exception of contractor support or acquisition of equipment. A variety of obligations and concerns would have to be resolved before a full range of Metsat user service responsibilities could be assigned to an industrial operator. Many services are provided "for the public good." Serious consideration would have to be given to ensure that this public function would not be compromised if the service would be given to an industrial provider.

STEREOSAT MARKET—\$22M for Data and \$49M Analysis Market Over Three Years for Mineral and Petroleum Exploration

The geologic community, and particularly the mineral and petroleum companies, have expressed a strong need and market for Stereosat data. A market study (completed in 1978) involving a number of mineral and petroleum companies and some Federal Government agencies, estimated that about 39,000 stereo pairs would be bought by U.S. industry at a price of \$450 per pair and an additional 10,000 pairs by governmental agencies. These estimates represent a data market of about \$22 million, over the assumed three year life of the satellite.

It is estimated that a stereo pair cannot be analyzed for less than \$2,000. If 50% of the pairs sold are actually analyzed, this suggests an additional analysis market of some \$49 million, over the three year period, about \$16 million per year.

Since the Stereosat market is basically characterized by users concerned with nonrenewable resources, there is a tendency for partial market saturation for data over a period of three to five years unless new sensing capabilities are introduced. However, it is important to emphasize that the saturation factor has been and is expected to be much less of a factor in the analytical services market associated with Stereosat due to the continued development of improved data processing, analysis and extractive techniques and the resultant capability of producing increasing effective data over the same geographic area.

APPENDIX 8

ECONOMIC FEASIBILITY REPORT INTRODUCTION

The following pages present the report of a consultant retained to analyze, from a business viewpoint, the feasibility of private sector ownership and operation of a Landsat-type remote sensing system. A ten-year period was selected for the investment/operation of the system as a "going-concern." It was recognized that there would be a great degree of government participation, even though the system would be privately owned. This includes the sunk costs of completed R&D, purchases of products, and a sizable subsidy to the firm. For comparison purposes, a base case of government ownership and operation costs was analyzed.

Costs and revenues were estimated from available sources. These are "best estimate" figures, compiled from many reports, surveys, studies, and discussions with experts.

The most important conclusion from this analysis is the demonstration of the sensitivity of the data to the various assumptions. These sensitivities are analyzed with respect to the cost to the government as measured by the "present value" of the various options. These options are fully explained in the text of the contractor report.

The chart on the next page summarizes the "present value" costs. The most striking sensitivity is in the market revenue estimate. If the "low market" (revenue/year to \$40 million per year after ten years) materializes, then the cost to the government is quite high. If the "high market" (revenue/year of about \$80 million after ten years) is realized, then the cost to the government can be significantly less.

The figures are much less sensitive to the particular rate of return on investment needed to encourage the private sector into the business and to the differences in the analysis from assuming that the private sector might be more efficient in its operations. Other variations, such as differences in the way selected costs are treated (capitalized or expensed), the addition of marketing costs, variations in the debt/equity ratio, etc., changed the bottom line figures, but none equalled the effect on the market assumption in importance.

The conclusion from this analysis is that private sector ownership and operation is only feasible if the government subsidizes the business to provide a reasonable return on investment.

**SUMMARY OF THE PRESENT VALUE COST TO THE GOVERNMENT OF PRIVATE SECTOR INVESTMENT IN
A LANDSAT-TYPE REMOTE SENSING SYSTEM (1980-1989)**
(In millions of dollars)

	Low Market Revenue Estimates			High Market Revenue Estimates		
	Present Value of Cost to Government ¹	Total Revenue (including subsidy)	Total Direct Government Subsidy	Present Value of Cost to Government ¹	Total Revenue (including subsidy)	Total Direct Government Subsidy
Base Case: Government Owns and Operates Entire System						
1. Without marketing costs	382	220		278	422	
2. With marketing costs ²				297	422	
Government leases services— Private ownership of system						
A. Without marketing costs						
Same system costing 15% less ³						
1. 10% ROI	313	519	298	173	467	45
2. 15% ROI	323	547	326	192	523	101
3. 20% ROI	332	572	352	209	573	151
Base system cost						
4. 10% ROI	369	611	391	243	579	157
5. 15% ROI	381	645	425	260	629	207
6. 20% ROI	391	676	456	276	674	252
B. With marketing costs²						
7. System costing 15% less 15% ROI				223	573	151
8. Base system, 15% ROI				291	679	258

Notes:

1. Cost to government includes subsidy, tax, depreciation charges, but excludes expected government purchases. Present value calculated at 10% as per OMB guidelines.
2. Assumes that only the high market exists with additional marketing expenses. Marketing costs are assumed to be 10% of sales in any given year.
3. For sensitivity analysis, assumes that the private sector can operate 15% more efficiently than the government.

**ECONOMIC FEASIBILITY OF PRIVATE SECTOR
PARTICIPATION IN REMOTE SENSING SATELLITE SYSTEMS**

Summary Report

**PREPARED FOR:
NASA/DEPARTMENT OF COMMERCE
PRESIDENTIAL TASK FORCE**

**BY:
TEMPLE, BARKER & SLOANE, INC.
33 HAYDEN AVENUE
LEXINGTON, MASSACHUSETTS 02173**

24 MAY 1979

TBS

FOREWORD

This report is a revision of the report with the same title submitted on April 15, 1979. The revisions include modifications to the cost projections by the FSIS Task Force and the exploration of additional issues related to the economics of private sector participation. This version of the report also contains a full listing of all data employed in the analysis.

INTRODUCTION

If the availability of remote sensing data is to continue for the foreseeable future, the government has three major policy options:

- Option 1: Own. Agencies of the government would continue to develop, operate, and own remote sensing satellite systems without private sector involvement.
- Option 2: Manage and Operate. The government would continue to develop and own remote sensing systems, but would contract with the private sector to manage and operate these systems.
- Option 3: Lease. The government would purchase remote sensing services from a private sector "venture" which would develop, own, and operate the necessary hardware and systems.¹

Temple, Barker & Sloane, Inc. (TBS) has been asked to evaluate and compare the financial and economic merits of these three policy options (there are, of course, many other considerations bearing on the decision). These evaluations were based upon three types of forecasts provided by members of the Task Force:

- Mission: Definition of the remote sensing system and services to be provided.
- Market: Size and expected growth of the market for the services to be provided.
- Costs: Capital expenditures and operating costs required to provide the specified services.

¹A fourth option, the establishment of an independent corporation similar to Comsat, is economically similar to Option 3.

Several sets of forecasts were reviewed by TBS. From these, projections were developed which, we believe, represent plausible "planning scenarios" for the future of remote sensing. While no claim is made for the accuracy of these projections as forecasts, they provide a reasonable basis for comparing the policy options. The forecasts used are summarized below.

Mission. The sensing capabilities, coverage frequency, backup readiness, and other parameters of the remote sensing system were defined inferentially from the currently planned series of satellites and support sub-systems referred to as "Landsat D-D'" and "Landsat Follow-on Option 2." Services provided by the venture (or government) were limited to "pre-processed data"; that is, "value-added processing" was assumed to be done by customers of the venture.

Market. There is considerable uncertainty associated with projections of demand for remote sensing data in general, and the data generated by this mission in particular. Consequently, the market forecast was provided at a "low" and a "high" level for the period FY1982 (when Landsat D data would first be available) to 1989. Even so, these must be regarded as planning parameters rather than levels which "bracket" the market. Not only are the levels uncertain, but the issues of price sensitivity, mix of products, and potential for market development have not been adequately explored by studies to date.

Costs. Investment costs and operating expenses were forecast for the defined mission for the period FY1980 to 1989. These are detailed in Exhibits 1 to 14.

CONCLUSIONS

Policy options were compared using as a criterion the present value of net government expenditures. This is defined as the sum of all incremental government expenditures (including tax credits) less revenues to the government and taxes. Table 1 shows the results projected for each option; detailed projections are in the exhibits.

	<u>High Market</u>	<u>Low Market</u>
Option 1-- <u>Own</u>	278	382
Option 2-- <u>Manage and Operate</u>	266	369
Option 3-- <u>Lease</u>	192 to 275	323 to 385

¹Discounted at 10 percent per OMB.

The table suggests two principal conclusions:

- The variation among the options is not dramatic, particularly in the "low market" case. Nevertheless, in both cases, Option 3 offers the lowest net cost to the government.
- The cost to the government is more sensitive to the market assumption than to the option chosen; for each option, the government spends 36 percent to 52 percent more under the "low" market" assumption than under the "high market".

An additional consideration is the position of the government in 1989. Under Options 1 and 2, the government would presumably continue to support remote sensing whatever the state of the market. Under Option 3, however, the government subsidies by 1989 are reduced to low levels under the low market assumptions and zero assuming the high market. Thus, the government might significantly reduce or eliminate entirely the need for further support for the remote sensing industry.

In summary, Option 3--contracting with a private venture to provide remote sensing services--appears to be the most economic option for the government, given the Task Force forecasts and their underlying assumptions. In addition, it is likely that the growth of the market would be enhanced if a private venture were engaged in expanding that market; as shown above, a larger market has the effect of reducing government costs further. Thus, absent other policy considerations, we recommend that the government pursue serious consideration of Option 3.

MAJOR ASSUMPTIONS EMPLOYED
IN OPTION 3 CALCULATIONS

The following are the major assumptions made to produce the analyses of the "lease" option. More detail is available in the Appendix.

1. Calculations are for a "venture" representing a concentric diversification by a relatively large, profitable corporation.
2. In order to be financially attractive, the venture would need to offer an internal rate of return of approximately 15 percent (in our judgement, a reasonable estimate for the cost of capital for a corporation of this type).
3. After ten years, the venture would be sold as a going concern for a residual value of seven times 1989 profit after taxes (in our judgement, a reasonable estimate for the appropriate price/earnings ratio for a corporation like the venture).
4. Under certain sub-options explored, the venture would be operated as a subsidiary with independent financing² and a debt-to-equity ratio of one-to-one (a somewhat high degree of financial leverage but one reasonably attainable, in our judgement, given sufficient government contractual guarantees). Under other sub-options explored, no such financial leverage is provided.
5. The necessary government purchases, or support subsidies, would decline linearly for eight years, beginning in 1982 (the year in which venture "product" would first become available for Landsat D) to zero or a level necessary to sustain the venture at an adequate level of profitability--20 percent return on equity by 1989. In this manner, the government would gradually "phase out of the business," permit the private sector to perform an appropriate function, and yet assure itself that the public interest benefits of remote sensing would still be obtained.

²Possibly provided or guaranteed by the government.

ANALYSIS OF OPTION 3

Beyond the broad framework discussed in the previous section, evaluating the "lease" option required detailed assumptions about the venture's market, operations, financial practices, etc. (See Appendix.) In several cases, however, little data was available on which to base an informed decision. In these instances, several possibilities were examined to assess the sensitivity of the outcome to the assumption made. The impact of five issues was examined in this way:

1. The size of the market for remotely sensed data.
2. The ability of the private sector to operate more efficiently (i.e., at lower cost) than the government.
3. The rate of return demanded by a private investor.
4. The use of debt capital by the venture.
5. The ability to account for certain costs as expenses.

The results are summarized in Table 2, which indicates that the economics of Option 3 are quite sensitive to the market size and efficiency assumptions, moderately impacted by the investor's rate of return, and relatively unaffected by the debt structure and expensing questions. Each issue is discussed separately below.

<u>Assumption</u>	<u>Range Examined</u>	<u>Average¹ Percent Change in Present Value of Net Government Outlays</u>
1. Market Size	\$40 million to \$80 million in 1989	(34.6)
2. Efficiency	0% to 15%	(20.5)
3. Rate of Return	10% to 20%	14.3
4. Capital Structure	No Debt to 50% Debt	(3.5)
5. Expense/Capitalization	Capitalize \$328 million to \$429 million	1.7

¹This column presents the effect of changing the assumption from the low value of the range to the high value, averaged over the cases examined. The table can be read: "On average, the present value of required net government outlays is 35 percent lower assuming an \$80 million market, in 1989 than assuming a \$40 million market."

1. Market Size

The size of the market is probably the most critical uncertainty facing a potential contractor. The impact of the size of the market is large (see Table 3), both for the investor and the government, over the range of "low" and "high" market estimates assumed.

	----- Other Assumptions -----			
	No Debt		50 Percent Debt	
	No Efficiency	15 Percent Efficiency	No Efficiency	15 Percent Efficiency
Low Market	385	327	381	323
High Market	275	205	260	192
Difference	(110)	(122)	(121)	(131)
Percent Change	(28.6)	(37.3)	(31.8)	(40.6)

From the government's point of view, the doubling of the market cuts some \$120 million from present-value costs. This result is straightforward: market demand and government purchases act on profits identically; thus, to achieve a given rate of return for the venture the government must match, dollar for dollar, any assumed shortfall of market demand. The effect on the government of a marginal dollar paid out is, however, offset by an income tax inflow and tempered by the present value discount factor.

2. Private Sector Efficiency

The hypothesis was advanced that the incentive structure of a profit-oriented venture would generate savings relative to the performance of the government, both in operating expenses and procurement of hardware. (Option 2--Manage and Operate--assumes these savings regarding operating expenses.) Fifteen percent was chosen as a plausible savings factor for sensitivity analysis. As Table 4 illustrates, such an assumption affects the cost to the government by more than 15 percent: a reduction in all costs reduces all magnitudes except revenues; thus the government benefits somewhat more than proportionally, particularly in the high market case.

	- - - - Other Assumptions - - - -			
	No Debt		50 Percent Debt	
	Low Market	High Market	Low Market	High Market
No Efficiency	385	275	381	260
15 Percent Efficiency	327	205	323	192
Difference	(58)	(70)	(58)	(68)
Percent Change	(15.1)	(25.5)	(16.5)	(26.2)

3. Required Rate of Return

Fifteen percent was generally accepted as a reasonable estimate of the return a contractor could expect when guaranteed a government market, and a ± 5 percent range was examined for sensitivity effects. Figure 1 shows that government outlays are less sensitive to the rate of return assumption than to the market size or efficiency assumptions--the differences among cases (different lines on the graph) are large relative to the effect of the rate assumption (differences along a given line). Figures are presented in Table 5.

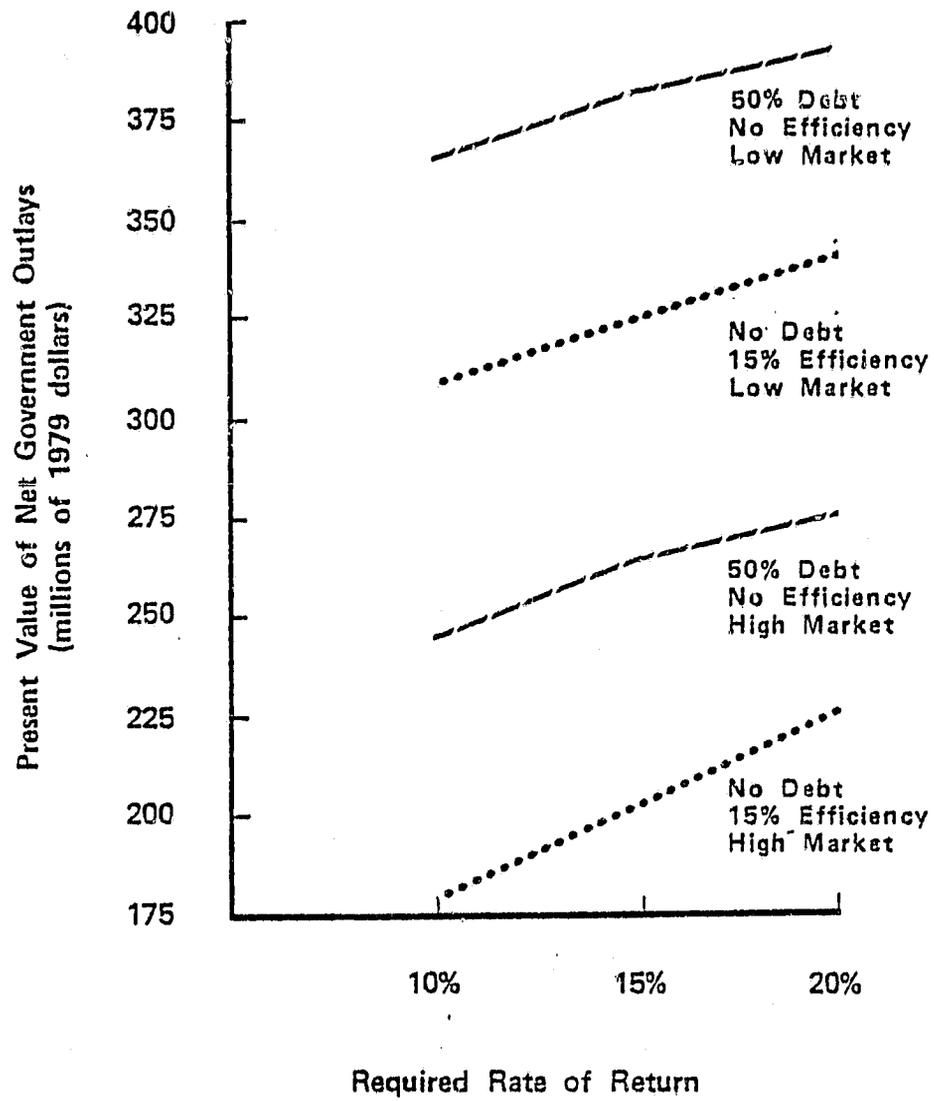
4. Capital Structure

A remote sensing venture might be capitalized in various ways, depending on the organization undertaking the project, financing available, terms of the government's arrangement with the venture, etc. In order to examine the impact of the venture's capital structure, two alternatives were defined:

- No Debt. The venture is assumed to be a wholly owned subsidiary of a large (relative to the venture) diversified corporation. Capital for the venture comes from the corporate pool of funds and must meet the corporate requirement for return on investment. Undertaking the venture has no material effect on the parent corporation's capital structure.

Figure 1

IMPACT OF REQUIRED RATE OF RETURN



	- - - - Other Assumptions - - - -			
	No Debt 15 Percent Efficiency		50 Percent Debt No Efficiency	
	High Market	Low Market	High Market	Low Market
15 Percent	205	327	260	381
10 Percent	179	309	243	369
Difference	(26)	(18)	(17)	(12)
Percent Change	(12.7)	(5.5)	(6.5)	(3.1)
15 Percent	205	327	260	381
20 Percent	226	344	276	391
Difference	21	17	16	10
Percent Change	10.2	5.2	6.2	2.6

- 50 Percent Debt. The subsidiary is able to obtain 50 percent of its long-term capital requirements on a non-recourse basis from a government agency such as the Federal Financing Bank. Thus, the investing parent corporation is still able to obtain the benefits of positive cash flows generated from tax losses in the year they are accrued; and the parent supplies only one half of the capital. This in turn affects the government subsidy required to produce a 15 percent internal rate of return for the parent.

The reduction of equity in the venture does in fact significantly reduce the required level of government agency purchases--for example, from \$478 million to \$425 million in the no efficiency, low market case (see Table 6). From the government's overall point of view, however, much of this gain is lost because tax revenues from the venture are reduced (i.e., the lower levels of government purchases have a large negative impact on profitability which in turn lowers income taxes paid by the venture). This does, however, shift the expenditure away from the agency purchasing service from the venture and into the federal deficit (or surplus).

From the parent company's perspective, the effects of debt capital are, first, to significantly lower the peak cash need of the venture; this is clearly an attractive feature. However, the lowered profitability could present a problem for companies concerned about reported earnings. For example, in the private sector efficient, high market case the cumulative profit after tax with no debt is \$74.6 million, but only \$27.5 million with 50 percent debt. In reality, however, a corporation would be able to diminish the significance of the effect by using alternative, well accepted accounting principles for financial reporting purposes (e.g., capitalizing R&D, using straight line financial depreciation, and writing off launch expenses over the life of the satellite). Such treatment would materially affect reported profit after tax.

Two second-order points concerning government-guaranteed financing may be mentioned. First, though no cost is directly associated with government loan guarantees, there is some probability that the venture will default, requiring government expenditure. Thus on an expected value basis, the guarantee does have a cost; conceivably, this could be recouped through the interest rate charged. Second, financing through federal agencies raises certain monetary policy questions concerning public versus private borrowing and the rate of inflation.

5. Capitalization of Costs

For tax purposes there is some possibility of alternative accounting treatments regarding the depreciation of satellites before being placed in service and the expensing of costs such as those of launch. The choice of treatment affects the venture's cash flow through the tax expense. To examine the importance of this question a case was constructed in which an additional \$101 million of costs, previously expensed, were capitalized. Table 7 indicates that this issue is not a critical one.

Table 6				
DEBT CAPITAL: EFFECT ON PRESENT VALUE OF NET GOVERNMENT OUTLAYS (millions of dollars)				
	- - - Other Assumptions - - -			
	No Efficiency		15 Percent Efficiency	
	Low Market	High Market	Low Market	High Market
<u>P.V. of Government Outlays--1979 Dollars</u>				
No Debt	385	275	327	205
50 Percent Debt	381	260	323	192
Difference	(4)	(15)	(4)	(13)
Percent Change	(1.0)	(5.5)	(1.2)	(6.3)
<u>Government Cash Flows by Type--Current Dollars</u>				
1. Purchases from Venture				
No Debt	478	272	372	157
50 Percent Debt	425	207	326	101
Difference	(53)	(65)	(46)	(56)
2. Taxes				
No Debt	(58.0)	(63.1)	(48.6)	(62.4)
50 Percent Debt	(13.6)	(23.1)	(10.6)	(27.8)
Difference	44.4	40.0	38.0	34.6
<u>Note:</u> The sum of the differences in taxes and purchases do not add to the difference in the present value of outlays because the former figures are in current dollars.				

Table 7		
MAXIMUM EXPENSING OF COSTS: IMPACT ON PRESENT VALUE OF NET GOVERNMENT OUTLAYS		
	Other Assumptions	
	No Debt 15 Percent Efficiency	50 Percent Debt 15 Percent Efficiency
	High Market	High Market
Maximum Expensing	205	192
Capitalization	210	194
Difference	5	2
Percent Change	2.4	1.0

* * * * *

The principal conclusion emerging from the sensitivity analyses is that more must be known about the market before the venture can be attractive to a private investor. As the prior section pointed out, the government also is interested in this determination because only in the high market case is the subsidy reduced to nothing by 1989. Again, if research indicates that a private venture is more likely to enlarge the market for remotely sensed data, then Option 3 appears attractive to both the government and the potential investor.

ADDITIONAL SUGGESTIONS FOR
EXPLORING/IMPLEMENTING OPTION 3

1. Mission Definition. Develop a statement of product/service requirements to be provided by the venture during FY1982-89 in order to receive payment for government purchase subsidies. There may be more economically attractive missions than those currently being considered.
2. Market Forecast. Conduct a study of the potential market for the products/services to be provided by the venture during FY1982-89, based on research with potential users. The results should provide a more reliable framework for structuring the relationship with the venture than exists at present.
3. Cost Forecast. Based on the changes in equipment/system program that no doubt would result from the completion of Steps 1 and 2, revise forecasts of investment and operating costs.
4. Private Sector Contract/Structure. This is a complex subject requiring further study. Elements of the procedure and contract form that probably merit exploration include:
 - a. The merits of establishing a quasi-public independent corporation, similar to Comsat.
 - b. The conduct of a "low-bid" auction among established companies. Low bid criteria might include discounted cost to the government, the increment of subsidy decline per year, the terminal subsidy, option provisions for follow-on contract period.

c. The establishment of certain technical and/or market guarantees. The objective here would be to lower the down-side risk exposure by the venture in order to reduce the magnitude of the required internal rate of return, and thus encourage a lower cost to the government. Under these conditions, rates of return comparable to those employed in utility regulation might be justified (e.g., 12 percent return on net assets for incremental investment).

d. The establishment of incentives to expand the private sector market. An example would be a 50/50 contribution sharing formula above a "baseline" established by the contract and based on the market research study.

e. Special audit provisions to support the contract provisions.

f. Renegotiation provisions if performance under the contract exceeded expected bounds resulting in either egregiously high profitability or possible venture financial failure.

g. Exploration of other issues associated with the private venture. Examples:

- Degree of exclusivity, if any, for data provided (by both venture and government)
- Freedom (or lack of freedom) to negotiate with foreign suppliers
- Ability (or lack thereof) to provide "additional information products"
- Price structure restrictions, if any
- Relationship with on-going NSA R&D efforts

Exhibit 1

SCHEMATIC RELATIONSHIP OF DATA, EXHIBITS, AND OUTPUT

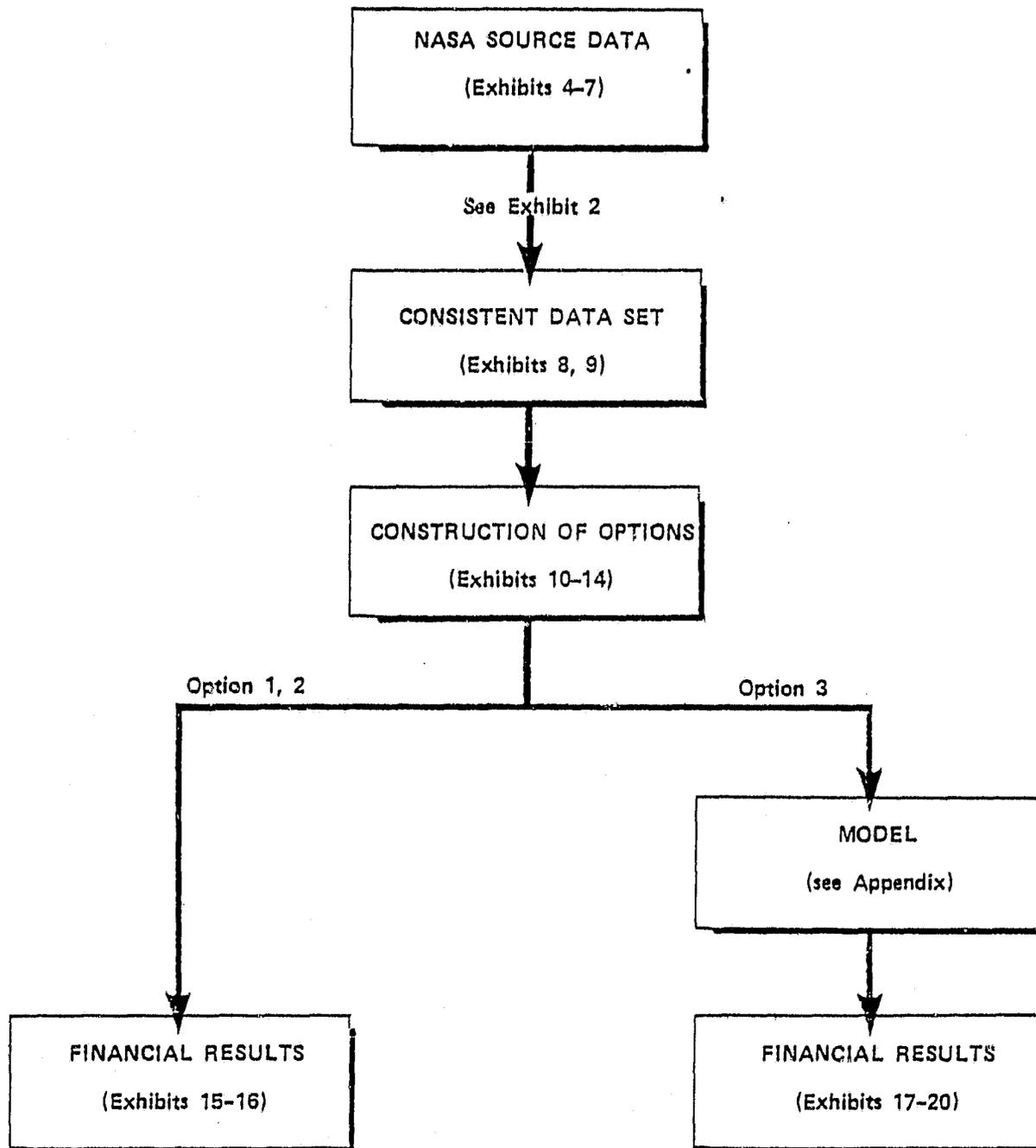


Exhibit 2

SOURCES AND ADJUSTMENTS OF DATA

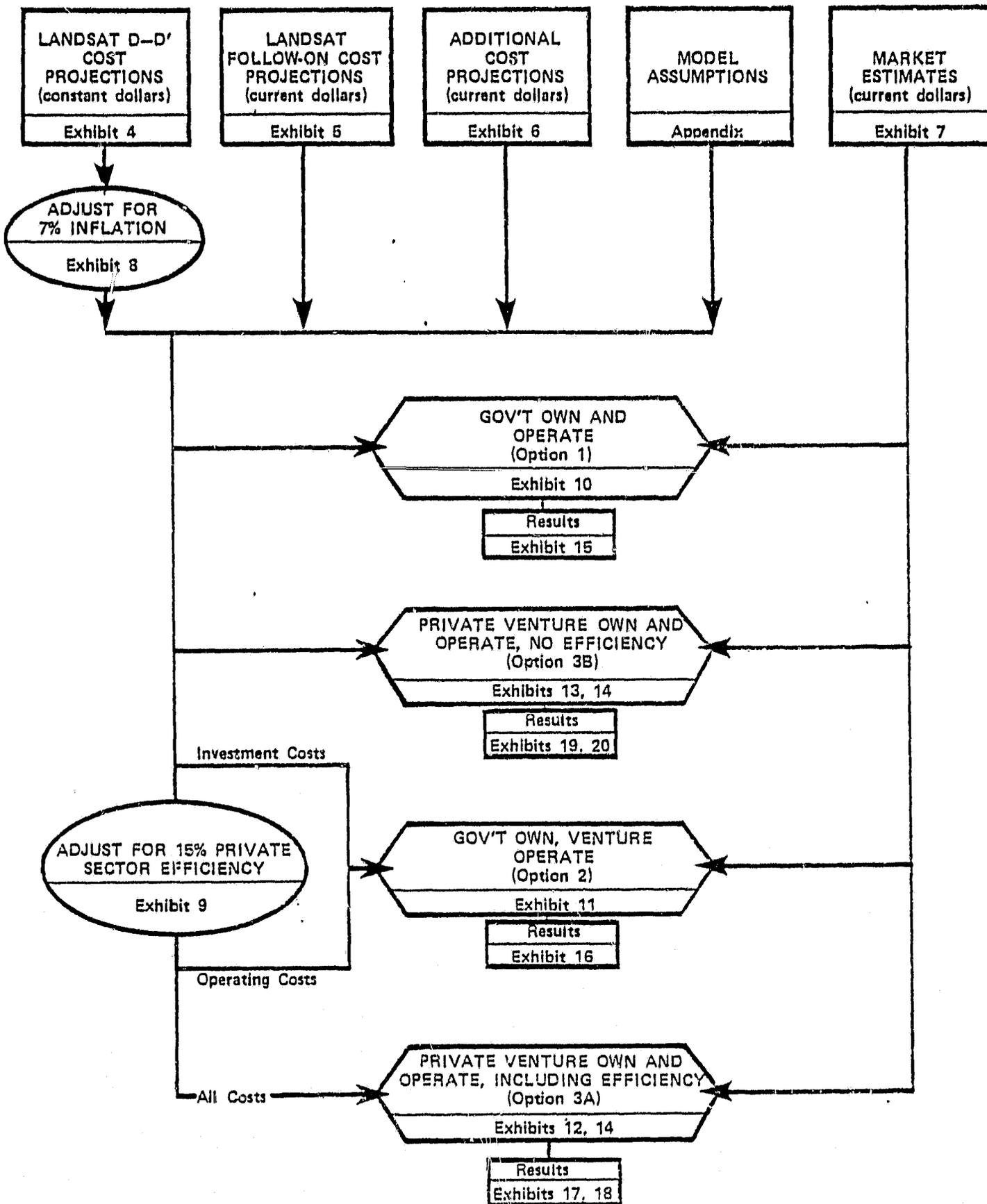
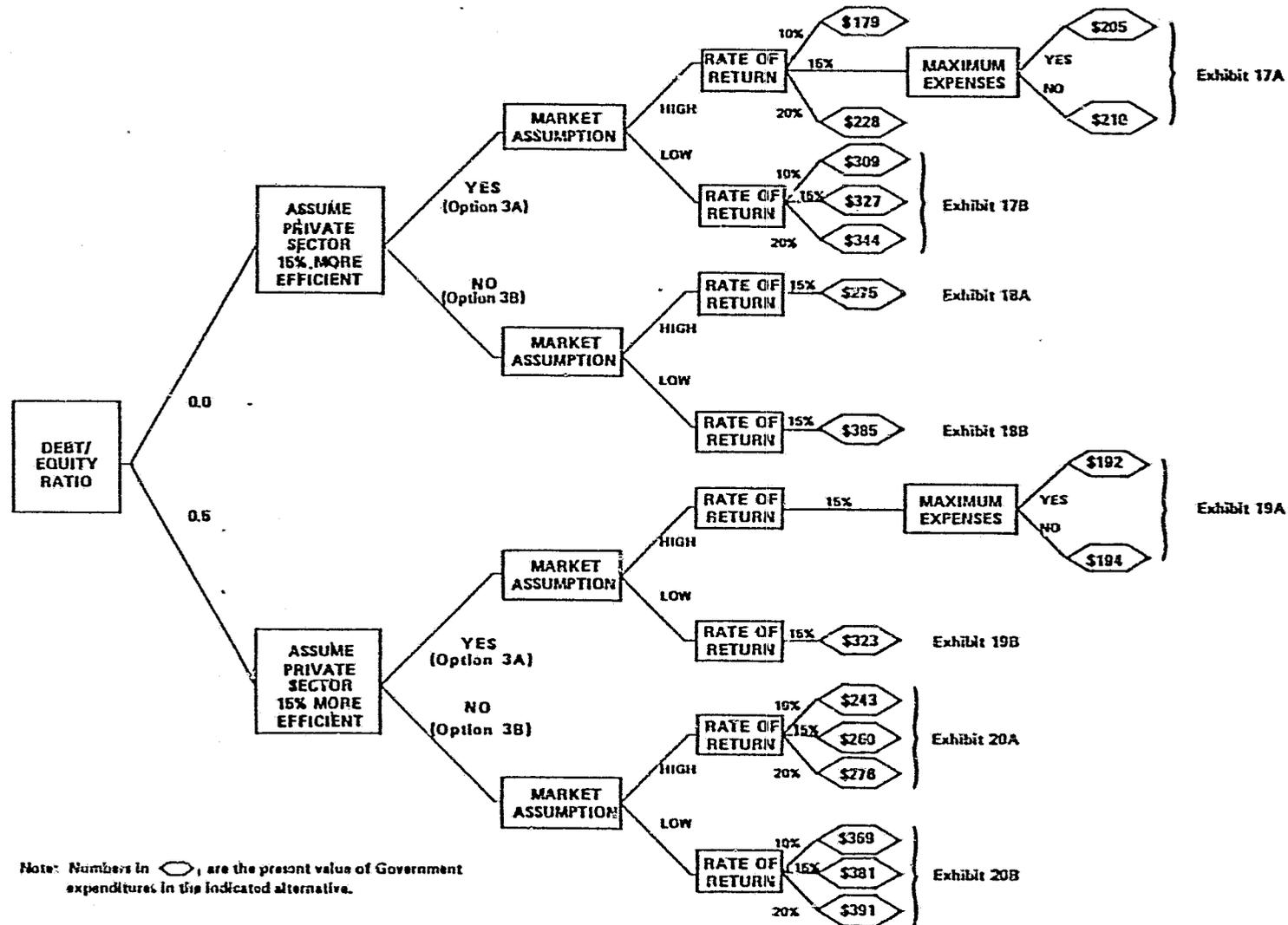


Exhibit 3

OPTION 3: PRIVATE VENTURE
OWN & OPERATE ALTERNATIVES EVALUATED



Note: Numbers in \diamond , are the present value of Government expenditures in the indicated alternative.

Exhibit 4
 PROJECTED COSTS FOR LANDSAT D-D' PROGRAM
 (millions of 1979 dollars)

	1980	1981	1982	1983	1984	1985
SPACECRAFT						
1. Mission System--Flight Segment	29.1	18.2	23.1	8.1		
2. Reliability	.065	.339	.930	.200	5.7	
3. In-House Support	.738	1.10	1.06	.295		
INSTRUMENTS						
4. Thematic Mapper	19.8	17.5	5.5	-		
5. Multi-spectral Scanner	7.9	13.0	1.2	.4		
6. Global Positioning System	1.8	1.4	.8	-		
7. In-House Support	.11	.234	.159	.10		
GROUND OPERATIONS						
8. Mission System--Ground Segment	11.2	20.7	11.6	2.0		
9. Maintenance & Operations	-	-	4.8	8.48	5.79	6.93
10. Other In-House Support	.125	.188	.393	.225	.119	
11. LAS Investigations	.378	.50	1.2	2.7	2.1	1.0
12. IMS	.424	.497	.556	.497	.574	.305
13. Headquarters APA	-	6.5	16.0	8.0	2.0	

Source: Goddard Space Flight Center.

Exhibit 5

PROJECTED COSTS FOR LANDSAT FOLLOW-ON OPTION 2 PROGRAM¹
(millions of current dollars)

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
1. MRS ² Proto-Flight	2.2	11.5	8.0	2.3	1.0					
2. MRS Flight		4.0	12.0	8.0	4.0	2.0				
3. MRS Integration					2.5	2.5	3.0			
4. MRS Investigation			.2	2.2	2.7	3.4	1.5			
5. MRS Preprocessing			1.3	4.3	1.4					
6. DMS/OCC/DOMSAT						12.5	13.2	14.0	14.9	15.8
7. S/C + M/U + INT			10.0	20.0	15.0	5.0				
8. Thematic Mapper (1)		5.0	10.0	5.0	4.0	1.0				
9. Launch Costs (Shuttle)			4.0	6.0	14.0	6.0	14.0	6.0	10.0	
10. Refurbishment				5.0	10.0	25.0	10.0	30.0	10.0	30.0
11. OERS Ø B	3.0	3.0								
12. Subtotal	5.2	23.5	45.5	52.8	54.6	57.5	41.7	50.0	34.9	45.8
13. 20% Contingency		7.2	11.4	13.2	13.7	14.4	10.4	12.5	8.7	11.5

¹Three versions of this program were developed by NASA; the above represents Option 2 of the three.

²MRS stands for Multi-spectral Resource Scanner.

Source: NASA Headquarters
Office of Space and Terrestrial Applications.

Exhibit 6
 ADDITIONAL COST PROJECTIONS
 (millions of current dollars)

	1980	1981	1982	1983	1984	1985	1985	1987	1988	1989
1. R&D	-	-	-	-	-	-	2	2	2	2
2. Launch Services	-	-	-	-	-	-	-	-	-	6.8
3. Spacecraft and Instrumentation: D-D' Program ¹	66.8	45.3	13.5	-	-	-	-	-	-	-
4. Hardware Procurement	-	-	-	-	-	-	35	30	22	20

¹Reflects costs not included in the D-D' projections which have already been committed to the Landsat program. Other additional costs reflect a "going concern" assumption--i.e., that previous expenditure levels would be maintained for programs not yet identified.

Source: PSIS Task Force Working Group
 Revised 4/7/79 and 4/26/79.

Exhibit 7
 MARKET PROJECTIONS
 1982-1989
 (millions of current dollars)

	1982	1983	1984	1985	1986	1987	1988	1989
<u>Low Market</u>								
1. Preprocessed Data	14.1	16.4	19.1	22.2	25.7	29.7	34.4	40.0
2. Foreign Station Fees	1.0	1.29	1.59	1.93	2.35	2.86	3.47	4.1
3. Total Revenues	15.1	17.7	20.7	24.1	28.1	32.6	37.9	44.1
<u>High Market</u>								
4. Preprocessed Data	28.2	32.8	38.2	44.4	51.4	59.5	68.8	80.0
5. Foreign Station Fees	1.0	1.29	1.59	1.93	2.35	2.86	3.47	4.1
6. Total Revenues	29.2	34.1	39.5	46.3	53.8	62.4	72.3	84.1

Source: PSIS Task Force Working Group, 4/26/79.

Exhibit B
 ADJUSTMENT OF LANDSAT DD' COST PROJECTIONS FOR INFLATION
 (millions of current dollars)

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	Source
Inflation Factor ¹	1.070	1.145	1.225	1.311	1.403	1.487	1.576	1.670	1.771	1.895	
1. Mission System--Ground Segment	11.9	23.7	14.2	2.62							Exhibit 4, Line 8
2. Maintenance & Operations			5.88	11.1	8.12	10.3					Exhibit 4, Line 9
3. In-house Support	.133	.215	.481	.294	.166						Exhibit 4, Line 10
4. LAS Investigations	.404	.572	1.47	3.53	2.95	1.48					Exhibit 4, Line 11
5. IMS	.453	.569	.681	.652	.805	.453					Exhibit 4, Line 12
6. Headquarters APA		7.44	19.6	16.5	2.81						Exhibit 4, Line 13

¹Assuming 7 percent annual inflation, this factor is equal to $(1.07)^t$ where t is equal to the number of years elapsed since 1979.

Exhibit 9

ADJUSTMENT OF COST PROJECTIONS TO REFLECT EFFICIENCIES REALIZED BY PRIVATE SECTOR¹
(millions of current dollars)

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	Source
Efficiency Factor @ 15%: Multiply by:	.85	.85	.85	.85	.85	.85	.85	.85	.85	.85	
1. MRS PF	1.87	9.77	6.8	1.96	.85						Exhibit 5, Line 1
2. MRS FLT		3.4	10.2	6.80	3.4	1.7					Exhibit 5, Line 2
3. MRS INTEG					2.13	2.13	2.55				Exhibit 5, Line 3
4. MRS INVES			.17	1.87	2.30	2.89	1.28				Exhibit 5, Line 4
5. MRS PREPROC			1.11	3.66	1.19						Exhibit 5, Line 5
6. DMS/OCC/DOMSAT						10.6	11.2	11.9	12.7	13.4	Exhibit 5, Line 6
7. S/C + M/U + INT (1)			8.5	17.0	12.8	4.3					Exhibit 5, Line 7
8. TM (1)		4.3	8.5	4.3	3.4	.85					Exhibit 5, Line 8
9. Shuttles			3.4	5.1	11.9	5.1	11.9	5.1	8.5		Exhibit 5, Line 9
10. Refurbishment				4.3	8.5	21.3	8.5	25.5	8.5	25.5	Exhibit 5, Line 10
11. Subtotal	1.87	17.5	38.7	44.9	46.4	48.9	35.4	42.5	29.7	38.9	Exhibit 5, Line 12
12. 20% Contingency		6.12	9.69	11.2	11.6	12.2	8.84	10.6	7.39	9.77	Exhibit 5, Line 13
GROUND OPERATIONS											
13. Mission System--Ground Segment	10.1	20.1	12.1	2.23							Exhibit 8, Line 1
14. Maintenance & Operations			4.99	9.43	6.9	8.76					Exhibit 8, Line 2
15. In-House Support	.113	.183	.409	.249	.141						Exhibit 8, Line 3
16. LAS Investigations	.343	.486	1.25	3.0	2.51	1.26					Exhibit 8, Line 4
17. IMS	.385	.483	.579	.554	.684	.385					Exhibit 8, Line 5
18. Headquarters APA		6.32	16.7	8.93	2.39						Exhibit 8, Line 6
19. R&D							1.7	1.7	1.7	1.7	Exhibit 6, Line 1
20. Launch Services										5.78	Exhibit 6, Line 2
21. Hardware Procurement							29.75	25.5	18.7	17.0	Exhibit 6, Line 4

¹The hypothesis was advanced that government cost estimates overstated the costs a private venture would incur because of the private sector's incentive or efficiency. To measure the importance of such savings, an efficiency factor of 15 percent was assumed. Exhibits 2 and 3 indicate where this assumption was made. Note that not all line items are reduced for efficiency under every option (see Exhibits 10-14).

Exhibit 10

SOURCES OF LINE ITEMS INCLUDED IN OPTION 1: GOVERNMENT OWN AND OPERATE
(millions of current dollars)

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	Source	
INVESTMENT SCHEDULE												
Hardware Procurement												
1.	MRS PF	2.2	11.5	8.0	2.3	1.0					Exhibit 5, Line 1	
2.	FLY		4.0	12.0	8.0	4.0	2.0	-			Exhibit 5, Line 2	
3.	INTEG					2.5	2.5	-			Exhibit 5, Line 3	
4.	S/C			10.0	20.0	15.0	5.0	-			Exhibit 5, Line 7	
5.	TM		5.0	10.0	5.0	4.0	1.0	-			Exhibit 5, Line 8	
6.	REFURB				5.0	10.0	25.0	-			Exhibit 5, Line 10	
7.	SHUTTLES											
	(do not include in total, but use in subtotal calculation)										(See below)	
8.	Subtotal		20.5	44.0	46.3	50.5	35.5	14.0	6.0	10.0		
9.	Capitalized Portion of 20% Contingency			6.3	11.0	11.6	12.6	10.4	-	-		
10.	D-D'	66.8	45.3	13.5	-	-	-	-	-	-	Note A	
11.	PSIS Revised Projections	-	-	-	-	-	35.0	30.0	22.0	20.0	Exhibit 6, Line 3	
12.	Total Hardware Procurement	69.0	60.6	56.5	49.6	48.1	45.9	35.0	30.0	22.0	Exhibit 6, Line 4	
Preprocessing Facilities												
13.	MRS Preprocessing			1.3	4.3	1.4					Exhibit 5, Line 5	
14.	Mission System											
15.	Ground Segment	11.9	23.7	14.2	2.62						Exhibit 8, Line 1	
	Total Preprocessing Facilities	11.9	23.7	15.5	6.9	1.4						
Launch Services												
16.	(See Shuttles, Supra)	-	-	-	-	-	-	-	-	6.8	Exhibit 6, Line 2	
R&D												
17.	MRS INVES			0.2	2.2	2.7	3.4				Exhibit 5, Line 4	
18.	LAS INVES	.404	.572	1.47	3.53	2.95	1.4				Exhibit 8, Line 4	
19.	PSIS Revised Projections							2.0	2.0	2.0	Exhibit 6, Line 1	
20.	Total R&D	.404	.572	1.67	5.7	5.7	4.8	2.0	2.0	2.0		
OPERATING EXPENSES												
Operations/Communications												
21.	DMS/OCC							12.5	13.2	14.0	15.8	Exhibit 5, Line 6
22.	Maintenance & Operations			5.88	11.1	8.12	10.3					Exhibit 6, Line 2
23.	In-House Support	.133	.215	.481	.294	.166						Exhibit 8, Line 3
24.	Total Operating Expenses	.133	.215	6.4	11.4	8.3	22.8	13.2	14.0	14.9	15.8	
Other Expenses												
25.	IMS	.453	.569	.681	.652	.805	.453					Exhibit 8, Line 5
26.	HQ APA	-	7.44	19.6	10.5	2.81						Exhibit 8, Line 6
27.	Remainder of 20% Contingency	-	0.9	0.4	1.6	1.1	4.0	3.7	3.5	3.7	4.0	Note A
28.	Total Other Expenses	.453	8.91	20.7	12.8	4.7	4.45	3.7	3.5	3.7	4.0	

Note A:
The "20% contingency" item is an allowance for unidentified expenses associated with a satellite program such as DD' and its follow-on. It was estimated by NASA as 20 percent of the follow-on program costs. The contingency allowance was then allocated to capital expenditures and expenses in proportion to the dollar amounts of costs assigned to those categories. Thus:

$$\text{Capitalized portion of contingency} = \left(\frac{\text{capitalized costs}}{\text{total costs}} \right) (20\% \text{ contingency})$$

$$\text{Expensed portion of contingency} = \left(\frac{\text{expensed costs}}{\text{total costs}} \right) (20\% \text{ contingency})$$

The line sources are as follows:

$$\text{Capitalized portion of contingency: Line 9, Exhibit 10} = \left(\frac{\text{Line 8, Exhibit 10}}{\text{Line 12, Exhibit 5}} \right) (\text{Line 13, Exhibit 5})$$

$$\text{Expensed portion of contingency: Line 27, Exhibit 10} = (\text{Line 13, Exhibit 5}) - (\text{Line 9, Exhibit 10}).$$

Exhibit 11
 SOURCES OF LINE ITEMS INCLUDED IN OPTION 2: GOVERNMENT OWN, PRIVATE VENTURE OPERATE
 (millions of current dollars)

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	Source	
<u>INVESTMENT SCHEDULE</u>												
<u>Hardware Procurement</u>												
1.	MRS PF	2.2	11.5	8.0	2.3	1.0					Exhibit 5, Line 1	
2.	FLT		4.0	12.0	8.0	4.0	2.0	-			Exhibit 5, Line 2	
3.	INTEG					2.5	2.5	-			Exhibit 5, Line 3	
4.	S/C (1)			10.0	20.0	15.0	5.0	-			Exhibit 5, Line 7	
5.	TM (1)		5.0	10.0	5.0	4.0	1.0	-			Exhibit 5, Line 8	
6.	REFURB				5.0	10.0	25.0	-			Exhibit 5, Line 10	
7.	SHUTTLES (do not include in total, but use in subtotal calculation)			(4.0)	6.0	14.0	6.0	14.0	6.0	10.0	(See below)	
8.	Subtotal		20.5	44.0	46.3	50.5	35.5	-	-	-		
9.	Capitalized Portion of 20% Contingency			11.0	11.6	12.6	10.4	-	-	-		
10.	D-D*	66.8	45.3	13.5							Note A, Exhibit 10 Exhibit 6, Line 3	
11.	PSIS Revised Projections						35.0	30.0	22.0	20.0	Exhibit 6, Line 4	
12.	Total Hardware Procurement	69.0	60.6	56.5	49.6	48.1	45.9	35.0	30.0	22.0	20.0	
<u>Preprocessing Facilities</u>												
13.	MRS Preprocessing			1.3	4.3	1.4					Exhibit 5, Line 5	
14.	Mission System Ground Segment	11.9	23.7	14.2	2.62						Exhibit 8, Line 1	
15.	Total Preprocessing Facilities	11.9	23.7	15.5	6.9	1.4						
<u>Launch Services</u>												
16.	(See Shuttles, Supra)	-	-	-	-	-	-	-	-	6.8	Exhibit 6, Line 2	
<u>R&D</u>												
17.	MRS INVES			0.2	2.2	2.7	3.4				Exhibit 5, Line 4	
18.	LAS INVES	.404	.572	1.47	3.53	2.95	1.4				Exhibit 8, Line 4	
19.	PSIS Revised Projections						2.0	2.0	2.0	2.0	Exhibit 6, Line 1	
20.	Total R&D	.404	.572	1.67	5.7	5.7	4.8	2.0	2.0	2.0		
<u>OPERATING EXPENSES</u> (Assumes 15% Efficiency Factor)												
<u>Operations/Communications</u>												
21.	DMS/DCC/DOHSAT						10.6	11.2	11.9	12.7	13.4	Exhibit 9, Line 6
22.	Maintenance & Operations			4.99	9.43	6.9	8.76					Exhibit 8, Line 14
23.	In-House Support	.113	.183	.409	.249	.141	-					Exhibit 9, Line 15
24.	Total Operations/Communications	.113	.183	5.4	9.65	7.04	19.4	11.2	11.9	12.7	13.4	
<u>Other Expenses</u>												
25.	IMS	.385	.483	.579	.554	.684	.385					Exhibit 9, Line 17
26.	HQ APA	-	6.32	16.7	8.93	2.39	-					Exhibit 9, Line 18
27.	Remainder of 20% Contingency	-	.765	.34	1.36	.935	3.4	3.15	2.98	3.15	3.4	Exhibit 10, Line 21
28.	Total Other Expenses	.385	7.57	16.6	10.8	4.00	3.79	3.15	2.98	3.15	3.4	

*Reduced by 15 percent efficiency factor.

Exhibit 12

SOURCES OF LINE ITEMS INCLUDED IN OPTION 3A:
PRIVATE VENTURE OWN & OPERATE, ASSUMING 15 PERCENT EFFICIENCY FACTOR
(millions of current dollars)

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	Source
INVESTMENT SCHEDULE											
Hardware Procurement											
1.		3.4	10.2	6.8	3.4	1.7					Exhibit 9, Line 2
2.		-	-	-	2.13	2.13	-				Exhibit 9, Line 3
3.		-	8.5	17.0	12.8	4.3					Exhibit 9, Line 7
4.		4.3	8.5	4.3	3.5	.85					Exhibit 9, Line 8
5.		-	-	4.3	8.5	21.3					Exhibit 9, Line 10
6.		6.12	9.69	11.2	11.6	12.2					Exhibit 9, Line 13
7.		-	-	-	-	-	29.8	25.5	18.7	17.0	Exhibit 9, Line 21
8.		13.8	36.9	43.6	41.8	42.5	29.8	25.5	18.7	17.0	
Preprocessing Facilities											
9.			1.11	3.66	1.19						Exhibit 9, Line 5
10.		10.1	20.1	12.1	2.23						Exhibit 9, Line 13
11.	10.1	20.1	13.2	5.89	1.19						
R&D											
Applications											
12.			0.17	1.87	2.3	2.89	-	-	-	-	Exhibit 9, Line 4
13.	.343	.48	1.25	3.0	2.51	1.26	-	-	-	-	Exhibit 9, Line 17
14.			1.42	4.87	4.81	4.15	1.7	1.7	1.7	1.7	Exhibit 9, Line 19
15.	.343	.48	1.42	4.87	4.81	4.15	1.7	1.7	1.7	1.7	
16.	1.87	9.77	6.80	1.96	.850	.000	.000	.000	.000	.000	Exhibit 9, Line 1
Launch Services											
17.			3.4	5.1	11.9	5.1	11.9	5.1	8.5		Exhibit 9, Line 9
18.										5.78	Exhibit 9, Line 20
19.			3.4	5.1	11.9	5.1	11.9	5.1	8.5	5.78	
OPERATING EXPENSES											
Operations/Communications											
20.						10.6	11.2	11.9	12.7	13.4	Exhibit 9, Line 6
21.			4.99	9.43	6.9	8.76					Exhibit 9, Line 14
22.	.113	.183	.409	.249	.141						Exhibit 9, Line 15
23.	.113	.183	5.4	9.68	7.04	19.4	11.2	11.9	12.7	13.4	
Other Expenses											
24.	.385	.483	.579	.554	.684	.385					Exhibit 9, Line 17
25.		6.32	16.7	8.93	2.39	-					Exhibit 9, Line 18
26.	.385	6.80	16.3	9.48	3.07	.385	-	-	-	-	

Exhibit 13
 SOURCES OF LINE ITEMS INCLUDED IN OPTION 3B:
 PRIVATE VENTURE OWN & OPERATE, ASSUMING NO EFFICIENCY FACTOR
 (millions of current dollars)

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	Source
<u>INVESTMENT SCHEDULE</u>											
<u>Hardware Procurement</u>											
1.		4.0	12.0	8.0	4.0	2.0	-				Exhibit 5, Line 2
2.		-	-	-	2.5	2.5	-				Exhibit 5, Line 3
3.		-	10.0	20.0	15.0	5.0	-				Exhibit 5, Line 7
4.		5.0	10.0	5.0	4.0	1.0	-				Exhibit 5, Line 8
5.		-	-	5.0	10.0	25.0	-				Exhibit 5, Line 10
6.		7.2	11.4	13.2	13.7	14.4	-				
7.		-	-	-	-	-	35.0	30.0	22.0	20.0	Exhibit 6, Line 4
8.		16.2	43.4	51.2	49.2	49.9	35.0	30.0	22.0	20.0	
<u>Preprocessing Facilities</u>											
9.		-	-	1.3	4.3	1.4					Exhibit 5, Line 5
10.		-	-	-	-	-					Exhibit 8, Line 1
11.	11.9	23.7	14.2	2.62	-						
	11.9	23.7	15.5	6.9	1.4						
<u>R&D</u>											
<u>Applications</u>											
12.				0.2	2.2	2.7	3.2				Exhibit 5, Line 4
13.	.404	.572	1.46	3.53	2.95	1.48					Exhibit 8, Line 4
14.							2.0	2.0	2.0	2.0	Exhibit 6, Line 1
15.	.404	.57	1.67	5.73	5.65	4.9	2.0	2.0	2.0	2.0	
16.	2.2	11.5	8.0	2.3	1.0	-	-	-	-	-	
<u>Launch Services</u>											
17.			4.0	6.0	14.0	6.0	14.0	6.0	10.0	-	Exhibit 5, Line 9
18.										6.8	Exhibit 6, Line 2
19.			4.0	6.0	14.0	6.0	14.0	6.0	10.0	6.8	
<u>OPERATING EXPENSES</u>											
<u>Operations/Communications</u>											
20.						12.5	13.2	14.0	14.9	15.8	Exhibit 5, Line 6
21.											Exhibit 8, Line 2
22.	.133	.215	5.88	11.1	8.12	10.3					Exhibit 8, Line 3
23.	.133	.215	.481	.294	.166	-					
	.113	.215	6.36	11.4	8.28	22.8	13.2	14.0	14.9	15.8	
<u>Other Expenses</u>											
24.	.453	.569	.681	.652	.805	.453					Exhibit 8, Line 5
25.	-	7.44	19.6	10.5	2.81	-					Exhibit 8, Line 6
26.	.453	8.0	20.3	11.2	3.62	.453	-	-	-	-	

Exhibit 14
EFFECT OF EXPENSING CERTAIN COSTS PREVIOUSLY CAPITALIZED
(millions of current dollars)

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	Source
<u>OPTION 3A</u>											
<u>Investment Schedule</u>											
1. Launch Services	0	0	0	0	0	0	0	0	0	0	
2. Instrumentation	0	0	0	0	0	0	0	0	0	0	
3. Applications	0	0	0	0	0	0	0	0	0	0	
<u>Expenses</u>											
<u>Other Expenses</u>											
Launch	0	0	3.4	5.1	11.9	5.1	11.9	5.1	8.5	5.78	Exhibit 12, Line 19
Applications	.343	.486	1.42	4.87	4.87	4.15	1.7	1.7	1.7	1.7	Exhibit 12, Line 15
Instrumentation	1.87	9.77	6.80	1.96	.858	0	0	0	0	0	Exhibit 12, Line 16
Other Expenses	.385	6.8	16.3	9.48	3.07	3.85	0	0	0	0	Exhibit 12, Line 26
4. Total Other Expenses	2.6	17.1	27.9	23.4	20.6	9.6	13.6	6.8	10.2	6.5	
<u>OPTION 3B</u>											
<u>Investment Schedule</u>											
5. Launch Services	0	0	0	0	0	0	0	0	0	0	
6. Instrumentation	0	0	0	0	0	0	0	0	0	0	
7. Applications	0	0	0	0	0	0	0	0	0	0	
<u>Expenses</u>											
<u>Other Expenses</u>											
Launch	0	0	4.0	6.0	14.0	6.0	14.0	6.0	10.0	6.8	Exhibit 13, Line 19
Applications	.404	.572	1.67	5.73	5.65	4.88	2.0	2.0	2.0	2.0	Exhibit 13, Line 15
Instrumentation	2.2	11.5	8.0	2.3	1.0	0	0	0	0	0	Exhibit 13, Line 16
Other Expenses	.453	8.0	20.3	11.2	3.62	.453	0	0	0	0	Exhibit 13, Line 26
8. Total Other Expenses	3.06	20.1	33.9	25.2	24.3	11.3	16.0	8.0	12.0	8.8	

¹ Changes are from Exhibit 12 (for Option 3A) and 13 (for Option 3B). They appear as changes to "Other Expenses" in Exhibits 17-20.

EXHIBIT 17.4
OPTION 3A

Page 1 of 8
Sources:
Exhibits 7, 12, 14
See Appendix

No Debt, Private Sector Efficient, Rapid Expensing, High Market, 10% IRR
(millions of current dollars)

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	TOTAL	
INVESTMENT SCHEDULE												
1	1	1	1	1	1	1	1	1	1	1	1	
1	1	1	1	1	1	1	1	1	1	1	1	
2	10.1	20.1	13.2	5.89	1.19	.000	.000	.000	.000	.000	50.5	Ex 12, Ln 11
3	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	Ex 14, Ln 1
4	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	Ex 14, Ln 2
5	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	Ex 14, Ln 3
6	.000	.000	2.92	.489	.570	.654	.742	.861	.991	1.17	8.40	
7	10.1	33.2	53.0	50.0	43.6	43.2	30.5	26.4	19.7	18.2	328	
INCOME STATEMENT												
8												
9	.000	.000	28.2	32.8	38.2	44.4	51.4	59.5	68.8	80.0	403	Ex 7, Ln 4
10	.000	.000	1.00	1.29	1.59	1.93	2.35	2.86	3.47	4.00	18.5	Ex 7, Ln 5
11	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	
12	.000	.000	29.2	34.1	39.8	46.3	53.8	62.4	72.3	84.0	422	
13	.000	.000	20.3	17.4	14.5	11.6	8.70	5.80	2.90	.000	81.2	
14	.000	.000	49.5	51.5	54.3	57.9	62.5	68.2	75.2	84.0	503	
15												
16	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	
17	.000	.000	49.5	51.5	54.3	57.9	62.5	68.2	75.2	84.0	503	
18	.113	.183	5.39	9.69	7.03	19.5	11.2	11.9	12.7	13.4	91.1	Ex 12, Ln 23
19	.006	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	Ex 14, Ln 4
20	2.89	11.7	22.7	30.4	34.1	37.2	38.8	35.6	31.7	27.2	270	
21	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	
22	2.60	17.1	27.9	23.4	20.6	9.60	13.6	6.80	10.2	6.50	138	
23	-5.60	-29.0	-6.49	-12.0	-7.43	-8.34	.877	13.8	20.6	36.9	3.34	
24	-2.58	-13.4	-2.99	-5.50	-3.42	-3.83	.404	6.37	9.47	17.0	1.54	
25	1.01	3.39	5.01	4.95	4.30	4.25	2.98	2.55	1.87	1.70	32.0	
26	-2.01	-12.3	1.50	-1.51	.286	-2.51	3.45	10.0	13.0	21.6	33.8	
CASH FLOW STATEMENT												
27	-2.01	-12.3	1.50	-1.51	.286	-2.51	3.45	10.0	13.0	21.6	33.8	
28	2.89	11.7	22.7	30.4	34.1	37.2	38.8	35.6	31.7	27.2	270	
29	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	
30	*	*	*	*	*	*	*	*	*	*	125	125
31	.872	-5.39	24.2	28.8	34.4	36.9	40.2	45.6	44.7	174	429	
32	10.1	33.2	53.0	50.0	43.6	43.2	30.5	26.4	19.7	18.2	328	

EXHIBIT 17 A
OPTION 3A

No Debt, Private Sector Efficient, Rapid Expensing, High Market, 10% IRR
(millions of current dollars)

Page 1 of 8
Sources:
Exhibits 7, 12, 14
See Appendix

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	TOTAL		
INVESTMENT SCHEDULE													

1	HARDWARE PROCUREMENT	.000	13.8	36.9	43.6	41.8	42.5	29.8	25.5	18.7	17.0	270	Ex 12, Ln 8
2	PRE-PROCESSING FACILITIES	10.1	20.1	13.2	5.89	1.19	.000	.060	.000	.000	.000	50.5	Ex 12, Ln 11
3	LAUNCH SERVICES R AND E	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	Ex 14, Ln 1
4	APPLICATIONS	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	Ex 14, Ln 2
5	INSTRUMENTATION	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	Ex 14, Ln 3
6	NET WORKING CAP ADDITION	.000	.000	2.92	.489	.570	.654	.742	.861	.991	1.17	8.40	
7	TOTAL FUNDS INVESTED	10.1	33.9	53.0	50.0	43.6	43.2	30.5	26.4	19.7	18.2	328	
INCOME STATEMENT													

8	REVENUES												
9	PRE-PROCESSED DATA	.000	.000	28.2	32.8	38.2	44.4	51.4	59.5	68.8	80.0	403	Ex 7, Ln 4
10	FOREIGN STATION FEES	.000	.000	1.00	1.29	1.59	1.93	2.35	2.86	3.47	4.00	18.5	Ex 7, Ln 5
11	OTHER INCOME	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	
12	TOTAL SALES	.000	.000	29.2	34.1	39.8	46.3	53.8	62.4	72.3	84.0	422	
13	GOVERNMENT PURCHASES	.000	.000	20.3	17.4	14.5	11.6	8.70	5.80	2.90	.000	81.2	
14	TOTAL REVENUES	.000	.000	49.5	51.5	54.3	57.9	62.5	68.2	75.2	84.0	503	
15	EXPENSES												
16	INFO. PRODUCT PROCESSING	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	
17	GROSS PROFIT	.000	.000	49.5	51.5	54.3	57.9	62.5	68.2	75.2	84.0	503	
18	OPERATIONS/COMMUNICATION	.113	.183	5.39	9.69	7.03	19.5	11.2	11.9	12.7	13.4	91.1	Ex 12, Ln 23
19	MARKETING COSTS	.000	.000	.600	.000	.000	.000	.000	.000	.000	.000	.000	Ex 14, Ln 4
20	DEPRECIATION	2.89	11.7	22.7	30.4	34.1	37.2	36.8	35.6	31.7	27.2	270	
21	INTEREST EXPENSE	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	
22	OTHER EXPENSES	2.60	17.1	27.9	23.4	20.6	9.60	13.6	6.80	10.2	6.50	138	
23	PROFIT BEFORE TAX	-5.60	-29.0	-6.49	-12.0	-7.43	-8.34	.877	13.8	20.6	36.9	3.34	
24	FEDERAL TAX	-2.58	-13.4	-2.99	-5.50	-3.42	-3.83	.404	6.37	9.47	17.0	1.54	
25	TAX CREDITS	1.01	3.39	5.01	4.95	4.30	4.25	2.98	2.55	1.87	1.70	32.0	
26	PROFIT AFTER TAX	-2.01	-12.3	1.50	-1.51	.286	-2.51	3.45	10.0	13.0	21.6	33.8	
CASH FLOW STATEMENT													

27	PROFIT AFTER TAX	-2.01	-12.3	1.50	-1.51	.286	-2.51	3.45	10.0	13.0	21.6	33.8	
28	DEPRECIATION	2.89	11.7	22.7	30.4	34.1	37.2	36.8	35.6	31.7	27.2	270	
29	LONG-TERM DEBT ADDITION	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	
30	RESIDUAL VALUE AFTER TAX	*	*	*	*	*	*	*	*	*	125	125	
31	SOURCES OF FUNDS	.872	-5.39	24.2	28.8	34.4	36.9	40.2	45.6	44.7	174	429	
LESS													
32	CAPITAL INVESTMENT	10.1	33.9	53.0	49.5	43.6	43.2	30.5	26.4	19.7	18.2	328	

EXHIBIT 17 A
OPTION 3A
No Debt, Private Sector Efficient, Rapid Expensing, High Market; 15% IRR
(millions of current dollars)

Page 3 of 8
Sources:
Exhibits 7, 12,
14

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	TOTAL
INVESTMENT SCHEDULE											
=====											
HARDWARE PROCUREMENT	.000	13.8	36.9	43.6	41.8	42.5	39.8	25.5	18.7	17.0	270
PRE-PROCESSING FACILITIES	10.1	20.1	13.2	5.89	1.19	.000	.000	.000	.000	.000	50.5
LAUNCH SERVICES	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
R AND D											
APPLICATIONS	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
INSTRUMENTATION	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
NET WORKING CAP ADDITION	.090	.000	2.92	.489	.570	.654	.742	.861	.991	1.17	8.40
TOTAL FUNDS INVESTED	10.1	33.9	53.0	50.0	43.6	43.2	39.5	26.4	19.7	18.2	328
INCOME STATEMENT											
=====											
REVENUES											
PRE-PROCESSED DATA	.000	.000	28.2	32.8	38.2	44.4	51.4	59.5	68.8	80.0	403
FOREIGN STATION FEES	.000	.000	1.00	1.29	1.59	1.93	2.35	2.86	3.47	4.00	18.5
OTHER INCOME	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
TOTAL SALES	.000	.000	29.2	34.1	39.8	46.3	53.8	62.4	72.3	84.0	422
GOVERNMENT PURCHASES	.000	.000	39.2	33.6	28.0	22.4	16.8	11.2	5.60	.000	157
TOTAL REVENUES	.000	.000	68.4	67.7	67.8	68.7	70.6	73.6	77.9	84.0	579
EXPENSES											
INFO. PRODUCT PROCESSING	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
GROSS PROFIT	.000	.000	68.4	67.7	67.8	68.7	70.6	73.6	77.9	84.0	579
OPERATIONS/COMMUNICATION	.113	.183	5.39	9.69	7.03	19.5	11.2	11.9	12.7	13.4	91.1
MARKETING COSTS	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
DEPRECIATION	2.89	11.7	22.7	30.4	34.1	37.2	36.8	35.6	31.7	27.2	270
INTEREST EXPENSE	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
OTHER EXPENSES	2.60	17.1	27.9	23.4	20.6	9.60	13.6	6.80	10.2	6.50	138
PROFIT BEFORE TAX	-5.60	-29.0	12.4	4.24	6.07	2.46	8.98	19.2	23.3	36.9	78.9
FEDERAL TAX	-2.58	-13.4	5.71	1.95	2.79	1.13	4.13	8.85	10.7	17.0	36.3
TAX CREDITS	1.01	3.39	5.01	4.95	4.30	4.25	2.98	2.55	1.87	1.70	32.0
PROFIT AFTER TAX	-2.01	-12.3	11.7	7.24	7.58	5.58	7.03	12.9	14.4	21.6	74.6
CASH FLOW STATEMENT											
=====											
PROFIT AFTER TAX	-2.01	-12.3	11.7	7.24	7.58	5.58	7.03	12.9	14.4	21.6	74.6
DEPRECIATION	2.89	11.7	22.7	30.4	34.1	37.2	36.8	35.6	31.7	27.2	270
LONG-TERM DEBT ADDITION	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
RESIDUAL VALUE AFTER TAX	*	*	*	*	*	*	*	*	*	*	125
SOURCES OF FUNDS	.072	-5.39	34.4	37.6	41.7	42.7	44.6	48.6	46.1	174	470
LESS											
CAPITAL INVESTMENT	10.1	33.9	50.1	49.5	43.0	42.5	39.5	26.4	19.7	18.2	328

EXHIBIT 17 A
OPTION 3A

Page 5 of 8
Sources:
Exhibits 7, 12.

No Debt, Private Sector Efficient, Deferred Expensing, High Market, 15% IRR
(millions of current dollars)

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	TOTAL
INVESTMENT SCHEDULE											
=====											
HARDWARE PROCUREMENT	.000	13.8	36.9	43.6	41.8	42.5	29.8	25.5	18.7	17.0	270
PRE-PROCESSING FACILITIES	10.1	20.1	13.2	5.89	1.19	.000	.000	.000	.000	.000	50.5
LAUNCH SERVICES	.000	.000	3.40	5.10	11.9	5.10	11.9	5.10	8.50	5.78	56.8
R AND D											
APPLICATIONS	.343	.486	1.42	4.87	4.87	4.15	1.70	1.70	1.70	1.70	22.9
INSTRUMENTATION	1.87	9.77	6.80	1.96	.858	.000	.000	.000	.000	.000	21.3
NET WORKING CAP ADDITION	.000	.000	2.92	.489	.570	.654	.742	.861	.991	1.17	8.40
TOTAL FUNDS INVESTED	12.3	44.2	64.6	61.9	61.2	52.4	44.1	33.2	29.9	25.7	429
INCOME STATEMENT											
=====											
REVENUES											
PRE-PROCESSED DATA	.000	.000	28.2	32.8	38.2	44.4	51.4	59.5	68.8	80.0	403
FOREIGN STATION FEES	.000	.000	1.00	1.29	1.59	1.93	2.35	2.86	3.47	4.00	18.5
OTHER INCOME	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
TOTAL SALES	.000	.000	29.2	34.1	39.8	46.3	53.8	62.4	72.3	84.0	422
GOVERNMENT PURCHASES	.000	.000	41.3	35.4	29.5	23.6	17.7	11.8	5.90	.000	165
TOTAL REVENUES	.000	.000	70.5	69.5	69.3	69.9	71.5	74.2	78.2	84.0	587
EXPENSES											
INFO. PRODUCT PROCESSING	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
GROSS PROFIT	.000	.000	70.5	69.5	69.3	69.9	71.5	74.2	78.2	84.0	587
OPERATIONS/COMMUNICATION	.113	.183	5.39	9.69	7.03	19.5	11.2	11.9	12.7	13.4	91.1
MARKETING COSTS	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
DEPRECIATION	3.52	15.1	28.4	37.9	44.5	47.4	48.4	46.5	42.5	37.2	352
INTEREST EXPENSE	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
OTHER EXPENSES	.385	6.80	16.3	9.48	3.07	3.58	.000	.000	.000	.000	39.6
PROFIT BEFORE TAX	-4.02	-22.1	20.4	12.5	14.7	-5.86	11.8	15.8	23.6	33.4	105
FEDERAL TAX	-1.85	-10.2	9.37	5.73	6.75	-2.70	5.43	7.27	10.6	15.4	48.2
TAX CREDITS	1.23	4.42	6.17	6.14	6.06	5.18	4.34	3.23	2.89	2.45	42.1
PROFIT AFTER TAX	-9.37	-7.52	17.2	12.9	14.0	4.86	10.7	11.8	15.3	20.5	98.7
CASH FLOW STATEMENT											
=====											
PROFIT AFTER TAX	-9.37	-7.52	17.2	12.9	14.0	4.86	10.7	11.8	15.3	20.5	98.7
DEPRECIATION	3.52	15.1	28.4	37.9	44.5	47.4	48.4	46.5	42.5	37.2	352
LONG-TERM DEBT ADDITION	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
RESIDUAL VALUE AFTER TAX	*	*	*	*	*	*	*	*	*	125	125
SOURCES OF FUNDS	2.58	7.60	45.6	50.7	58.5	52.3	59.2	58.2	57.8	183	575
LESS											
CAPITAL INVESTMENT	12.3	44.2	64.6	61.9	61.2	52.4	44.1	33.2	29.9	25.7	429

EXHIBIT 17 B
OPTION 3A
No Debt, Private Sector Efficient, Rapid Expensing, Low Market, 10% IRR
(millions of current dollars)

Page 1 of 6
Sources:
Exhibits 7, 12, 14.

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	TOTAL
INVESTMENT SCHEDULE											
=====											
HARDWARE PROCUREMENT	.000	13.8	36.9	43.6	41.8	42.5	29.8	25.5	18.7	17.0	270
PRE-PROCESSING FACILITIES	10.1	20.1	13.2	5.89	1.19	.000	.000	.000	.000	.000	50.5
LAUNCH SERVICES	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
R AND D											
APPLICATIONS	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
INSTRUMENTATION	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
NET WORKING CAP ADDITION	.000	.000	1.51	.259	.300	.344	.392	.451	.531	.623	4.41
TOTAL FUNDS INVESTED	10.1	33.9	51.6	49.7	43.3	42.8	30.2	26.0	19.2	17.6	324
INCOME STATEMENT											
=====											
REVENUES											
PRE-PROCESSED DATA	.000	.000	14.1	16.4	19.1	22.2	25.7	29.7	34.4	40.0	202
FOREIGN STATION FEES	.000	.000	1.00	1.29	1.59	1.93	2.35	2.86	3.47	4.10	18.6
OTHER INCOME	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
TOTAL SALES	.000	.000	15.1	17.7	20.7	24.1	28.1	32.6	37.9	44.1	220
GOVERNMENT PURCHASES	.000	.000	59.8	54.1	48.4	42.7	37.0	31.3	25.6	19.9	319
TOTAL REVENUES	.000	.000	74.9	71.8	69.1	66.8	65.1	63.9	63.5	64.0	539
EXPENSES											
INFO. PRODUCT PROCESSING	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
GROSS PROFIT	.000	.000	74.9	71.8	69.1	66.8	65.1	63.9	63.5	64.0	539
OPERATIONS/COMMUNICATION	.113	.183	5.39	9.69	7.03	19.5	11.2	11.9	12.7	13.4	91.1
MARKETING COSTS	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
DEPRECIATION	2.89	11.7	22.7	30.4	34.1	37.2	36.8	35.6	31.7	27.2	270
INTEREST EXPENSE	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
OTHER EXPENSES	2.60	17.1	27.9	23.4	20.6	9.60	13.6	6.80	10.2	6.50	138
PROFIT BEFORE TAX	-5.60	-29.0	18.9	8.34	7.37	.565	3.48	9.54	8.88	16.9	39.3
FEDERAL TAX	-2.58	-13.4	8.70	3.84	3.39	.260	1.60	4.39	4.09	7.77	18.1
TAX CREDITS	1.01	3.39	5.01	4.95	4.30	4.25	2.98	2.55	1.87	1.70	32.0
PROFIT AFTER TAX	-2.01	-12.3	15.2	9.45	8.28	4.56	4.86	7.70	6.67	10.8	53.3
CASH FLOW STATEMENT											
=====											
PROFIT AFTER TAX	-2.01	-12.3	15.2	9.45	8.28	4.56	4.86	7.70	6.67	10.8	53.3
DEPRECIATION	2.89	11.7	22.7	30.4	34.1	37.2	36.8	35.6	31.7	27.2	270
LONG-TERM DEBT ADDITION	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
RESIDUAL VALUE AFTER TAX	*	*	*	*	*	*	*	*	*	69.7	69.7
SOURCES OF FUNDS	.872	-5.39	37.9	39.8	42.4	41.7	41.6	43.3	38.4	108	393
LESS											
CAPITAL INVESTMENT	10.1	33.9	50.1	49.5	43.0	42.5	29.8	25.5	18.7	17.0	320
NET WORKING CAP ADDITION	.000	.000	1.51	.259	.300	.344	.392	.451	.531	.623	4.41

EXHIBIT 17 B
OPTION 3A
No Debt, Private Sector Efficient, Rapid Expensing, Low Market, 15% IRR
(millions of current dollars)

Page 3 of 6
Sources:
Exhibits 7, 12, 14.

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	TOTAL
INVESTMENT SCHEDULE =====											
HARDWARE PROCUREMENT	.000	13.8	36.9	43.6	41.8	42.5	29.8	25.5	18.7	17.0	370
PRE-PROCESSING FACILITIES	10.1	20.1	13.2	5.89	1.19	.000	.000	.000	.000	.000	50.5
LAUNCH SERVICES	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
R AND D											
APPLICATIONS	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
INSTRUMENTATION	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
NET WORKING CAP ADDITION	.000	.000	1.51	.259	.300	.344	.392	.451	.531	.623	4.41
TOTAL FUNDS INVESTED	10.1	33.9	51.6	49.7	43.3	42.8	30.2	26.0	19.2	17.6	324
INCOME STATEMENT =====											
REVENUES											
PRE-PROCESSED DATA	.000	.000	14.1	16.4	19.1	22.2	25.7	29.7	34.4	40.0	202
FOREIGN STATION FEES	.000	.000	1.00	1.29	1.59	1.93	2.35	2.86	3.47	4.10	18.6
OTHER INCOME	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
TOTAL SALES	.000	.000	15.1	17.7	20.7	24.1	28.1	32.6	37.9	44.1	220
GOVERNMENT PURCHASES	.000	.000	73.1	65.5	57.9	50.3	42.7	35.1	27.5	19.9	372
TOTAL REVENUES	.000	.000	88.2	83.2	78.6	74.4	70.8	67.7	65.4	64.0	592
EXPENSES											
INFO. PRODUCT PROCESSING	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
GROSS PROFIT	.000	.000	88.2	83.2	78.6	74.4	70.8	67.7	65.4	64.0	592
OPERATIONS/COMMUNICATION	.113	.183	5.39	9.69	7.03	19.5	11.2	11.9	12.7	13.4	91.1
MARKETING COSTS	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
DEPRECIATION	2.89	11.7	22.7	30.4	34.1	37.2	36.8	35.6	31.7	27.2	270
INTEREST EXPENSE	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
OTHER EXPENSES	2.60	17.1	27.9	23.4	20.6	9.60	13.6	6.80	10.2	6.50	138
PROFIT BEFORE TAX	-5.60	-29.0	32.2	19.7	16.9	8.16	9.18	13.3	10.8	16.9	92.5
FEDERAL TAX	-2.58	-13.4	14.8	9.08	7.76	3.76	4.22	6.14	4.96	7.77	42.6
TAX CREDITS	1.01	3.39	5.01	4.95	4.30	4.25	2.98	2.55	1.87	1.70	32.0
PROFIT AFTER TAX	-2.01	-12.3	22.4	15.6	13.4	8.66	7.94	9.75	7.69	10.8	82.0
CASH FLOW STATEMENT =====											
PROFIT AFTER TAX	-2.01	-12.3	22.4	15.6	13.4	8.66	7.94	9.75	7.69	10.8	82.0
DEPRECIATION	2.89	11.7	22.7	30.4	34.1	37.2	36.8	35.6	31.7	27.2	270
LONG-TERM DEBT ADDITION	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
RESIDUAL VALUE AFTER TAX	*	*	*	*	*	*	*	*	*	69.7	69.7
SOURCES OF FUNDS	.872	-5.39	45.1	46.0	47.5	45.8	44.7	45.4	39.4	108	422
LESS											
CAPITAL INVESTMENT	10.1	33.9	51.6	49.7	43.3	42.8	30.2	26.0	19.2	17.6	324

SOURCES OF FUNDS	.872	-.539	45.1	46.0	47.5	45.8	44.7	45.4	39.4	108	422
LESS											
CAPITAL INVESTMENT	10.1	33.9	50.1	49.5	43.0	42.5	29.8	25.5	18.7	17.0	320
NET WORKING CAP ADDITION	.000	.000	1.51	.259	.300	.344	.392	.451	.531	.623	4.41
USES OF FUNDS	10.1	33.9	51.6	49.7	43.3	42.8	30.2	26.0	19.2	17.6	324
NET FUNDS GENERATED (REQ)	-9.23	-34.4	-6.50	-3.78	4.21	2.98	14.5	19.4	20.1	90.1	97.5
CUMULATIVE SOURCE OF FUNDS	-9.23	-43.7	-50.2	-54.0	-49.7	-46.8	-32.2	-12.8	7.33	97.5	
PRESENT VALUE OF FUNDS	-8.39	-28.5	-4.89	-2.58	2.01	1.68	7.45	9.06	8.55	34.8	19.8
INT. RATE OF RETURN	.149	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000

Ex.178 p4

BALANCE SHEET

ASSETS

CURRENT ASSETS	.000	.000	4.53	5.31	6.21	7.24	8.41	9.77	11.4	13.2	
FIXED ASSETS	10.1	44.0	94.1	144	187	229	259	284	303	320	
LESS DEPRECIATION	2.89	14.6	37.3	67.7	102	139	176	211	243	270	
NET FIXED ASSETS	7.21	29.4	56.8	75.9	84.8	90.1	83.2	73.0	60.0	49.8	
TOTAL ASSETS	7.21	29.4	61.3	81.2	91.0	97.4	91.6	82.8	71.4	63.1	

LIABILITIES

CURRENT LIABILITIES	.000	.000	3.02	3.54	4.14	4.83	5.61	6.51	7.57	8.82	
LONG-TERM DEBT	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	
TOTAL LIABILITIES	.000	.000	3.02	3.54	4.14	4.83	5.61	6.51	7.57	8.82	
EQUITY INVESTMENT	9.23	43.7	50.2	54.0	49.7	46.8	32.2	12.8	-7.33	-27.7	
RETAINED EARNINGS	-2.01	-14.3	8.10	23.7	37.1	45.8	53.7	63.5	71.2	82.0	
TOTAL EQUITY	7.21	29.4	58.3	77.7	86.9	92.5	86.0	76.3	63.8	54.2	
TOTAL LIABILITIES+EQUITY	7.21	29.4	61.3	81.2	91.0	97.4	91.6	82.8	71.4	63.1	

EFFECT ON GOVERNMENT

CAPITAL INVESTMENT	66.8	45.3	13.5	.000	.000	.000	.000	.000	.000	.000	126
PURCHASED FROM VENTURE	.000	.000	73.1	65.5	57.9	50.3	42.7	35.1	27.5	19.9	372
TAX CREDITS	1.01	3.39	5.01	4.95	4.30	4.25	2.98	2.55	1.57	1.70	32.0
LESS TAXES PAID	-2.58	-13.4	14.8	9.08	7.78	3.78	4.22	6.14	4.96	13.8	48.6
NET GOVT EXPENDITURES	70.4	62.0	76.8	61.4	54.4	50.8	41.5	31.5	24.4	7.81	481
PV OF NET GOVT EXP	327	.000	.000	.000	.900	.000	.000	.000	.000	.000	

EXHIBIT 17 B
OPTION 3A
No Debt, Private Sector Efficient, Rapid Expensing, Low Market, 20% IRR
(millions of current dollars)

Page 5 of 6
Sources:
Exhibits 7, 12, 14

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	TOTAL
INVESTMENT SCHEDULE											
HARDWARE PROCUREMENT	.000	13.8	36.9	43.6	41.8	42.5	29.8	25.5	18.7	17.0	270
PRE-PROCESSING FACILITIES	10.1	20.1	13.2	5.89	1.19	.000	.000	.000	.000	.000	50.5
LAUNCH SERVICES	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
R AND D APPLICATIONS	.000	.000	.600	.000	.000	.000	.000	.000	.000	.000	.000
INSTRUMENTATION	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
NET WORKING CAP ADDITION	.000	.000	1.51	.259	.300	.344	.392	.451	.571	.623	4.41
TOTAL FUNDS INVESTED	10.1	33.9	-51.6	49.7	43.3	42.8	30.2	26.0	19.2	17.6	324
INCOME STATEMENT											
REVENUES											
PRE-PROCESSED DATA	.000	.000	14.1	16.4	19.1	22.2	25.7	29.7	34.4	40.0	202
FOREIGN STATION FEES	.000	.000	1.00	1.29	1.59	1.93	2.35	2.86	3.47	4.10	18.6
OTHER INCOME	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
TOTAL SALES	.000	.000	15.1	17.7	20.7	24.1	28.1	32.6	37.9	44.1	220
GOVERNMENT PURCHASES	.000	.000	85.7	76.3	66.9	57.5	48.1	38.7	29.3	19.9	422
TOTAL REVENUES	.000	.000	101	94.0	87.6	81.6	76.2	71.3	67.2	64.0	643
EXPENSES											
INFO. PRODUCT PROCESSING	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
GROSS PROFIT	.000	.000	101	94.0	87.6	81.6	76.2	71.3	67.2	64.0	643
OPERATIONS/COMMUNICATION	.113	.183	5.39	9.69	7.03	19.5	11.2	11.9	12.7	13.4	91.1
MARKETING COSTS	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
DEPRECIATION	2.89	11.7	22.7	30.4	34.1	37.2	36.8	35.6	31.7	27.2	270
INTEREST EXPENSE	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
OTHER EXPENSES	2.60	17.1	27.9	23.4	20.6	9.60	13.6	6.80	10.2	6.50	138
PROFIT BEFORE TAX	-5.60	-29.0	44.8	30.5	25.9	15.4	14.6	16.9	12.6	16.9	143
FEDERAL TAX	-2.58	-13.4	20.6	14.0	11.9	7.07	6.71	7.79	5.79	7.77	65.8
TAX CREDITS	1.01	3.39	5.01	4.95	4.30	4.25	2.98	2.55	1.87	1.70	32.0
PROFIT AFTER TAX	-2.01	-12.3	29.2	21.4	18.3	12.5	10.9	11.7	8.66	10.8	109
CASH FLOW STATEMENT											
PROFIT AFTER TAX	-2.01	-12.3	29.2	21.4	18.3	12.5	10.9	11.7	8.66	10.8	109
DEPRECIATION	2.89	11.7	22.7	30.4	34.1	37.2	36.8	35.6	31.7	27.2	270
LONG-TERM DEBT ADDITION	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
RESIDUAL VALUE AFTER TAX	*	*	*	*	*	*	*	*	*	*	69.7
SOURCES OF FUNDS	.872	-5.39	51.9	51.8	52.4	49.7	47.6	47.3	40.4	108	449
LESS											
CAPITAL INVESTMENT	10.1	33.9	-51.6	49.7	43.3	42.8	30.2	26.0	19.2	17.6	324

114
412
523

EXHIBIT 18A

OPTION 3B

Page 1 of 2
Source: Exhibits
7,13, 14No Debt, Private Sector Not Efficient, Rapid Expansion, High Market 15% IRR
(millions of current dollars)

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	TOTAL
INVESTMENT SCHEDULE =====											
1 HARDWARE PROCUREMENT	.000	16.2	43.4	51.2	49.2	49.9	35.0	30.0	22.0	20.0	317Ex.13, Ln 8
2 PRE-PROCESSING FACILITIES	11.9	23.7	15.5	6.90	1.40	.000	.000	.000	.000	.000	59.4Ex. 13, Ln4
3 LAUNCH SERVICES R AND D	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000Ex.14, Ln 1
4 APPLICATIONS	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000Ex 14, Ln 2
5 INSTRUMENTATION	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000Ex 14, Ln 3
6 NET WORKING CAP ADDITION	.000	.000	2.92	.489	.570	.654	.742	.861	.991	1.18	8.41
7 TOTAL FUNDS INVESTED	11.9	39.9	61.8	58.6	51.2	50.6	35.7	30.9	23.0	21.2	385
INCOME STATEMENT =====											
8 REVENUES											
9 PRE-PROCESSED DATA	.000	.000	28.2	32.8	38.2	44.4	51.4	59.5	68.8	80.0	403Ex 7, Ln 4
10 FOREIGN STATION FEES	.000	.000	1.00	1.29	1.59	1.93	2.35	2.86	3.47	4.10	18.6Ex 7, Ln 5
11 OTHER INCOME	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
12 TOTAL SALES	.000	.000	29.2	34.1	39.8	46.3	53.8	62.4	72.7	84.1	422
13 GOVERNMENT PURCHASES	.000	.000	67.9	58.2	48.5	38.8	29.1	19.4	9.7	.000	272
14 TOTAL REVENUES	.000	.000	97.1	92.3	88.3	85.1	82.9	81.8	82.0	84.1	693
15 EXPENSES											
16 INFO. PRODUCT PROCESSING	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
17 GROSS PROFIT	.000	.000	97.1	92.3	88.3	85.1	82.9	81.8	82.0	84.1	693
18 OPERATIONS/COMMUNICATION	.133	.215	6.36	11.4	8.28	22.8	13.2	14.0	14.9	15.8	107Ex 13, Ln23
19 MARKETING COSTS	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
20 DEPRECIATION	3.40	13.8	26.7	35.7	40.1	43.7	43.2	41.9	37.2	32.0	318
21 INTEREST EXPENSE	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
22 OTHER EXPENSES	3.06	20.1	33.9	25.2	24.3	11.3	16.0	8.00	12.0	8.80	163Ex 14, Ln 4
23 PROFIT BEFORE TAX	-6.59	-34.1	30.1	20.0	15.6	7.35	10.4	17.9	17.8	27.5	106
24 FEDERAL TAX	-3.03	-15.7	13.9	9.21	7.19	3.38	4.80	8.23	8.20	12.7	48.8
25 TAX CREDITS	1.19	3.99	5.89	5.81	5.06	4.99	3.50	3.00	2.20	2.00	37.6
26 PROFIT AFTER TAX	-2.37	-14.4	22.2	14.6	13.5	8.96	9.14	12.7	11.8	16.9	94.9
CASH FLOW STATEMENT =====											
27 PROFIT AFTER TAX	-2.37	-14.4	22.2	14.6	13.5	8.96	9.14	12.7	11.8	16.9	94.9
28 DEPRECIATION	3.40	13.8	26.7	35.7	40.1	43.7	43.2	41.9	37.2	32.0	318
29 LONG-TERM DEBT ADDITION	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
30 RESIDUAL VALUE AFTER TAX	*	*	*	*	*	*	*	*	*	104	104
31 SOURCES OF FUNDS	1.03	-6.19	48.9	52.3	53.6	52.6	52.3	54.5	49.1	153	516
LESS											
32 CAPITAL INVESTMENT	11.9	39.9	61.8	58.6	51.2	50.6	35.7	30.9	23.0	21.2	385

EXHIBIT 18 B
OPTION 3B
No Debt, Private Sector Not Efficient, Rapid Expensing, Low Market, 15% IRR
(millions of current dollars)

Page 1 of 2
Sources:
Exhibits 7, 13, 14.

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	TOTAL
INVESTMENT SCHEDULE											
=====											
HARDWARE PROCUREMENT	.000	16.2	43.4	51.2	49.2	49.9	35.0	30.0	22.0	20.0	317
PRE-PROCESSING FACILITIES	11.9	23.7	15.5	6.90	1.40	.000	.000	.000	.000	.000	59.4
LAUNCH SERVICES	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
R AND D											
APPLICATIONS	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
INSTRUMENTATION	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
NET WORKING CAP ADDITION	.000	.000	1.51	.259	.300	.344	.392	.451	.531	.623	4.41
TOTAL FUNDS INVESTED	11.9	39.9	60.4	58.4	50.9	50.2	35.4	30.5	22.5	20.6	381
INCOME STATEMENT											
=====											
REVENUES											
PRE-PROCESSED DATA	.000	.000	14.1	16.4	19.1	22.2	25.7	29.7	34.4	40.0	202
FOREIGN STATION FEES	.000	.000	1.00	1.29	1.59	1.93	2.35	2.86	3.47	4.10	18.6
OTHER INCOME	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
TOTAL SALES	.000	.000	15.1	17.7	20.7	24.1	28.1	32.6	37.9	44.1	220
GOVERNMENT PURCHASES	.000	.000	87.4	79.5	71.6	63.7	55.8	47.9	40.0	32.1	478
TOTAL REVENUES	.000	.000	102	97.2	92.3	87.8	83.9	80.5	77.9	76.2	690
EXPENSES											
INFO. PRODUCT PROCESSING	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
GROSS PROFIT	.000	.000	102	97.2	92.3	87.8	83.9	80.5	77.9	76.2	698
OPERATIONS/COMMUNICATION	.133	.215	6.36	11.4	8.28	22.8	13.2	14.0	14.9	15.8	107
MARKETING COSTS	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
DEPRECIATION	3.40	13.8	26.7	35.7	40.1	43.7	43.2	41.9	37.2	32.0	318
INTEREST EXPENSE	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
OTHER EXPENSES	3.06	20.1	33.9	25.2	24.3	11.3	16.0	8.00	12.0	8.80	163
PROFIT BEFORE TAX	-6.59	-34.1	35.5	24.9	19.6	10.0	11.4	16.6	13.7	19.6	111
FEDERAL TAX	-3.03	-15.7	16.3	11.5	9.03	4.62	5.26	7.63	6.31	9.02	50.9
TAX CREDITS	1.19	3.99	5.89	5.81	5.06	4.99	3.50	3.60	2.20	2.00	37.6
PROFIT AFTER TAX	-2.37	-14.4	25.1	19.3	15.7	10.4	9.68	12.0	9.61	12.6	97.4
CASH FLOW STATEMENT											
=====											
PROFIT AFTER TAX	-2.37	-14.4	25.1	19.3	15.7	10.4	9.68	12.0	9.61	12.6	97.4
DEPRECIATION	3.40	13.8	26.7	35.7	40.1	43.7	43.2	41.9	37.2	32.0	318
LONG-TERM DEBT ADDITION	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
RESIDUAL VALUE AFTER TAX	*	*	*	*	*	*	*	*	*	81.1	81.1
SOURCES OF FUNDS	1.03	-6.19	51.8	54.9	55.7	54.1	52.9	53.8	46.9	126	496
LESS											
CAPITAL INVESTMENT	11.9	39.9	58.9	58.1	50.6	49.9	35.0	30.0	22.0	20.0	376
NET WORKING CAP ADDITION	.000	.000	1.51	.259	.300	.344	.392	.451	.531	.623	4.41

EXHIBIT 19A

Page 1 of 4
Sources: Ex. 7, 12, 14.

OPTION 3A

Debt: Equity = 1:1, Private Sector Efficient, Rapid Expensing, High Market, 15% IRR
(millions of current dollars)

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	TOTAL
INVESTMENT SCHEDULE											
=====											
1 HARDWARE PROCUREMENT	.000	13.8	36.9	43.6	41.8	42.5	29.8	25.5	18.7	17.0	270 Ex 12, Ln 8
2 PRE-PROCESSING FACILITIES	10.1	20.1	13.2	5.89	1.19	.000	.000	.000	.000	.000	50.5 Ex 12, Ln 11
3 LAUNCH SERVICES R AND D	.000	.000	.000	.000	.000	.000	.060	.000	.000	.000	.000 Ex 14, Ln 1
4 APPLICATIONS	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000 Ex 14, Ln 1
5 INSTRUMENTATION	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000 Ex 14, Ln 1
6 NET WORKING CAP ADDITION	.000	.000	2.92	.489	.570	.654	.742	.861	.991	1.17	8.40
7 TOTAL FUNDS INVESTED	10.1	33.9	53.0	50.0	43.6	43.2	30.5	26.4	19.7	18.2	328
INCOME STATEMENT											
=====											
8 REVENUES											
9 PRE-PROCESSED DATA	.000	.000	28.2	32.8	38.2	44.4	51.4	59.5	68.8	80.0	403 Ex 4, Ln 4
10 FOREIGN STATION FEES	.000	.000	1.00	1.29	1.59	1.93	2.35	2.86	3.47	4.00	18.5 Ex 4, Ln 5
11 OTHER INCOME	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
12 TOTAL SALES	.000	.000	29.2	34.1	39.8	46.3	53.8	62.4	72.3	84.0	422
13 GOVERNMENT PURCHASES	.000	.000	25.2	21.6	18.0	14.4	10.8	7.20	3.60	.000	101
14 TOTAL REVENUES	.000	.000	54.4	55.7	57.8	60.7	64.6	69.6	75.9	84.0	523
15 EXPENSES											
16 INFO. PRODUCT PROCESSING	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
17 GROSS PROFIT	.000	.000	54.4	55.7	57.8	60.7	64.6	69.6	75.9	84.0	523
18 OPERATIONS/COMMUNICATION	.113	.113	5.39	9.69	7.03	19.5	11.2	11.9	12.7	13.4	91.1 Ex 1, Ln 23
19 MARKETING COSTS	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
20 DEPRECIATION	2.89	11.7	22.7	30.4	34.1	37.2	36.8	35.6	31.7	27.2	270
21 INTEREST EXPENSE	.301	1.31	2.38	3.90	5.50	3.91	3.52	3.90	4.15	2.39	31.3
22 OTHER EXPENSES	2.60	17.1	27.9	23.4	20.6	9.60	13.6	6.80	10.2	6.50	138 Ex 14, Ln 4
23 PROFIT BEFORE TAX	-5.98	-30.3	-3.98	-11.7	-9.43	-9.44	-5.46	11.3	17.1	34.5	-8.40
24 FEDERAL TAX	-2.75	-14.0	-1.83	-5.36	-4.34	-4.34	-2.51	5.22	7.88	15.9	-3.86
25 TAX CREDITS	1.01	3.39	5.01	4.95	4.30	4.25	2.98	2.55	1.87	1.70	32.0
26 PROFIT AFTER TAX	-2.22	-13.0	2.86	-1.35	-7.94	-8.50	2.69	8.67	11.1	20.3	27.5
CASH FLOW STATEMENT											

EXHIBIT 19 A
OPTION 3A

Page 3 of 4
Sources:
Exhibits 7, 12.

Debt: Equity = 1:1, Private Sector Efficient, Deferred Expensing, High Market, 15% IRR

(millions of current dollars)

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	TOTAL
INVESTMENT SCHEDULE											
=====											
HARDWARE PROCUREMENT	.000	13.8	36.9	43.6	41.8	42.5	29.8	28.5	18.7	17.0	270
PRE-PROCESSING FACILITIES	10.1	20.1	13.2	5.89	1.19	.000	.000	.000	.000	.000	50.5
LAUNCH SERVICES	.000	.000	3.40	5.10	11.9	5.10	11.9	5.10	8.50	5.78	56.8
R AND D											
APPLICATIONS	.343	.486	1.42	4.87	4.87	4.15	1.70	1.70	1.70	1.70	22.9
INSTRUMENTATION	1.87	9.77	6.80	1.96	.858	.000	.000	.000	.000	.000	21.3
NET WORKING CAP ADDITION	.000	.000	2.92	4.89	.570	.654	.742	.861	.991	1.17	8.40
TOTAL FUNDS INVESTED	12.3	44.2	64.6	61.9	61.2	52.4	44.1	33.2	29.9	25.7	429
INCOME STATEMENT											
=====											
REVENUES											
PRE-PROCESSED DATA	.000	.000	28.2	32.8	38.2	44.4	51.4	59.5	68.8	80.0	403
FOREIGN STATION FEES	.000	.000	1.00	1.29	1.59	1.93	2.35	2.86	3.47	4.00	18.5
OTHER INCOME	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
TOTAL SALES	.000	.000	29.2	34.1	39.8	46.3	53.8	62.4	72.3	84.0	422
GOVERNMENT PURCHASES	.000	.000	23.8	20.4	17.0	13.6	10.2	6.80	3.40	.000	95.2
TOTAL REVENUES	.000	.000	53.0	54.5	56.8	59.9	64.0	69.2	75.7	84.0	517
EXPENSES											
INFO. PRODUCT PROCESSING	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
GROSS PROFIT	.000	.000	53.0	54.5	56.8	59.9	64.0	69.2	75.7	84.0	517
OPERATIONS/COMMUNICATION	.113	.183	5.39	9.69	7.03	19.5	11.2	11.9	12.7	13.4	91.1
MARKETING COSTS	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
DEPRECIATION	3.52	15.1	28.4	37.9	44.5	47.4	48.4	46.5	42.5	37.2	352
INTEREST EXPENSE	.465	1.68	2.96	4.82	7.11	4.94	4.59	5.02	5.52	3.20	40.3
OTHER EXPENSES	.385	6.80	16.3	9.48	3.07	3.58	.000	.000	.000	.000	39.6
PROFIT BEFORE TAX	-4.48	-23.8	-.088	-7.36	-4.94	-15.5	-.291	5.78	14.9	30.2	-5.55
FEDERAL TAX	-2.06	-10.9	-.040	-3.39	-2.27	-7.14	-.174	2.66	6.87	13.9	-2.55
TAX CREDITS	1.23	4.42	6.17	6.14	6.03	5.18	4.34	3.23	2.89	2.45	42.1
PROFIT AFTER TAX	-1.19	-8.43	6.12	2.17	3.40	-3.21	4.18	6.35	11.0	18.8	39.1
CASH FLOW STATEMENT											
=====											
PROFIT AFTER TAX	-1.19	-8.43	6.12	2.17	3.40	-3.21	4.18	6.35	11.0	18.8	39.1
DEPRECIATION	3.52	15.1	28.4	37.9	44.5	47.4	48.4	46.5	42.5	37.2	352
LONG-TERM DEBT ADDITION	4.40	14.5	18.1	12.0	8.34	2.48	-2.15	-6.65	-6.31	-5.77	39.0
RESIDUAL VALUE AFTER TAX	*	*	*	*	*	*	*	*	*	105	105
SOURCES OF FUNDS	6.73	21.2	52.7	52.1	56.2	46.7	50.5	46.2	47.2	156	535
LESS											
=====											

EXHIBIT 19 B
OPTION 3A

Debt: Equity = 1:1, Private Sector Efficient, Rapid Expensing, Low Market, 15% IRR

Page 1 of 2
Sources:
Exhibits 7.12.14

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	TOTAL
(millions of current dollars)											
INVESTMENT SCHEDULE											
=====											
HARDWARE PROCUREMENT	.000	13.8	36.9	43.6	41.8	42.5	29.8	25.5	18.7	17.0	270
PRE-PROCESSING FACILITIES	10.1	20.1	13.2	5.09	1.19	.000	.000	.000	.000	.000	50.5
LAUNCH SERVICES	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
R AND D											
APPLICATIONS	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
INSTRUMENTATION	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
NET WORKING CAP ADDITION	.000	.000	1.51	.259	.300	.344	.392	.451	.531	.623	4.41
TOTAL FUNDS INVESTED	10.1	33.9	51.6	49.7	43.3	42.8	30.2	26.0	19.2	17.6	324
INCOME STATEMENT											
=====											
REVENUES											
PRE-PROCESSED DATA	.000	.000	14.1	16.4	19.1	22.2	25.7	29.7	34.4	40.0	202
FOREIGN STATION FEES	.000	.000	1.00	1.29	1.59	1.93	2.35	2.86	3.47	4.10	18.6
OTHER INCOME	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
TOTAL SALES	.000	.000	15.1	17.7	20.7	24.1	28.1	32.6	37.9	44.1	226
GOVERNMENT PURCHASES	.000	.000	69.5	61.3	53.1	44.9	36.7	28.5	20.3	12.1	326
TOTAL REVENUES	.000	.000	84.6	79.0	73.8	69.0	64.8	61.1	58.2	56.2	547
EXPENSES											
INFO. PRODUCT PROCESSING	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
GROSS PROFIT	.000	.000	84.6	79.0	73.8	69.0	64.8	61.1	58.2	56.2	547
OPERATIONS/COMMUNICATION	.113	.183	5.39	9.69	7.03	19.5	11.2	11.9	12.7	13.4	91.1
MARKETING COSTS	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
DEPRECIATION	2.89	11.7	22.7	30.4	34.1	37.2	36.8	35.6	31.7	27.2	270
INTEREST EXPENSE	.381	1.31	2.33	3.82	5.38	3.82	3.42	3.75	3.94	2.23	30.4
OTHER EXPENSES	2.60	17.1	27.9	23.4	20.6	9.60	13.6	6.80	10.2	6.50	138
PROFIT BEFORE TAX	-5.98	-30.3	26.3	11.7	6.69	-1.05	-2.44	2.98	-3.53	6.87	16.6
FEDERAL TAX	-2.75	-14.0	12.1	5.39	3.08	-4.84	-1.12	1.37	-1.62	3.16	7.62
TAX CREDITS	1.01	3.39	5.01	4.95	4.30	4.25	2.98	2.55	1.87	1.70	32.0
PROFIT AFTER TAX	-2.22	-13.0	19.2	11.3	7.91	3.68	2.85	4.16	1.68	5.41	41.0
CASH FLOW STATEMENT											
=====											
PROFIT AFTER TAX	-2.22	-13.0	19.2	11.3	7.91	3.68	2.85	4.16	1.68	5.41	41.0
DEPRECIATION	2.89	11.7	22.7	30.4	34.1	37.2	36.8	35.6	31.7	27.2	270
LONG-TERM DEBT ADDITION	3.61	11.1	14.5	9.70	4.60	2.84	-3.29	-4.84	-6.23	-4.79	27.1
RESIDUAL VALUE AFTER TAX	*	*	*	*	*	*	*	*	*	*	34.9
SOURCES OF FUNDS	4.27	9.83	56.4	51.3	46.6	43.7	36.3	34.9	27.1	62.7	373
LESS											
CAPITAL INVESTMENT	10.1	33.9	50.1	49.5	43.0	42.5	29.8	25.5	18.7	17.0	320
NET WORKING CAP ADDITION	.000	.000	1.51	.259	.300	.344	.392	.451	.531	.623	4.41

EXHIBIT 20A
OPTION 3B

Debt: Equity = 1:1, Private Sector Not Efficient, Rapid Expensing, High Market, 10% IRR
(millions of current dollars)

Page 1 of 6
Sources:
Ex. 7, 13, 14

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	TOTAL	
INVESTMENT SCHEDULE												
1	.000	16.2	43.4	51.2	49.2	49.9	35.0	30.0	22.0	20.0	317	Ex 13, Ln 8
2	11.9	23.7	15.5	6.90	1.40	.000	.000	.000	.000	.000	59.4	Ex 13, Ln 11
3	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	Ex 14, Ln 5
4	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	Ex 14, Ln 6
5	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	Ex 14, Ln 7
6	.000	.000	2.92	.489	.570	.654	.742	.861	.991	1.18	8.41	
7	11.9	39.9	61.8	58.6	51.2	50.6	35.7	30.9	23.0	21.2	385	
INCOME STATEMENT												
8	REVENUES											
9	.000	.000	28.2	32.8	38.2	44.4	51.4	59.5	68.8	80.0	403	Ex 7, Ln 4
10	.000	.000	1.00	1.29	1.59	1.93	2.35	2.86	3.47	4.10	18.6	Ex 7, Ln 5
11	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	
12	.000	.000	29.2	34.1	39.8	46.3	53.8	62.4	72.3	84.1	422	
13	.000	.000	39.2	33.6	28.0	22.4	16.8	11.2	5.60	.000	157	
14	.000	.000	68.4	67.7	67.8	68.7	70.6	73.6	77.9	84.1	579	
15	EXPENSES											
16	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	
17	.000	.000	68.4	67.7	67.8	68.7	70.6	73.6	77.9	84.1	579	
18	.133	.215	6.36	11.4	8.28	22.8	13.2	14.0	14.9	15.8	107	Ex 13, Ln 13
19	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	
20	3.40	13.8	26.7	35.7	40.1	43.7	43.2	41.9	37.2	32.0	318	
21	.449	1.54	2.76	4.55	6.42	4.56	4.10	4.53	4.80	2.75	36.5	
22	3.06	20.1	33.9	25.2	24.3	11.3	16.0	8.00	12.0	8.80	163	Ex 14, Ln 8
23	-7.04	-35.7	-1.35	-9.14	-11.3	-13.6	-5.97	5.16	8.92	24.8	-45.2	
24	-3.24	-16.4	-6.21	-4.20	-5.20	-6.26	-2.75	2.37	4.11	11.4	-20.8	
25	1.19	3.99	5.89	5.81	5.06	4.99	3.50	3.00	2.20	2.00	37.6	
26	-2.61	-15.3	5.16	.876	-1.04	-2.36	.278	5.79	7.02	15.4	13.2	
CASH FLOW STATEMENT												
27	-2.61	-15.3	5.16	.876	-1.04	-2.36	.278	5.79	7.02	15.4	13.2	
28	3.40	13.8	26.7	35.7	40.1	43.7	43.2	41.9	37.2	32.0	318	
29	4.25	13.0	17.6	11.5	5.54	3.44	-3.74	-5.51	-7.13	-5.46	33.5	
30	*	*	*	*	*	*	*	*	*	86.9	86.9	
31	5.04	11.6	49.4	48.0	44.6	44.8	39.8	42.2	37.1	129	451	
32	11.9	39.9	58.6	58.1	50.6	50.6	35.7	30.9	23.0	21.2		

31	SOURCES OF FUNDS	5.04	11.6	49.4	48.0	44.6	44.8	39.8	42.2	37.1	129	451
	LESS											
32	CAPITAL INVESTMENT	11.9	39.9	58.9	58.1	50.6	49.9	35.0	30.0	22.0	20.0	376
33	NET WORKING CAP ADDITION	.000	.000	2.92	.489	.570	.654	.742	.861	.992	1.18	8.41
34	USES OF FUNDS	11.9	39.9	61.8	58.6	51.2	50.6	35.7	30.9	25.0	21.2	385
35	NET FUNDS GENERATED (REQ)	-6.86	-28.3	-12.4	-10.6	-6.58	-5.80	4.01	11.3	14.1	108	66.6
36	CUMULATIVE SOURCE OF FUNDS	-6.86	-35.2	-47.6	-58.2	-64.7	-70.5	-66.5	-55.2	-41.1	66.6	
37	PRESENT VALUE OF FUNDS	-6.24	-23.4	-9.31	-7.23	4.09	-3.27	2.06	5.27	6.09	41.5	1.29
38	INT. RATE OF RETURN	.099	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000

Ex.20A p2

BALANCE SHEET

ASSETS

39	CURRENT ASSETS	.000	.000	8.75	10.2	11.9	13.9	16.1	18.7	21.7	25.2	
40	FIXED ASSETS	11.9	51.8	111	169	219	269	304	334	356	376	
41	LESS DEPRECIATION	3.40	17.2	43.9	79.6	120	163	207	248	286	318	
42	NET FIXED ASSETS	8.50	34.6	66.8	89.2	99.7	106	97.7	85.8	70.6	58.6	
43	TOTAL ASSETS	8.50	34.6	75.5	99.4	112	120	114	105	92.3	83.8	

LIABILITIES

44	CURRENT LIABILITIES	.000	.000	5.84	6.82	7.96	9.27	10.7	12.5	14.5	16.8	
45	LONG-TERM DEBT	4.25	17.3	34.8	53.3	51.8	55.3	51.5	46.0	38.9	33.5	
46	TOTAL LIABILITIES	4.25	17.3	40.7	53.1	59.8	64.5	62.3	58.5	53.4	50.3	
47	EQUITY INVESTMENT	6.86	35.2	47.6	58.2	64.7	70.5	66.5	55.2	41.1	20.3	
48	RETAINED EARNINGS	-2.61	-17.9	-12.7	-11.9	-32.9	-15.3	-15.0	-9.19	-2.17	13.2	
49	TOTAL EQUITY	4.25	17.3	34.8	46.3	51.8	55.3	51.5	46.0	38.9	33.5	
50	TOTAL LIABILITIES+EQUITY	8.50	34.6	75.5	99.4	112	120	114	105	92.3	83.8	

EFFECT ON GOVERNMENT

51	CAPITAL INVESTMENT	66.8	45.3	13.5	.000	.000	.000	.000	.000	.000	.000	126
52	PURCHASED FROM VENTURE	.000	.000	39.2	33.6	28.0	22.4	16.8	11.2	5.60	.000	157
53	TAX CREDITS	1.19	3.99	5.89	5.81	5.06	4.99	3.50	3.00	2.20	2.00	37.6
54	LESS TAXES PAID	-3.24	-16.4	-22.1	-4.20	-5.20	-6.26	-2.75	2.37	4.11	32.1	-0.62
55	NET GOVT EXPENDITURES	71.2	65.7	59.2	43.6	38.3	33.7	23.0	11.8	3.69	-30.1	320
56	PV OF NET GOVT EXP	243	.000	.000	.000	.000	.600	.600	.000	.000	.000	

EXHIBIT 20 A
OPTION 3B

Debt: Equity = 1:1, Private Sector Not Efficient, Rapid Expensing, High Market, 15% IRR
(millions of current dollars)

Page 3 of 6
Sources:
Exhibits 7, 13, 14

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	TOTAL
INVESTMENT SCHEDULE											

HARDWARE PROCUREMENT	.000	14.2	43.4	51.2	49.2	49.9	35.0	30.0	22.0	20.0	317
PRE-PROCESSING FACILITIES	11.9	23.7	15.5	6.90	1.40	.000	.000	.000	.000	.000	59.4
LAUNCH SERVICES	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
R AND D											
APPLICATIONS	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
INSTRUMENTATION	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
NET WORKING CAP ADDITION	.000	.000	2.92	.489	.570	.654	.742	.861	.991	1.18	8.41
TOTAL FUNDS INVESTED	11.9	39.9	61.8	58.6	51.2	50.6	35.7	30.9	23.0	21.2	385
INCOME STATEMENT											

REVENUES											
PRE-PROCESSED DATA	.000	.000	28.2	32.8	38.2	44.4	51.4	59.5	68.6	80.0	403
FOREIGN STATION FEES	.000	.000	1.00	1.29	1.59	1.93	2.35	2.86	3.47	4.10	18.6
OTHER INCOME	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
TOTAL SALES	.000	.000	29.2	34.1	39.8	46.3	53.8	62.4	72.3	84.1	422
GOVERNMENT PURCHASES	.000	.000	51.8	44.4	37.0	29.6	22.2	14.8	7.40	.000	207
TOTAL REVENUES	.000	.000	81.0	78.5	76.8	75.9	76.0	77.2	79.7	84.1	629
EXPENSES											
INFO. PRODUCT PROCESSING	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
GROSS PROFIT	.000	.000	81.0	78.5	76.8	75.9	76.0	77.2	79.7	84.1	629
OPERATIONS/COMMUNICATION	.133	.215	6.36	11.4	8.28	22.8	13.2	14.0	14.9	15.8	107
MARKETING COSTS	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
DEPRECIATION	3.40	13.8	26.7	35.7	40.1	43.7	43.2	41.9	37.2	32.0	318
INTEREST EXPENSE	.449	1.54	2.78	4.55	6.42	4.56	4.10	4.53	4.80	2.75	26.5
OTHER EXPENSES	3.06	20.1	33.9	25.2	24.3	11.3	16.0	8.00	12.0	8.80	163
PROFIT BEFORE TAX	-7.04	-35.7	11.2	1.66	-2.30	-6.41	-5.67	8.76	10.7	24.8	5.16
FEDERAL TAX	-3.24	-16.4	5.17	.765	-1.06	-2.95	-2.61	4.03	4.93	11.4	2.37
TAX CREDITS	1.19	3.99	5.69	5.81	5.06	4.99	3.50	3.00	2.20	2.00	37.6
PROFIT AFTER TAX	-2.61	-15.3	12.0	6.71	3.82	1.53	3.19	7.73	7.99	15.4	40.4
CASH FLOW STATEMENT											

PROFIT AFTER TAX	-2.61	-15.3	12.0	6.71	3.82	1.53	3.19	7.73	7.99	15.4	40.4
DEPRECIATION	3.40	13.8	26.7	35.7	40.1	43.7	43.2	41.9	37.2	32.0	318
LONG-TERM DEBT ADDITION	4.25	13.0	17.6	11.5	5.54	3.44	-3.74	-5.51	-7.13	-5.40	33.5
RESIDUAL VALUE AFTER TAX	*	*	*	*	*	*	*	*	*	86.9	86.9
SOURCES OF FUNDS	5.04	11.6	56.2	53.8	49.4	43.6	42.7	44.1	38.1	129	478
LESS											
CAPITAL INVESTMENT	11.9	39.9	61.8	58.6	51.2	50.6	35.7	30.9	23.0	21.2	385

EXHIBIT 20A

OPTION 3B

Debt: Equity = 1:1, Private Sector Not Efficient, Rapid Expensing, High Market, 20% IEE

Page 5 of 6
Sources: Exhibit
7, 13, M

(millions of current dollars)

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	TOTAL
INVESTMENT SCHEDULE											
=====											
HARDWARE PROCUREMENT	.000	16.2	43.4	51.2	49.2	49.9	35.0	30.0	22.0	20.0	317
PRE-PROCESSING FACILITIES	11.9	23.7	15.5	6.90	1.40	.000	.000	.000	.000	.000	59.4
LAUNCH SERVICES	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
R AND D											
APPLICATIONS	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
INSTRUMENTATION	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
NET WORKING CAP ADDITION	.000	.000	2.92	.489	.570	.654	.742	.861	.991	1.18	8.41
TOTAL FUNDS INVESTED	11.9	39.9	41.8	58.6	51.2	50.6	35.7	30.9	23.0	21.2	385
INCOME STATEMENT											
=====											
REVENUES											
PRE-PROCESSED DATA	.000	.000	28.2	32.8	38.2	44.4	51.4	59.5	68.8	80.0	403
FOREIGN STATION FEES	.000	.000	1.00	1.29	1.59	1.93	2.35	2.86	3.47	4.10	18.6
OTHER INCOME	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
TOTAL SALES	.000	.000	29.2	34.1	39.8	46.3	53.8	62.4	72.3	84.1	422
GOVERNMENT PURCHASES	.000	.000	63.0	54.0	45.0	36.0	27.0	18.0	9.00	.000	252
TOTAL REVENUES	.000	.000	92.2	88.1	84.8	82.3	80.8	80.4	81.3	84.1	674
EXPENSES											
INFO. PRODUCT PROCESSING	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
GROSS PROFIT	.000	.000	92.2	88.1	84.8	82.3	80.8	80.4	81.3	84.1	674
OPERATIONS/COMMUNICATION	.133	.215	6.36	11.4	8.28	22.8	13.2	14.0	14.9	15.8	107
MARKETING COSTS	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
DEPRECIATION	3.40	13.8	26.7	35.7	40.1	43.7	43.2	41.9	37.2	32.0	318
INTEREST EXPENSE	.449	1.54	2.78	4.55	6.42	4.56	4.10	4.53	4.80	2.75	36.5
OTHER EXPENSES	3.06	20.1	33.9	25.2	24.3	11.3	16.0	8.00	12.0	8.80	163
PROFIT BEFORE TAX	-7.04	-35.7	22.4	11.3	5.70	-.011	4.23	12.0	12.3	24.8	50.0
FEDERAL TAX	-3.24	-16.4	10.3	5.18	2.62	-.005	1.95	5.50	5.67	11.4	23.0
TAX CREDITS	1.19	3.99	5.89	5.81	5.06	4.99	3.50	3.00	2.20	2.00	37.6
PROFIT AFTER TAX	-2.61	-15.3	18.0	11.9	8.14	4.98	5.79	9.46	8.86	15.4	64.6
CASH FLOW STATEMENT											
=====											
PROFIT AFTER TAX	-2.61	-15.3	18.0	11.9	8.14	4.98	5.79	9.46	8.86	15.4	64.6
DEPRECIATION	3.40	13.8	26.7	35.7	40.1	43.7	43.2	41.9	37.2	32.0	318
LONG-TERM DEBT ADDITION	4.25	13.0	17.6	11.5	5.54	3.44	-3.74	-5.51	-7.13	-5.40	33.5
RESIDUAL VALUE AFTER TAX	*	*	*	*	*	*	*	*	*	*	86.9
SOURCES OF FUNDS	5.04	11.6	62.3	59.0	53.8	52.1	45.3	45.8	39.0	129	503
LESS											
CAPITAL INVESTMENT	11.9	39.9	58.9	58.1	50.6	49.9	35.0	30.0	23.0	20.0	374

EXHIBIT 20B
OPTION 3B

Page 1 of 6
Sources: Ex.7,13,14

Debt: Equity = 1:1, Private Sector Not Efficient, Rapid Expensing, Low Market, 10% IRR

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	TOTAL
(millions of current dollars)											
INVESTMENT SCHEDULE											
HARDWARE PROCUREMENT	.000	16.2	43.4	51.2	49.2	49.9	35.0	30.0	22.0	20.0	317
PRE-PROCESSING FACILITIES	11.9	23.7	15.5	6.90	1.40	.000	.000	.000	.000	.000	59.4
LAUNCH SERVICES	.000	.000	.000	.000	.000	.000	.000	.900	.000	.000	.060
R AND D											
APPLICATIONS	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
INSTRUMENTATION	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
NET WORKING CAP ADDITION	.000	.000	1.51	.259	.300	.344	.392	.451	.531	.623	4.41
TOTAL FUNDS INVESTED	11.9	39.9	60.4	58.4	50.9	50.2	35.4	30.5	22.5	20.6	381
INCOME STATEMENT											
REVENUES											
PRE-PROCESSED DATA	.000	.000	14.1	16.4	19.1	22.2	25.7	29.7	34.4	40.0	202
FOREIGN STATION FEES	.000	.000	1.00	1.29	1.59	1.93	2.35	2.86	3.47	4.10	18.6
OTHER INCOME	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
TOTAL SALES	.000	.000	15.1	17.7	20.7	24.1	28.1	32.6	37.9	44.1	220
GOVERNMENT PURCHASES	.000	.000	74.8	67.4	60.0	52.6	45.2	37.8	30.4	23.0	391
TOTAL REVENUES	.000	.000	89.9	85.1	80.7	76.7	73.3	70.4	68.3	67.1	611
EXPENSES											
INFO. PRODUCT PROCESSING	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
GROSS PROFIT	.000	.000	89.9	85.1	80.7	76.7	73.3	70.4	68.3	67.1	611
OPERATIONS/COMMUNICATION	.133	.215	6.36	11.4	8.28	22.8	13.2	14.0	14.9	15.8	107
MARKETING COSTS	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
DEPRECIATION	3.40	13.8	26.7	35.7	40.1	43.7	43.2	41.9	37.2	32.0	318
INTEREST EXPENSE	.449	1.54	2.73	4.47	6.30	4.47	4.00	4.38	4.59	2.59	35.5
OTHER EXPENSES	3.06	20.1	33.9	25.2	24.3	11.3	16.0	8.00	12.0	8.80	163
PROFIT BEFORE TAX	-7.04	-35.7	20.2	8.34	1.72	-5.52	-3.17	2.11	-4.64	7.93	-11.6
FEDERAL TAX	-3.24	-16.4	9.29	3.84	.790	-2.54	-1.46	.969	-.213	3.65	-5.32
TAX CREDITS	1.19	3.99	5.89	5.81	5.06	4.99	3.50	3.00	2.20	2.00	37.6
PROFIT AFTER TAX	-2.61	-15.3	16.8	10.3	5.99	2.01	1.79	4.14	1.95	6.28	31.4
CASH FLOW STATEMENT											
PROFIT AFTER TAX	-2.61	-15.3	16.8	10.3	5.99	2.01	1.79	4.14	1.95	6.28	31.4
DEPRECIATION	3.40	13.8	26.7	35.7	40.1	43.7	43.2	41.9	37.2	32.0	318
LONG-TERM DEBT ADDITION	4.25	13.0	16.9	11.3	5.41	3.28	-3.91	-5.71	-7.36	-5.68	31.5
RESIDUAL VALUE AFTER TAX	*	*	*	*	*	*	*	*	*	40.5	40.5
SOURCES OF FUNDS	5.04	11.6	60.4	57.3	51.5	49.0	41.1	40.3	31.8	73.1	421
LESS											
CAPITAL INVESTMENT	11.9	39.9	60.4	58.4	50.9	50.2	35.4	30.5	22.5	20.6	381

EXHIBIT 20B
OPTION 3B

Page 3 of 8
Sources: Ex 7,13,14

Debt: Equity = 1.1, Private Sector Not Efficient, Rapid Expensing, Low Market 15% IRR
(millions of current dollars)

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	TOTAL
INVESTMENT SCHEDULE											
HARDWARE PROCUREMENT	.000	16.2	43.4	51.2	49.2	49.9	35.0	30.0	22.0	20.0	317
PRE-PROCESSING FACILITIES	11.9	23.7	15.5	6.90	1.40	.000	.000	.000	.000	.000	59.4
LAUNCH SERVICES	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
R AND D											
APPLICATIONS	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
INSTRUMENTATION	.000	.000	.000	.000	.000	.000	.000	.000	.000	.060	.000
NET WORKING CAP. ADDITION	.000	.000	1.51	.259	.300	.344	.392	.451	.531	.623	4.41
TOTAL FUNDS INVESTED	11.9	39.9	60.4	58.4	50.9	50.2	35.4	30.5	22.5	20.6	381
INCOME STATEMENT											
REVENUES											
PRE-PROCESSED DATA	.000	.000	14.1	16.4	19.1	22.2	25.7	29.7	34.4	40.0	202
FOREIGN STATION FEES	.000	.000	1.00	1.29	1.59	1.93	2.35	2.86	3.47	4.10	18.6
OTHER INCOME	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
TOTAL SALES	.000	.000	15.1	17.7	20.7	24.1	28.1	32.6	37.9	44.1	220
GOVERNMENT PURCHASES	.000	.000	83.2	74.6	66.0	57.4	48.8	40.2	31.6	23.0	425
TOTAL REVENUES	.000	.000	98.3	92.3	86.7	81.5	76.9	72.8	69.5	67.1	645
EXPENSES											
INFO. PRODUCT PROCESSING	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
GROSS PROFIT	.000	.000	98.3	92.3	86.7	81.5	76.9	72.8	69.5	67.1	645
OPERATIONS/COMMUNICATION	.133	.215	6.36	11.4	0.28	22.8	13.2	14.0	14.9	15.8	107
MARKETING COSTS	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
DEPRECIATION	3.40	13.8	26.7	35.7	40.1	43.7	43.2	41.9	37.2	32.0	318
INTEREST EXPENSE	.449	1.54	2.73	4.47	6.30	4.47	4.00	4.38	4.59	2.59	35.5
OTHER EXPENSES	3.06	20.1	33.9	25.2	24.3	11.3	16.0	8.00	12.0	8.80	163
PROFIT BEFORE TAX	-7.04	-35.7	28.6	15.5	7.72	-7.19	.435	4.51	.736	7.93	22.0
FEDERAL TAX	-3.24	-16.4	13.2	7.15	3.55	-3.31	.200	2.07	.339	3.65	10.1
TAX CREDITS	1.19	3.99	5.89	5.81	5.06	4.99	3.50	3.00	2.20	2.00	37.6
PROFIT AFTER TAX	-2.61	-15.3	21.3	14.2	9.23	4.60	3.73	5.43	2.60	6.28	49.5
CASH FLOW STATEMENT											
PROFIT AFTER TAX	-2.61	-15.3	21.3	14.2	9.23	4.60	3.73	5.43	2.60	6.28	49.5
DEPRECIATION	3.40	13.8	26.7	35.7	40.1	43.7	43.2	41.9	37.2	32.0	318
LONG-TERM DEBT ADDITION	4.25	13.0	16.9	11.3	5.41	3.28	-3.91	-5.71	-7.36	-5.68	31.5
RESIDUAL VALUE AFTER TAX	*	*	*	*	*	*	*	*	*	40.5	40.5
SOURCES OF FUNDS	5.04	11.6	64.9	61.2	54.7	51.6	43.0	41.6	32.5	73.1	439
LESS											
CAPITAL INVESTMENT	11.9	39.9	58.9	58.1	50.4	49.9	35.0	30.0	22.0	20.6	381

EXHIBIT 20B
OPTION 3B

Page 5 of 6
Sources: Ex7,13,14

Debt: Equity = 1.1, Private Sector Not Efficient, Rapid Expensing, Low Market 20% IRR
(millions of current dollars)

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	TOTAL
INVESTMENT SCHEDULE =====											
HARDWARE PROCUREMENT	.000	16.2	43.4	51.2	49.2	49.9	35.0	30.0	22.0	20.0	317
PRE-PROCESSING FACILITIES	11.9	23.7	15.5	6.90	1.40	.000	.000	.000	.000	.000	59.4
LAUNCH SERVICES	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
R AND D											
APPLICATIONS	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
INSTRUMENTATION	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
NET WORKING CAP ADDITION	.000	.000	1.51	.259	.300	.344	.392	.451	.531	.623	4.41
TOTAL FUNDS INVESTED	11.9	39.9	60.4	58.4	50.9	50.2	35.4	30.5	22.5	20.6	381
INCOME STATEMENT =====											
REVENUES											
PRE-PROCESSED DATA	.000	.000	14.1	16.4	19.1	22.2	25.7	29.7	34.4	40.0	302
FOREIGN STATION FEES	.000	.000	1.00	1.29	1.59	1.93	2.35	2.86	3.47	4.10	18.6
OTHER INCOME	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
TOTAL SALES	.000	.000	15.1	17.7	20.7	24.1	28.1	32.6	37.8	44.1	220
GOVERNMENT PURCHASES	.000	.000	90.9	81.2	71.5	61.8	52.1	42.4	32.7	23.0	456
TOTAL REVENUES	.000	.000	106	98.9	92.2	85.9	80.2	75.0	70.6	67.1	676
EXPENSES											
INFO. PRODUCT PROCESSING	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
GROSS PROFIT	.000	.000	106	98.9	92.2	85.9	80.2	75.0	70.6	67.1	676
OPERATIONS/COMMUNICATION	.133	.215	6.36	11.4	8.28	22.8	13.2	14.0	14.9	15.8	107
MARKETING COSTS	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
DEPRECIATION	3.40	13.8	26.7	35.7	40.1	43.7	43.2	41.9	37.2	32.0	318
INTEREST EXPENSE	.449	1.54	2.73	4.47	6.30	4.47	4.00	4.38	4.59	2.59	35.5
OTHER EXPENSES	3.06	20.1	33.9	25.2	24.3	11.3	16.0	8.00	12.0	8.80	163
PROFIT BEFORE TAX	-7.04	-35.7	36.3	23.1	13.2	3.68	3.73	6.71	1.84	7.93	52.8
FEDERAL TAX	-3.24	-16.4	16.7	10.2	6.08	1.69	1.72	3.08	.845	3.45	24.3
TAX CREDITS	1.19	3.99	5.89	5.81	5.06	4.99	3.50	3.00	2.20	2.00	37.6
PROFIT AFTER TAX	-2.61	-15.3	25.5	17.8	12.2	6.98	5.52	6.62	3.19	6.28	66.2
CASH FLOW STATEMENT =====											
PROFIT AFTER TAX	-2.61	-15.3	25.5	17.8	12.2	6.98	5.52	6.62	3.19	6.28	-66.2
DEPRECIATION	3.40	13.8	26.7	35.7	40.1	43.7	43.2	41.9	37.2	32.0	318
LONG-TERM DEBT ADDITION	4.25	13.0	16.9	11.3	5.41	3.28	-3.91	-5.71	-7.36	-5.68	31.5
RESIDUAL VALUE AFTER TAX	*	*	*	*	*	*	*	*	*	*	40.5
SOURCES OF FUNDS	5.04	11.6	69.1	64.8	57.7	53.9	44.8	42.8	33.1	73.1	456
LESS											
CAPITAL INVESTMENT	11.9	39.9	60.4	58.4	50.9	50.2	35.4	30.5	22.5	20.6	381

124

MARKETING COSTS - 10%
 DEBT: EQUITY = 1:1; NO EFFICIENCY, HIGH MARKET, IRR 15%
 (millions of current dollars)

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	TOTAL
INVESTMENT SCHEDULE											
=====											
HARDWARE PROCUREMENT	.000	16.2	43.4	51.2	49.2	49.9	35.0	30.0	22.0	20.0	317
PRE-PROCESSING FACILITIES	11.9	23.7	15.5	6.90	1.40	.000	.000	.000	.300	.000	59.4
LAUNCH SERVICES	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
R AND D											
APPLICATIONS	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
INSTRUMENTATION	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
NET WORKING CAP ADDITION	.000	.000	2.92	.489	.570	.654	.742	.861	.991	1.18	8.41
TOTAL FUNDS INVESTED	11.9	39.9	61.8	58.6	51.2	50.6	35.7	30.9	23.0	21.2	385
INCOME STATEMENT											
=====											
REVENUES											
PRE-PROCESSED DATA	.000	.000	28.2	32.8	38.2	44.4	51.4	59.5	68.8	80.0	403
FOREIGN STATION FEES	.000	.000	1.00	1.29	1.59	1.93	2.35	2.86	3.47	4.10	18.6
OTHER INCOME	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
TOTAL SALES	.000	.000	29.2	34.1	39.8	46.3	53.8	62.4	72.3	84.1	422
GOVERNMENT PURCHASES	.000	.000	64.4	55.2	46.0	36.8	27.6	18.4	9.20	.000	258
TOTAL REVENUES	.000	.000	93.6	89.3	85.8	83.1	81.4	80.8	81.5	84.1	679
EXPENSES											
INFO. PRODUCT PROCESSING	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
GROSS PROFIT	.000	.000	93.6	89.3	85.8	83.1	81.4	80.8	81.5	84.1	679
OPERATIONS/COMMUNICATION	.133	.215	6.36	11.4	8.28	22.8	13.2	14.0	14.9	15.8	107
MARKETING COSTS	.000	.000	2.92	3.41	3.98	4.63	5.37	6.24	7.23	8.41	42.2
DEPRECIATION	3.40	13.8	26.7	35.7	40.1	43.7	43.2	41.9	37.2	32.0	318
INTEREST EXPENSE	.449	1.54	2.78	4.55	6.42	4.56	4.10	4.53	4.80	2.75	36.5
OTHER EXPENSES	3.06	20.1	33.9	25.2	24.3	11.3	16.0	8.00	12.0	8.80	163
PROFIT BEFORE TAX	-7.04	-35.7	20.9	9.05	2.72	-3.84	-5.42	6.12	5.30	16.4	13.4
FEDERAL TAX	-3.24	-16.4	9.63	4.16	1.25	-1.77	-2.50	2.82	2.44	7.52	6.15
TAX CREDITS	1.19	3.99	5.89	5.81	5.06	4.99	3.50	3.00	2.20	2.00	37.6
PROFIT AFTER TAX	-2.61	-15.3	17.2	10.7	6.53	2.91	3.21	6.31	5.06	10.8	44.8
CASH FLOW STATEMENT											
=====											
PROFIT AFTER TAX	-2.61	-15.3	17.2	10.7	6.53	2.91	3.21	6.31	5.06	10.8	44.8
DEPRECIATION	3.40	13.8	26.7	35.7	40.1	43.7	43.2	41.9	37.2	32.0	318
LONG-TERM DEBT ADDITION	4.25	13.0	17.6	11.5	5.54	3.44	-3.74	-5.51	-7.13	-5.40	33.5
RESIDUAL VALUE AFTER TAX	*	*	*	*	*	*	*	*	*	64.0	64.0
SOURCES OF FUNDS	5.04	11.6	61.5	57.8	52.2	50.0	42.7	42.7	35.2	101	460

MARKETING COSTS = 10%

DEBT: EQUITY = 1:1, EFFICIENT, HIGH MARKET, IRR = 15%
(millions of current dollars)

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	TOTAL
INVESTMENT SCHEDULE =====											
HARDWARE PROCUREMENT	.000	13.8	36.9	43.6	41.8	42.5	29.8	25.5	18.7	17.0	270
PRE-PROCESSING FACILITIES	10.1	20.1	13.2	5.89	1.19	.000	.000	.000	.000	.000	50.5
LAUNCH SERVICES	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
R AND D											
APPLICATIONS	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
INSTRUMENTATION	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
NET WORKING CAP ADDITION	.000	.000	2.92	.489	.570	.654	.742	.851	.991	1.17	8.40
TOTAL FUNDS INVESTED	10.1	33.9	53.0	50.0	43.6	43.2	30.5	26.4	19.7	18.2	328
INCOME STATEMENT =====											
REVENUES											
PRE-PROCESSED DATA	.000	.000	28.2	32.8	38.2	44.4	51.4	59.5	68.8	80.0	403
FOREIGN STATION FEES	.000	.000	1.00	1.29	1.59	1.93	2.35	2.84	3.47	4.00	18.5
OTHER INCOME	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
TOTAL SALES	.000	.000	29.2	34.1	39.8	46.3	53.8	62.4	72.3	84.0	422
GOVERNMENT PURCHASES	.000	.000	37.8	32.4	27.0	21.6	16.2	10.8	5.40	.000	151
TOTAL REVENUES	.000	.000	67.0	66.5	66.8	67.9	70.0	73.2	77.7	84.0	573
EXPENSES											
INFO. PRODUCT PROCESSING	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
GROSS PROFIT	.000	.000	67.0	66.5	66.8	67.9	70.0	73.2	77.7	84.0	573
OPERATIONS/COMMUNICATION	.113	.183	5.39	9.89	7.03	19.5	11.2	11.9	12.7	13.4	91.1
MARKETING COSTS	.000	.000	2.92	3.41	3.98	4.63	5.37	6.24	7.23	8.40	42.2
DEPRECIATION	2.89	11.7	22.7	30.4	34.1	37.2	36.8	35.6	31.7	27.2	270
INTEREST EXPENSE	.381	1.31	2.38	3.40	5.50	3.91	3.52	3.49	4.15	2.39	31.3
OTHER EXPENSES	2.60	17.1	27.9	23.4	20.6	9.60	13.6	6.60	10.2	6.50	138
PROFIT BEFORE TAX	-5.98	-30.3	5.70	-4.26	-4.41	-6.88	-5.21	8.70	11.7	26.1	-177
FEDERAL TAX	-2.75	-14.0	2.62	-1.96	-2.03	-3.16	-2.40	4.00	5.39	12.0	-1.082
TAX CREDITS	1.01	3.39	5.01	4.95	4.30	4.25	2.98	2.55	1.87	1.70	32.0
PROFIT AFTER TAX	-2.22	-13.0	8.09	2.85	1.92	.536	2.70	7.25	8.19	15.8	31.9
CASH FLOW STATEMENT =====											
PROFIT AFTER TAX	-2.22	-13.0	8.09	2.85	1.92	.536	2.70	7.25	8.19	15.8	31.9
DEPRECIATION	2.89	11.7	22.7	30.4	34.1	37.2	36.8	35.6	31.7	27.2	270
LONG-TERM DEBT ADDITION	3.61	11.1	15.2	9.81	4.73	2.99	-3.12	-4.63	-6.00	-4.52	29.1
RESIDUAL VALUE AFTER TAX	*	*	*	*	*	*	*	*	*	87.8	87.8
SOURCES OF FUNDS	4.77	9.87	45.0	47.8	40.7	40.7	75.4	38.2	33.9	125	419

DEBT: EQUITY = 1:1, EFFICIENT, HIGH MARKET, IRR 10%
(millions of current dollars)

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	TOTAL
INVESTMENT SCHEDULE											
=====											
HARDWARE PROCUREMENT	.000	13.8	36.9	43.6	41.8	42.5	29.8	25.5	18.7	17.0	270
PRE-PROCESSING FACILITIES	10.1	20.1	13.2	5.89	1.19	.000	.000	.000	.000	.000	50.5
LAUNCH SERVICES	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
R AND D											
APPLICATIONS	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
INSTRUMENTATION	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
NET WORKING CAP ADDITION	.000	.000	2.92	.489	.570	.654	.742	.861	.991	1.17	6.46
TOTAL FUNDS INVESTED	10.1	33.9	53.0	50.0	43.6	43.2	30.5	26.4	19.7	18.2	328
INCOME STATEMENT											
=====											
REVENUES											
PRE-PROCESSED DATA	.000	.000	28.2	32.8	38.2	44.4	51.4	59.5	68.8	80.0	403
FOREIGN STATION FEES	.000	.000	1.00	1.29	1.59	1.93	2.35	2.86	3.47	4.00	18.5
OTHER INCOME	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
TOTAL SALES	.000	.000	29.2	34.1	39.8	46.3	53.8	62.4	72.3	84.9	422
GOVERNMENT PURCHASES	.000	.000	11.2	9.60	8.00	6.40	4.80	3.20	1.60	.000	44.8
TOTAL REVENUES	.000	.000	40.4	43.7	47.8	52.7	58.6	65.6	73.9	84.0	467
EXPENSES											
INFO. PRODUCT PROCESSING	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
GROSS PROFIT	.000	.000	40.4	43.7	47.8	52.7	58.6	65.6	73.9	84.0	467
OPERATIONS/COMMUNICATION	.113	.193	5.39	9.69	7.03	19.5	11.2	11.9	12.7	13.4	91.1
MARKETING COSTS	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
DEPRECIATION	2.89	11.7	22.7	30.4	34.1	37.2	36.8	35.6	31.7	27.2	270
INTEREST EXPENSE	.381	1.31	2.38	3.90	5.50	3.91	3.52	3.90	4.15	2.39	31.3
OTHER EXPENSES	2.60	17.1	27.9	23.4	20.6	9.60	13.6	6.80	10.2	6.50	138
PROFIT BEFORE TAX	-5.98	-30.3	-18.0	-23.7	-19.4	-17.4	-6.55	7.34	15.1	34.5	-64.4
FEDERAL TAX	-2.75	-14.0	-8.27	-10.9	-8.94	-8.02	-3.01	3.38	6.96	15.9	-29.6
TAX CREDITS	1.01	3.39	5.01	4.5	4.30	4.25	2.98	2.55	1.87	1.70	32.0
PROFIT AFTER TAX	-2.22	-13.0	-4.70	-7.83	-6.19	-5.17	-5.55	6.51	10.0	20.3	-2.77
CASH FLOW STATEMENT											
=====											
PROFIT AFTER TAX	-2.22	-13.0	-4.70	-7.83	-6.19	-5.17	-5.55	6.51	10.0	20.3	-2.77
DEPRECIATION	2.89	11.7	22.7	30.4	34.1	37.2	36.8	35.6	31.7	27.2	270
LONG-TERM DEBT ADDITION	3.61	11.1	15.0	9.81	4.73	2.99	-3.12	-4.63	-6.00	-4.52	29.1
RESIDUAL VALUE AFTER TAX	\$	\$	\$	\$	\$	\$	\$	\$	\$	\$	\$
NET CHANGES OF EQUITY	1.29	9.9	33.0	36.4	32.2	35.7	38.9	37.4	35.7	31.5	332

DEBT: EQUITY = 1:1, EFFICIENT, HIGH MARKET, IRR 20%

(millions of current dollars)

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	TOTAL
INVESTMENT SCHEDULE											
=====											
HARDWARE PROCUREMENT	.000	13.8	36.9	43.6	41.8	42.5	29.8	25.5	18.7	17.0	270
PRE-PROCESSING FACILITIES	10.1	20.1	13.2	5.89	1.19	.000	.000	.000	.000	.000	50.5
LAUNCH SERVICES	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
R AND D											
APPLICATIONS	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
INSTRUMENTATION	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
NET WORKING CAP ADDITION	.000	.000	2.92	.489	.570	.654	.742	.861	.991	1.17	8.40
TOTAL FUNDS INVESTED	10.1	33.9	53.0	50.0	43.6	43.2	30.5	25.4	19.7	18.2	328
INCOME STATEMENT											
=====											
REVENUES											
PRE-PROCESSED DATA	.000	.000	28.2	32.8	38.2	44.4	51.4	59.5	68.8	80.0	403
FOREIGN STATION FEES	.000	.000	1.00	1.29	1.59	1.93	2.35	2.86	3.47	4.00	18.5
OTHER INCOME	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
TOTAL SALES	.000	.000	29.2	34.1	39.8	46.3	53.8	62.4	72.3	84.0	422
GOVERNMENT PURCHASES	.000	.000	37.8	32.4	27.0	21.6	16.2	10.8	5.40	.000	151
TOTAL REVENUES	.000	.000	67.0	66.5	66.8	67.9	70.0	73.2	77.7	84.0	573
EXPENSES											
INFO. PRODUCT PROCESSING	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
GROSS PROFIT	.000	.000	67.0	66.5	66.8	67.9	70.0	73.2	77.7	84.0	573
OPERATIONS/COMMUNICATION	.113	.183	5.39	9.69	7.03	19.5	11.2	11.9	12.7	13.4	91.1
MARKETING COSTS	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
DEPRECIATION	2.89	11.7	22.7	30.4	34.1	37.2	36.8	35.6	31.7	27.2	270
INTEREST EXPENSE	.381	1.31	2.38	3.90	5.50	3.91	3.52	3.90	4.15	2.39	31.3
OTHER EXPENSES	2.60	17.1	27.9	23.4	20.6	9.60	13.6	6.80	10.2	6.50	138
PROFIT BEFORE TAX	-5.98	-30.3	8.62	-8.56	-4.32	-2.24	4.85	14.9	18.9	34.5	42.0
FEDERAL TAX	-2.75	-14.0	3.97	-3.94	-1.99	-1.03	.23	6.87	8.71	15.9	19.3
TAX CREDITS	1.01	3.39	5.01	4.95	4.30	4.25	2.98	2.55	1.87	1.70	32.0
PROFIT AFTER TAX	-2.22	-13.0	9.67	4.49	4.07	3.04	5.60	10.6	12.1	20.3	54.7
CASH FLOW STATEMENT											
=====											
PROFIT AFTER TAX	-2.22	-13.0	9.67	4.49	4.07	3.04	5.60	10.6	12.1	20.3	54.7
DEPRECIATION	2.89	11.7	22.7	30.4	34.1	37.2	36.8	35.6	31.7	27.2	270
LONG-TERM DEBT ADDITION	3.61	11.1	15.2	9.81	4.73	2.99	-3.12	-4.63	-6.00	-4.52	29.1
RESIDUAL VALUE AFTER TAX	*	*	*	*	*	*	*	*	*	111	111
SOURCES OF FUNDS	4.27	9.83	47.5	44.7	42.9	43.2	39.3	41.6	37.8	154	405

DEBT: EQUITY = 1:1, EFFICIENT, LOW MARKET, IRR = 10%
(millions of current dollars)

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	TOTAL
INVESTMENT SCHEDULE =====											
HARDWARE PROCUREMENT	.000	13.8	36.9	43.6	41.8	42.5	29.8	25.5	18.7	17.0	270
PRE-PROCESSING FACILITIES	10.1	20.1	13.2	5.89	1.19	.000	.000	.000	.000	.000	50.5
LAUNCH SERVICES	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
R AND D											
APPLICATIONS	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
INSTRUMENTATION	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
NET WORKING CAP ADDITION	.000	.000	1.51	.259	.300	.344	.392	.451	.531	.623	4.41
TOTAL FUNDS INVESTED	10.1	33.9	51.6	49.7	43.3	42.8	30.2	26.0	19.2	17.6	324
INCOME STATEMENT =====											
REVENUES											
PRE-PROCESSED DATA	.000	.000	14.1	16.4	19.1	22.2	25.7	29.7	34.4	40.0	202
FOREIGN STATION FEES	.000	.000	1.00	1.29	1.59	1.93	2.35	2.86	3.47	4.10	18.6
OTHER INCOME	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
TOTAL SALES	.000	.000	15.1	17.7	20.7	24.1	28.1	32.6	37.9	44.1	220
GOVERNMENT PURCHASES	.000	.000	62.5	55.3	48.1	40.9	33.7	26.5	18.3	12.1	298
TOTAL REVENUES	.000	.000	77.6	73.0	68.8	65.0	61.8	59.1	57.2	56.2	519
EXPENSES											
INFO. PRODUCT PROCESSING	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
GROSS PROFIT	.000	.000	77.6	73.0	68.8	65.0	61.8	59.1	57.2	56.2	519
OPERATIONS/COMMUNICATION	.113	.183	5.39	9.69	7.03	19.5	11.2	11.9	12.7	13.4	91.1
MARKETING COSTS	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
DEPRECIATION	2.89	11.7	22.7	30.4	34.1	37.2	36.8	35.6	31.7	27.2	270
INTEREST EXPENSE	.381	1.31	2.33	3.82	5.38	3.82	3.42	3.75	3.64	2.23	30.4
OTHER EXPENSES	2.60	17.1	27.9	23.4	20.6	9.60	13.6	6.80	10.2	6.50	138
PROFIT BEFORE TAX	-5.98	-30.3	19.3	5.73	1.69	-5.05	-3.24	.935	-1.35	6.87	-11.4
FEDERAL TAX	-2.75	-14.0	8.87	2.63	.776	-2.32	-1.49	.453	-.622	3.16	-5.26
TAX CREDITS	1.01	3.39	5.01	4.95	4.30	4.25	2.98	2.55	1.87	1.70	32.0
PROFIT AFTER TAX	-2.22	-13.0	15.4	8.04	5.21	1.52	1.23	3.08	1.14	5.41	25.8
CASH FLOW STATEMENT =====											
PROFIT AFTER TAX	-2.22	-13.0	15.4	8.04	5.21	1.52	1.23	3.08	1.14	5.41	25.8
DEPRECIATION	2.89	11.7	22.7	30.4	34.1	37.2	36.8	35.6	31.7	27.2	270
LONG-TERM DEBT ADDITION	3.61	11.1	14.5	9.70	4.60	2.84	-3.29	-4.84	-6.23	-4.79	27.1
RESIDUAL VALUE AFTER TAX	*	*	*	*	*	*	*	*	*	34.9	34.9
SOURCES OF FUNDS	4.27	9.83	52.6	48.1	43.9	41.5	34.7	33.9	26.6	62.7	358

DEBT: EQUITY = 1:1, EFFICIENT, LOW MARKET, IRR 20%
(millions of current dollars)

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	TOTAL
INVESTMENT SCHEDULE =====											
HARDWARE PROCUREMENT	.000	13.8	36.9	43.6	41.8	42.5	29.8	25.5	18.7	17.0	270
PRE-PROCESSING FACILITIES	10.1	20.1	13.2	5.89	1.19	.000	.000	.000	.000	.000	50.5
LAUNCH SERVICES	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
R AND D											
APPLICATIONS	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
INSTRUMENTATION	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
NET WORKING CAP ADDITION	.000	.000	1.51	.259	.300	.344	.392	.451	.531	.623	4.41
TOTAL FUNDS INVESTED	10.1	33.9	51.6	49.7	43.3	42.8	30.2	26.0	19.2	17.6	324
INCOME STATEMENT =====											
REVENUES											
PRE-PROCESSED DATA	.000	.000	14.1	16.4	19.1	22.2	25.7	29.7	34.4	40.0	202
FOREIGN STATION FEES	.000	.000	1.00	1.29	1.59	1.93	2.35	2.86	3.47	4.10	18.6
OTHER INCOME	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
TOTAL SALES	.000	.000	15.1	17.7	20.7	24.1	28.1	32.6	37.9	44.1	220
GOVERNMENT PURCHASES	.000	.000	75.8	66.7	57.6	48.5	39.4	30.3	21.2	12.1	352
TOTAL REVENUES	.000	.000	90.9	84.4	78.3	72.6	67.5	62.9	59.1	56.2	572
EXPENSES											
INFO. PRODUCT PROCESSING	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
GROSS PROFIT	.000	.000	90.9	84.4	78.3	72.6	67.5	62.9	59.1	56.2	572
OPERATIONS/COMMUNICATION	.113	.183	5.39	9.69	7.03	19.5	11.2	11.9	12.7	13.4	91.1
MARKETING COSTS	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
DEPRECIATION	2.89	11.7	22.7	30.4	34.1	37.2	36.8	35.6	31.7	27.2	270
INTEREST EXPENSE	.381	1.31	2.33	3.82	5.38	3.82	3.42	3.75	3.94	2.23	30.4
OTHER EXPENSES	2.60	17.1	27.9	23.4	20.6	9.60	13.6	6.80	10.2	6.50	138
PROFIT BEFORE TAX	-5.98	-30.3	32.6	17.1	11.2	2.55	2.46	4.78	.547	6.87	41.8
FEDERAL TAX	-2.75	-14.0	15.0	7.88	5.15	1.17	1.13	2.20	.252	3.16	19.2
TAX CREDITS	1.01	3.39	5.01	4.95	4.30	4.25	2.98	2.55	1.87	1.70	32.0
PROFIT AFTER TAX	-2.22	-13.0	22.6	14.2	10.3	5.63	4.31	5.13	2.17	5.41	54.6
CASH FLOW STATEMENT =====											
PROFIT AFTER TAX	-2.22	-13.0	22.6	14.2	10.3	5.63	4.31	5.13	2.17	5.41	54.6
DEPRECIATION	2.89	11.7	22.7	30.4	34.1	37.2	36.8	35.6	31.7	27.2	270
LONG-TERM DEBT ADDITION	3.61	11.1	14.5	9.70	4.60	2.84	-3.29	-4.84	-6.23	-4.79	27.1
RESIDUAL VALUE AFTER TAX	*	*	*	*	*	*	*	*	*	34.9	34.9
SOURCES OF FUNDS	4.27	9.83	59.8	54.2	49.0	45.6	37.8	35.9	27.6	62.7	307

APPENDIX

To evaluate the several variants of Option 3--"Lease"-- a computer-based simulation model was developed. This Appendix describes the workings of that model.

Most of the inputs to the model are taken directly from Exhibits 12, 13, and 14 (depending on the case being analyzed-- see Exhibit 3). The sources are cited more precisely for each line item of the model output in Exhibit A1, attached. The notes to that exhibit appear below:

NOTES

1. In each model run a figure for Internal Rate of Return was targeted. Also, Return on Equity in the final year was constrained to equal or exceed 20 percent. To achieve these rates, government purchases--which fall directly to profit before taxes--were raised or lowered. Thus, government purchases are a "plug" figure, representing the subsidy required by the venture rather than a measurement of government demand.
2. This line was included to reflect any variable costs of processing information products. Since such products were excluded from consideration as a matter of policy, no costs appear here.
3. No marketing costs were added to expenses in Option 3 for two reasons: (1) the private venture was thought to be able to achieve the same revenues as the government without such expenditures (assuming that the government-owned venture (Options 1 and 2) would make no effort to develop the market), and (2) market information is currently insufficient to determine how revenues might grow in response to any such marketing effort.
4. Depreciation was calculated according to the double-declining balance method, assuming a useful life of seven years.
5. Interest Expense was calculated on Long-term Debt utilizing projections of the prime lending rate supplied by Data Resources, Inc.

6. Federal tax was calculated at 46 percent of profit before tax.
7. Investment tax credits were figured as 10 percent of a given year's new investment, consistent with an economic life of seven years.
8. The Residual Value Recovery represents the market value of the venture, at the end of ten years' operations. It is calculated as seven times profit after tax in the last year; this multiple is consistent with expected earnings growth similar to growth of GNP.
9. The Present Value of Funds (generated) was calculated using a discount rate of 10 percent per year as the cost of capital, as suggested by the Office of Management and Budget.
10. The Internal Rate of Return is the discount rate which makes the net present value of funds generated equal to zero.
11. Current Assets were derived by the model as 30 percent of Total Sales while Current Liabilities were defined as 20 percent of Total Sales. Thus, Net Working Capital is equal to 10 percent of Total Sales.
12. Fixed Assets are equal to the cumulative sum of funds invested less the cumulative sum of Net Working Capital.
13. Long-term Debt was derived employing an assumption of a Debt Equity ratio equal to 1:1. It was calculated as follows:

$$\frac{(\text{Total Assets}) \text{ less } (\text{Current Liabilities})}{2}$$

Total Equity was calculated using the same formula.

14. Equity Investment was derived by subtracting retained earnings from Total Equity.
15. The schedule of Effect on Government reiterates those lines of the foregoing analysis which most directly impact the government, summing them to the line Net Government Expenditures. Line 50 represents those funds already committed by the government to the

Landsat Program as it currently exists (see Exhibit 6). Line 51 represents the cost of products for which the government is expected to contract with the venture, appearing on line 13 as government purchases. Line 52 represents a certain amount of tax revenue that the government will forego to the advantage of the venture as prescribed by current tax laws (appearing on line 25). Line 53 shows the amount of revenue that the government can expect from taxes on the profits generated by the venture (line 26). The sum of these represents the funds which the government could be expected to provide in order for the venture to attain the model's criteria, stated in Note 1, that the internal rate of return equals 15 percent, and the return on equity in the tenth year equals 20 percent.

16. Present value calculated using 10 percent discount rate.

EXHIBIT A 1

(millions of current dollars)

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	TOTAL	
INVESTMENT SCHEDULE												
1 HARDWARE PROCUREMENT	.000	14.2	43.4	51.2	49.2	49.9	35.0	36.0	22.0	20.0		317
2 FRC-PROCESSING FACILITIES	11.9	23.7	15.5	6.90	1.40	.000	.000	.000	.000	.000		59.4
3 LAUNCH SERVICES K AND D	.000	.000	4.00	6.00	14.0	6.00	14.0	6.00	10.0	6.80		66.8
4 APPLICATIONS	.404	.572	1.67	5.73	5.65	4.88	2.00	2.00	2.00	2.00		26.9
5 INSTRUMENTATION	2.20	11.5	8.00	2.30	1.00	.000	.000	.000	.000	.000		25.0
6 NET WORKING CAPITAL	.000	.000	2.92	3.41	3.98	4.63	5.37	6.24	7.23	0.41		
7 TOTAL FUNDS INVESTED	14.5	52.0	75.5	75.5	75.2	65.4	56.4	44.2	41.2	37.2		
												Sum Lines 1-6
INCOME STATEMENT												
8 REVENUES												
9 FRC-PROCESSED DATA	.000	.000	28.2	32.8	38.2	44.4	51.4	59.5	68.8	80.0		403
10 FOREIGN STATION FEES	.000	.000	1.00	1.29	1.59	1.93	2.35	2.82	3.47	4.10		18.6
11 OTHER INCOME	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000		.000
12 TOTAL SALES	.000	.000	29.2	34.1	39.8	46.3	53.8	62.4	72.3	84.1		472
13 GOVERNMENT PURCHASES	.000	.000	97.3	83.4	69.5	55.6	41.7	27.8	13.9	.000		309
14 TOTAL REVENUES	.000	.000	127	117	109	102	95.5	90.2	86.2	84.1		811
												Sum Lines 12, 13
15 EXPENSES												
16 INFO. PRODUCT PROCESSING	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000		.000
17 GROSS PROFIT	.000	.000	127	117	109	102	95.5	90.2	86.2	84.1		811
												Line 14 less Line 16
18 OPERATIONS/COMMUNICATION	.133	.215	6.36	11.4	8.28	22.8	13.2	14.0	14.9	15.8		107
19 MARKETING COSTS	.000	.000	.060	.000	.000	.000	.000	.000	.000	.000		.000
20 DEPRECIATION	4.14	17.8	33.5	44.5	52.3	55.7	56.9	54.6	50.0	43.7		413
21 INTEREST EXPENSE	.548	1.98	3.46	5.64	8.31	5.77	5.36	5.85	6.41	3.70		47.0
22 OTHER EXPENSES	.453	8.00	20.3	11.2	3.62	.453	.000	.000	.000	.000		44.0
23 PROFIT BEFORE TAX	-5.28	-28.0	62.9	44.7	36.8	17.2	20.0	15.7	14.9	20.9		200
												Line 17 Less Lines 18-22
24 FEDERAL TAX	-2.43	-12.9	28.9	20.6	16.9	7.89	9.18	7.22	6.85	9.60		91.9
25 TAX CREDITS	1.45	5.20	7.26	7.21	7.13	6.08	5.10	3.80	3.40	2.88		49.5
26 PROFIT AFTER TAX	-1.40	-9.93	41.2	31.4	27.0	15.3	15.9	12.3	11.4	14.1		157
												Note 7
CASH FLOW STATEMENT												
27 PROFIT AFTER TAX	-1.40	-9.93	41.2	31.4	27.0	15.3	15.9	12.3	11.4	14.1		157
28 DEPRECIATION	4.14	17.8	33.5	44.5	52.3	55.7	56.9	54.6	50.0	43.7		413
29 RESIDUAL VALUE RECOVERY	*	*	*	*	*	*	*	*	*	99.0		99.0
30 FUNDS FROM OPER.	2.74	7.88	74.7	75.9	79.3	71.1	72.8	64.9	61.4	157		670
												Sum Lines 27-29
LESS												
31 CAPITAL INVESTMENT	14.5	52.0	72.6	72.1	71.3	60.8	51.0	38.0	34.0	28.8		495
32 INC. IN WORKING CAP.	.000	.000	2.92	.489	.570	.654	.742	.861	.991	1.18		8.41
33 USES OF FUNDS	14.5	52.0	75.5	72.6	71.8	61.4	51.7	38.9	35.0	30.0		503
												Sum Lines 31, 32

Note 11

Sum
Lines 1-6

Sum
Lines 9-11
Note 1

Sum
Lines
12, 13

Note 2

Line 14 less
Line 16

Note 3

Note 4

Note 5

Line 17
Less Lines 18-22

Note 6

Note 7

See Line 26
See Line 20
Note 8

Sum
Lines
27-29

Line 7 supra
8.41

Sum
Lines
31, 32