

This rationale supports the Congressional objective as well as encompassing the principal requirements of users, sponsors and investors⁶. The ISS user's needs can be conservatively assumed to be that securing access to the ISS must be equitable, execution of experiments or programs needs to be assured and timely, and the costs for project development, integration and operation aboard ISS must be consistent with the expected scientific or business return. In addition, for a commercial user, the cost-benefit of ISS utilization should be competitive in the space market and quantifiable in real dollars. From a sponsor's or investor's perspective, the management approach should minimize non-productive overhead cost, provide equitable management control in proportion to the investment, and have a capability of attracting new capital investments.

Many precedents exist for NGOs. Some of the more familiar examples are discussed in the next section.

3. MANAGEMENT APPROACHES

This section characterizes the various management options along with examples highlighting key features.

3.1. Definition of Corporation

A corporation may be defined as a legal entity, enabled by legislation, that permits a group of people, either as shareholders (for-profit companies) or members (non-profit companies), to create an organization which can then focus on pursuing set objectives, and which is empowered with legal rights. In general terms, the three types of corporations are: Public, in which stock can be owned by the public at large; Private, which is owned by its employees or a select group of shareholders; and Government, in which stock is wholly or partially owned by the government. Although somewhat misleading, a Government Corporation is often termed a "Public Corporation" because it is established and governed for the public good through the auspices of the Government. In this study, we shall use these synonymously. The traditional commercial corporation could serve to implement tasks from an NGO under contract or subcontract to it but would not be a viable management entity for the NGO itself initially. Also, a Government Corporation can indeed transition to becoming a traditional public one. In the context of implementing an NGO, we shall later redefine "Private Corporation".

3.2. Government Corporation

⁶ In this study, it is assumed that the "investor" provides funds for disbursement by the NGO for either philanthropic or business reasons. In effect, the NGO serves as the arbiter of entrepreneurial funding.

A Government Corporation (GC) is an important version of a Non-Government Organization. Government Corporations are incorporated under and subject to the Government Corporation Control Act, Title 31 (31 USC 91). Although there are many definitions of GC, the one provided by NAPA⁷ is heuristically useful and will be adopted here.

A wholly owned GC in general:

- Pursues a government mission assigned by its enabling statute
- Is financed by government funding (appropriations)
- With assets owned by the government (either in whole or in part), and
- Is controlled by a Board appointed by the government (President).

According to OMB⁸, the conditions where using a GC is appropriate are:

- The operation is primarily businesslike
- It primarily sells goods and services
- Is substantially self-financing
- There is likely a continuing demand for its goods or services
- There is an absence of a commercially competitive market for the goods or services
- There is a need to continue services to an unprofitable market
- It serves public not private purposes

Examples of wholly owned GC's include:

- Alternative Agricultural Research and Commercialization Corporation
- Commodity Credit Corporation
- Corporation for National and Community Service
- Export-Import Bank
- Federal Crop Insurance Corporation
- Government National Mortgage Association
- Panama Canal Commission
- Pennsylvania Avenue Development Corporation
- Pension Benefit Guaranty Corporation
- St. Lawrence Seaway Development Corporation
- Tennessee Valley Authority
- Uranium Enrichment Corporation

and examples of mixed ownership GC's:

- Central Bank for Cooperative
- Corporation for Public Broadcasting
- Federal Deposit Insurance Corporation
- Federal Home Loan Banks
- Federal Land Banks
- Financing Corporation

⁷ NAPA, Report on Government Corporations, Vols. I-II, Washington, D.C. 1981.

⁸ Government Corporations. OMB M-96-05, A. M. Rivlin

- National Railroad Passenger Corporation (AMTRAK)
- Resolution Funding Corporation
- Resolution Trust Corporation
- United States Railway Association

Note however, one finds examples of wholly owned GC's, such as TVA, which commingle funding, i.e., supplement the federally provided appropriation. In addition, there is a mixed-ownership version of a GC that involves both public and private equity, control by a Board selected by the government and private stockholders, and shared ownership of assets. To confuse the issue of definition, a private (non-profit) corporation, such as the Corporation for Public Broadcasting, claims independence from statutory regulations while its Board is appointed by the President and all its funding is derived from federal funding.

Government Corporations are established to carry out business type programs that need a high degree of autonomy, flexibility, and business oriented enterprise (i.e., sell goods or services to the public). They fall in to three general categories: producing utility type services (TVA), producing financial or insurance services (Crop insurance program), and grant institutions (OPIC). However, many of the business-oriented enterprises would not otherwise succeed without government funding.

Federal Government Corporations are favored by Congress when the mission is basically commercial and it is necessary to establish a company that meets needs not provided by private sector goods and services. Few GC's operate in highly competitive markets. By organizing the entity along corporate lines, it is believed that the transition to privatization — wherein the Federal share of equity is bought out — can be facilitated. Almost all GC's have the power to sue and be sued, make contracts, hold property, and to borrow funds. Most are governed by a Board of Directors elected by either shareholders or appointed by the President (sometimes subject to Senate confirmation). Many are exempt from civil service rules, the Freedom Of Information Act (FOIA), and even the Government Corporation Control Act (GCCA)⁹ which was intended to regulate how GC's are created and supervised. However, the GCCA does prohibit the Executive branch from creating new GC's without explicit legal authorization. Financially, most partially owned government corporations are exempt from use-or-lose rules regarding unexpended funds, can enter into multi-year commitments, issue stock, and buy or sell assets without complying with federal procurement and disposal regulations. In wholly owned GC's, the government holds 100% of the equity and exercises 100% of the votes on the Board. In mixed ownership GC's such as the Resolution Trust Corp., the Government may own some or none of the equity. Their charter usually guarantees that the President will appoint at least a minority of the Directors and the market assumes that securities and other debt instruments carry an implicit guarantee from the federal government. The federal

⁹ 31 USC 9101, et seq.

government holds no stock in private GC's, such as COMSAT, but may reserve the right to select Board members.

Financially, one of the major advantages of a GC, aside from increased efficiency and providing a "captive" agency for a particular constituency, is that it may be given "off budget" status insulating it from Gramm-Rudman-Hollings budget reductions or spending caps. This exemption may enable an activity to survive in an otherwise hostile budget-cutting environment. One of the main disadvantages of a GC is that vesting ownership in the targeted beneficiaries may create significant conflicts of financial interests albeit maximizing profit return to the venture. Another small disadvantage is that a GC borrows at a premium rate compared to that available to the Treasury but still lower than to a private corporation. A third disadvantage, which could arise if privatization is the ultimate goal, is the prospect of failure that, in turn affects the risk associated with investing in the GC.

Several GC's, because of their similarity in purpose to the ISS NGO which also have a broad, international scope of operations include:

- COMSAT
- INTELSAT
- International Development Research Center (Canada).

3.2.1. Communications Satellite Corporation (COMSAT)

COMSAT is a well-known example of an aerospace related Government Corporation. Most foreign aerospace companies are partially government owned; similar examples include Aerospatiale (48% French Government owned) and Alenia (Italian Government owned). COMSAT develops advanced satellite communications technologies. The corporation provides technical consulting services and develops market-driven wireless networking products for commercial and government customers worldwide. COMSAT's digital networking business provides multinational corporations and other companies in emerging international markets with all the capabilities, services and resources they need for start-to-finish networking solutions, regardless of existing local telecommunications infrastructure.

Founded as a US Government Corporation in the 1960's, COMSAT received money to become the first vendor in the international satellite communications business, and still holds a reasonable share of the business. It received government spectrum licenses that only recently became available to private corporations, and it has amassed a stable and experienced workforce over the past thirty years. It has broadened its reach to offer a more comprehensive range of service and compete with networking technologies.

Originally, the Communications Satellite Act of 1962 subjected COMSAT to special restrictions. After 1985, the FCC authorized several international satellite systems separate from INTELSAT and, in 1993, the FCC substantially eliminated prior restrictions for competitors, thereby increasing market competition. In 1997, COMSAT began lobbying to reduce restrictions specific to COMSAT in order to become more competitive.

FCC regulation of the corporation's capital structure and debt financing activities limits COMSAT to \$200 M in debt, and a maximum long-term debt to capital ratio of 45%, and interest coverage ratio of 2.3 to 1, though the FCC does regulate the debt ratio of all satellite providers.

3.2.2. AMTRAK

AMTRAK is a mixed ownership government corporation that essentially has a monopoly over passenger train service in the United States. It receives Federal subsidies that equal roughly \$350 M a year. However, AMTRAK has always operated at a loss and depends on the subsidy. AMTRAK's liability potential also impacts its profitability. Amtrak is subject to the FOIA provisions, Government Corporation Control Act, and general accounting requirements, but is otherwise exempt from many other provisions such as FAR and pay scale limitations.

3.2.3. Panama Canal Commission

This entity was established as a wholly owned U.S. Government Corporation within the Executive Branch by the Canal Act of 1979. It operates, maintains and improves the Canal. It is supervised by a 9-member Board with 5 from US, appointed by the President with advice from the Senate, and 4 from Panama.

3.2.4. International Development Research Centre

IDRC is a public corporation created by Canadian Parliament to help researchers and communities in developing world solutions to social, economic and environmental problems. It is organized into 11 Secretariats, overseen by independent Steering Committees who ensure that appropriate research priorities are maintained. It is governed by a 21-member international Board, 11 of which are from Canada. A Senior Management Committee oversees the direction and strategies employed. It is empowered to enter into contracts or agreements with governments, public or private corporations, and individuals. It is government funded but may acquire and dispose of contributions.

3.3. State-Based Corporations

Several examples of organizations with similar objectives to the ISS NGO that are State sponsored include:

3.3.1. Spaceport Florida Authority

Established in 1989 and empowered under Chapter 331, Part Two, Florida Statutes, the Spaceport Florida Authority (SFA) is responsible for statewide space-related economic and academic development, including regulatory and operational support to the space transportation industry. It has supported over \$200 million in new industrial and federal space program investments statewide. Its mission includes:

Space Transportation -- The SFA operates much like an airport or seaport authority, providing infrastructure, access and operational support for expendable, reusable, and suborbital launch vehicle programs.

Economic Development -- It works with industry and local, state and federal agencies and elected officials to support space-related programs and investment in Florida. The SFA provides financing, advocacy, technical support, business incentives, and facility/infrastructure development for space-related projects.

Academic Development -- The SFA works closely with public and private universities and colleges in the state to increase their involvement in space-related research and education.

The Spaceport Authority's executive director reports to a nine-member board of supervisors appointed by the governor and legislature. Seven board members are appointed by the governor, serve two and three-year terms. Two board members are appointed each by the leadership of the Florida Senate and House of Representatives. These legislative appointees are non-voting members of the board. The board holds quarterly public meetings, usually near the Cape Canaveral spaceport.

3.3.2. Tellico Reservoir Development Agency (TRDA)

TRDA is a non-profit public corporation created by the State of Tennessee that operates much like a private company. It is controlled by a nine-member board of Directors and is directed by an Executive Director who has the responsibility for the day to day operation and management of the Tellico Lake Project. The Agency is empowered by state law with authority to provide a broad range of services to the Project.

3.3.3. Alabama Supercomputer Authority (ASA)

The ASA is an Alabama public corporation that develops and operates the statewide Alabama Research and Education Network and the Alabama Supercomputer Center. It is governed by a 16-member Board, appointed by the Governor, Lt. Governor, and Speaker, which sets policy and direction. Funding comes from the Alabama Education Trust fund, sales of services to industrial firms, and from federal contracts and grants. Facilities are made available at published commercial rates.

3.3.4. Kansas Technology Enterprise Corporation (KTEC)

The KTEC is a quasi-public corporation established by the state to promote advanced technology economic development. Funding is provided by the State Legislature from lottery and racing commission funds leverage with private sector and federal funds, employing a return-on-investment philosophy. KTEC is governed by a 20-member Board of individuals from the private sector, government and academia.

3.4. Government Sponsored Enterprise (GSE)

In addition to the standard Government Corporation, another category of GC has been introduced designated as Government-Sponsored Enterprises. These are characterized as:

- Typically financed by private investors
- Privately owned or controlled
- Regulated by the Government to protect its interests
- Profit seeking

GSE's are a special form of a GC limited by Congress to lending to a particularly constituency coupled with explicit or implicit federal guarantees allowing them to offer subsidized loans. According to the congressional definition of a GSE, its applicability as an NGO approach for utilization management is questionable. It could be appropriate only when functioning as a source of venture capital for commercial development.

GSE are chartered by the Government, with special privileges such as lending powers, to accomplish public purposes. They must have a clearly articulated "exit strategy" and an express sunset date. A key feature of a GSE is that it is perceived to have the full faith backing of the Government. GSE's can become privatized afterwards under appropriate conditions. Examples of GSE's include:

- (a) Student Loan Marketing Association (Sallie Mae)
- (b) Federal Home Loan banks system institutions (FHLBs)
- (c) Federal National Mortgage Association (Fannie Mae)

3.4.1. Fannie Mae

This GSE was created by government charter and operated as a government entity from 1938-1968. In 1968, it was converted to a private company with common stock that is publicly traded. The Charter Act (12 U.S.C. § 1716 *et seq.*) enacted in the Housing and Urban Development Act of 1968 (the 1968 Act), the Federal National Mortgage Association was divided into two separate institutions, the present Corporation and the Government National Mortgage Association (Ginnie Mae), a wholly owned corporate instrumentality of the United States within HUD which carried on certain special financing assistance and management and liquidation functions. Under the 1968 Act, Fannie Mae was constituted as a federally chartered corporation and the entire equity interest in Fannie Mae became stockholder-owned.

Although the 1968 Act eliminated all federal ownership interest in Fannie Mae, it did not terminate government regulation of the Corporation.¹⁰ Under the Charter Act, approval of the Secretary of the Treasury is required for Fannie Mae's issuance of its debt obligations and Mortgage Backed Securities (MBS). In addition, the 1992 Act established OFHEO, an independent office within HUD under the management of a Director who is responsible for ensuring that the Corporation is adequately capitalized and operating safely in accordance with the 1992 Act. The 1992 Act not only established minimum capital, risk-based capital, and critical capital requirements for Fannie Mae but also required the Director to establish a risk-based capital test to be used to determine the amount of total capital the Corporation must have to exceed the risk-based capital level from time to time. OFHEO issued a final rule (the "Rule") in 1996 related to the minimum capital levels for Fannie Mae and Freddie Mac that sets forth how minimum capital requirements for both entities are to be calculated, reported, and classified on a quarterly basis. The Rule, which finalized an original proposal dated June 1995, formalized the interim capital standards applied by OFHEO, with which Fannie Mae has been in compliance since their inception.

Under the 1992 Act, the Secretary of HUD retains general regulatory authority to promulgate rules and regulations to carry out the purposes of the Charter Act, excluding authority over matters granted exclusively to the Director in the 1992 Act. The Secretary of HUD also must approve any new conventional mortgage program that is significantly different from those approved or engaged in prior to the 1992 Act. The Secretary is required to approve any new program unless it is not authorized by the Charter Act of the Corporation or the Secretary finds that it is not in the public interest. However, until one year after the final regulations establishing the risk-based capital test are in effect, the Secretary must disapprove a new program if the Director determines that the program would risk significant deterioration of the financial condition of Fannie Mae. The Secretary has adopted regulations related to the program approval requirement. Fannie Mae cannot issue new securities or banking instruments without government approval and it is subject to lawsuits over its corporate practices, just as any other corporation.

Fannie Mae is exempt from all taxation by any state or by any county, municipality, or local taxing authority except for real property taxes. Fannie Mae is not exempt from payment of federal corporate income taxes. Also, Fannie Mae may conduct its business without regard to any qualifications or similar statute in any state of the United States or the District of Columbia.

Thirteen members of Fannie Mae's eighteen-member Board of Directors are elected by the holders of the Corporation's common stock, and the remaining five members are appointed by the President of the United States. The appointed directors must include one person from the home building industry, one person from the mortgage lending industry, and one person from the real estate industry. Under the 1992 Act, one appointed director also must be from an organization that has represented consumer or community interests for not less than two years or a person who has demonstrated a career commitment to the provision of housing for low-income households. Any member of the Board of Directors that is appointed by the President of the United States may be removed by the President for good cause.

Fannie Mae has an Employee Stock Ownership Plan (ESOP) for qualified employees. Fannie Mae may contribute to the ESOP an amount based on defined earnings goals, not to exceed 4 percent of the aggregate base salary for all participants. The contribution is made in the subsequent year either in shares of Fannie Mae common stock or in cash that is used to purchase such stock.

3.5. Private/Public Consortia

A consortium is a legal entity, member-based, not-for-profit organization serving its members and the public (community) for some stated purpose. The members typically share costs, common interests and capabilities. Appropriate examples are the Association of Universities for Research in Astronomy (AURA) and The Universities Space Research Association. These consortia have competed for specific NASA opportunities, particularly, in the development, operation, and administration of NASA Science Institutes. They typically become involved through a procurement contract involving the normal procurement and regulatory constraints.

3.5.1. Universities Space Research Association (USRA)

USRA was incorporated 30 years ago in the District of Columbia as a private nonprofit corporation under the auspices of the National Academy of Sciences. Institutional membership in the Association has grown from 49 colleges and universities when it was founded, to 82 in 1999. All member institutions have graduate programs

¹⁰ The government oversight of the company is not inappropriate, if it were unregulated, it would probably be subject to

in space sciences or aerospace engineering. Besides 77 member institutions in the United States, there are two member institutions in Canada, one in England, and 2 in Israel. USRA provides a mechanism through which universities can cooperate effectively with one another, with the government, and with other organizations to further space science and technology and promote education in these areas. Its mission is carried out through the institutes, centers, divisions, and programs that it administers. A unique feature of USRA is its system of Science Councils, which are standing panels of scientific experts who provide program guidance in specific areas of research. Most of USRA's activities are funded by grants and traditional procurement contracts from the National Aeronautics and Space Administration.

USRA operates and administers the:

- (a) Lunar & Planetary Institute, founded by the National Academy of Sciences to manage research access preeminence in planetary and solar system science, shares the facilities of the USRA Center for Advanced Space Studies in Houston, Texas, with the Divisions of Space Life Sciences and Educational Programs.
- (b) Institute for Computer Applications in Science and Engineering (ICASE) at the NASA Langley Research Center,
- (c) Research Institute for Advanced Computer Science (RIACS) at the NASA Ames Research Center
- (d) Center of Excellence in Space Data and Information Sciences (CESDIS) at the NASA Goddard Space Flight Center
- (e) NASA Institute for Advanced Concepts (NIAC).

Because USRA member organizations cover a broad range of science disciplines including aerospace engineering, it is not surprising that it has been used by NASA to establish a variety of discipline "Centers" (equivalent to Institutes) at nearly all NASA Centers. Its responsibility has even extended to being selected (competitively) by Ames Research Center as the prime contractor with extensive management responsibilities for the SOFIA project. As a consortia/association, it can call upon a wide range of intellectual talent and adapt as the mission changes in emphasis and has collaborated or served as the lead with government, educational, and commercial entities. Although USRA members are an excellent source of scientific guidance, they provide no capital investment; NASA provides the bulk of the funding. It is encumbered by the usual regulations associated with accepting NASA funds. Although it functions like a typical commercial contractor (for SOFIA) it has no experience in commercial development and its technology expertise is tied to space science (and computer science). It is difficult to locate a consortium that addresses both commercial development and science.

antitrust and monopolization charges. Fannie Mae did over \$1 Trillion in business in 1998.

3.5.2. Association of Universities for Research in Astronomy (AURA)

AURA is a non-profit corporation chartered under the laws of the State of Arizona, was formed in 1957. It is a consortium of educational and other non-profit institutions that operates world-class astronomical observatories that they term “centers”. The consortium is comprised of 29 U.S. institutions and 5 international affiliates. As a university governed management group, AURA has been responsible for the operation of the Space Telescope Science Institute (STScI), instituted in 1981, and several other astronomical observatories worldwide. These include the National Optical Astronomy Observatories (NOAO), located in Tucson, Arizona, which is comprised of the Kitt Peak National Observatory in Arizona; Cerro Tololo Inter-American Observatory in Chile; and the National Solar Observatory at Sacramento Peak.

3.6. Cooperatives and Associations

A Cooperative is an enterprise or organization that is owned by and operated for the benefit of those using its services. A cooperative is an autonomous association of persons united voluntarily to meet their common economic, social, and cultural needs and aspirations through a jointly owned and democratically controlled enterprise. A Cooperative is normally used in an existing competitive market.

3.6.1. INTELSAT

Although the most familiar cooperatives are those associated with real estate and agriculture, INTELSAT, which has some analogous functionality and requirements as the ISS NGO, is an international cooperative that is partially owned by US based COMSAT, which is also the largest individual shareholder. INTELSAT operates on a commercial basis as a cost-sharing cooperative with the long-term objective of providing services at prices that meet its revenue requirements. Each shareholder contributes to INTELSAT and receives capital repayments and compensation for the use of capital in proportion to its investment share. INTELSAT has had striking success in achieving international cooperation among its 142 member based countries. It does allow its members to create and use competing entities.

Because it is a non-profit, it is tax exempt, although it does have the same reporting requirements. INTELSAT can rewrite its agreements and make amendments to its charter in ways that corporations sometimes may not achieve. Congress does not bind INTELSAT; the members do. However, the restrictions of international law do come into play. Non members can also access INTELSAT service, thus not limiting its market potential or, conversely, implying a monopolistic control. INTELSAT achieved more privatization by spinning off a fully private venture, incorporating it in the Netherlands, and giving it corporate assets (6 satellites) to invest in the market potential of regional customer oriented video and multimedia application. INTELSAT owns 10 percent through an independent trust arrangement.

Some disadvantages include restrictions on INTELSAT's ability to become a privatized and commercialized entity, which can only come about through international agreement. In addition, INTELSAT is not a monopoly and its competitive position is eroding. To address this, the INTELSAT Signatories and Management must agree on the best way to restructure while guaranteeing that they can meet the needs of those countries that are still dependent upon the INTELSAT system. In order to privatize, INTELSAT needs for the US and its member countries to not only adhere to international agreements, but also encourage the privatization, and apply regulatory authority uniformly.

3.6.2. Associations

An Association is a group of persons who share common interests or a common purpose and who are organized with varying degrees of formality. An example of an Association is the nonprofit American Institute of Aeronautics and Astronautics (AIAA) is the principal society and voice serving the aerospace profession. Its primary purpose is to advance the arts, sciences, and technology of aeronautics and astronautics and to foster and promote the professionalism of those engaged in these pursuits. Although founded and based in the United States, AIAA is a global organization with nearly 30,000 individual professional members, over 50 corporate members, thousands of customers worldwide, and an active international outreach.

Independent non-profit or association examples may include Aerospace Corporation (an independent non-profit originally created by the Secretary of the Air Force) or Mitre, an independent non-profit that operates primarily defense related Federally Funded Research and Development Centers (FFRDC). Since most associations are focussed groups of professionals, and normally not involved in operational activities, they are not seriously considered in this study.

3.7. NASA Science Institutes and Commercial Space Centers

3.7.1. Science Institutes

A NASA Science Institute¹¹ is defined as:

“A non-Federal entity established to accomplish an ongoing research program; An organization devoted to research, the development and transfer of technology, and the provision of services to the

¹¹ NASA Science Institutes Plan, A Report of the NASA Science Institutes Team, Final Publication (Incorporating Public Comments And Revisions), National Aeronautics And Space Administration Washington, D.C., February 1996

scientific community, and the public; and, An organization responsible for facilitating scientific and industrial community access to NASA's space and ground-based assets.”

The procedures and guidelines for establishing NASA Science Institute are detailed in “Establishing Science and Research Institutes”, NPG: 5000.1, Code H, April 26, 1999. In general:

- Institutes will be chartered and directly funded at the direction of the NASA Enterprises.
- NASA Centers will provide services and support to the Institutes. Any core function (including related science) remaining at a host Center that falls within the mission area of an Institute will be funded through the Institute.
- The NASA Chief Scientist will be responsible for coordinating science community involvement in the formulation of Institute plans and continually assessing the quality of the science at each Institute, including any associated NASA component.

However, the definition for an Institute as proposed in the Zero Base Review was modified to read:

- A non-Federal entity established to accomplish an ongoing research program;
- An organization devoted to research, the development and/or transfer of technology, and the provision of services to the scientific community and the public; and,
- An organization responsible for facilitating scientific and industrial community access to NASA's space and ground-based assets.

An Institute is an independent entity with the ability to enter into collaboration with NASA. The form of this collaboration and mode of operation may vary for each of the different Institutes proposed. While Institutes may engage in significant collaborations with NASA Centers, central to each of these arrangements is the existence of a legal entity separable from NASA.

It is expected that Institutes will be operated by universities, consortia or other non-profit organizations in partnership with for-profit industry as appropriate. It is not expected that a single model for an Institute can deal with the wide range of missions and scopes identified for the Institutes under consideration. However, Institutes will have a number of common characteristics.

External Leadership - Each Institute will have identifiable intellectual leadership outside of NASA. Institute Directors will not be NASA employees. Similarly, Institute Boards of Directors will not include NASA employees. Institutes will be established to allow for shared ownership and the more substantive involvement of communities external to NASA. Institutes will foster cooperation, not competition, among the government, academic, and industry sectors.

Corporate Identity and Affiliation with NASA - A clear identity with NASA and a part of its mission is an essential common characteristic for each Institute proposed. This corporate identity is likely to be

established through the Agency's long-term funding commitments to the Institute. It is reasonable to expect that Institutes may wish to acknowledge NASA's sponsorship and support in their institutional advertising, annual reports, press release credits, and other documents for public dissemination.

Competitive Selection and Peer Review - All work assigned to Institutes should be the result of a competitive selection process. This competitive process may be part of the initial selection process or subsequent selections for scientific research grants or individual projects. In the case of scientific research, all selections should result from a process that conforms to standard policies including peer review as appropriate.

Inclusion of Research, Technology, and Service Components - Each Institute will be responsible for: conducting and enabling peer reviewed research for the development of new scientific knowledge and understanding of nature; creating, developing, and/or transferring new technology; and providing value-added services to its external customers.

Degree of Independence - As mission organizations, Institutes will be expected to behave proactively, exercising the necessary degree of entrepreneurialship, autonomy and judgment required to achieve their stated goals and objectives while contributing to NASA's mission. As independent entities, Institutes may also obtain support from other funding sources, open new lines of business, and perform work for others subject to a determination by their Board of Directors that such work is not inconsistent with the Institute's overall mission.

Off-Site Business Office - Science Institutes will have a physical presence and will not be merely "virtual" organizations. Consistent with an Institute's identity as an independent entity, separate and easy access should be provided for the external science community to make use of Institute services and facilities. In order to facilitate this non-government business, at a minimum, each Institute established should maintain a business office and "front-door" organization off-site from any affiliated NASA Center.

IPA Eligible - It will be desirable for an Institute to have as its operator or sponsor an organization which is able to exercise the flexible employment arrangements provided under the terms of Intergovernmental Personnel Act or IPAs. The IPA program provides a proven means for exchanging critical ideas, knowledge, skills, and human resources between the Federal government and other sectors. (Examples of IPA eligible organizations include state and local governments, institutions of higher education, and some non-profit organizations.)

NASA Science Institutes that are primarily operated through a Cooperative Agreement with NASA include:

- Global Hydrology and Climate Center (MSFC)
- Astromaterials Institute (JSC)
- Goddard Institute for Space Studies (GISS)
- Astrobiology Institute (ARC)
- Microgravity Institute [Fluid and Combustion] (LERC)

Proposed Institutes:

- Microgravity Institute [Materials Sciences and Biotechnology] (MSFC)
- Space Science Institute (MSFC)
- Atmospheric Sciences Institute (LARC)
- Space Power and On-Board Propulsion Institute (LERC)
- National Space Science Data Center (GSFC)
- Goddard Earth Sciences and Technology Center (New, CAN is in RFP stage)

A special Institute arrangement is used to procure the services through Cal Tech at the Jet Propulsion Laboratory under direct contract to NASA.

Institutes require stable funding from NASA to support core service and research functions. While in some ways they have the broadest charter of any NASA entity, they may argue that they cannot always fully conduct a full range of activities due to the limited budget they are allocated. A second disadvantage is that a NASA Institute remains a NASA entity, usually lead by a NASA civil servant or appointee, and has therefore limited flexibility and freedom from bureaucratic constraints. It is difficult for a NASA Institute to act in a promotional mode to achieve outside funding, although not expressly prohibited.

3.7.2. Commercial Space Centers

NASA's commercial development research program, within the Office of Life and Microgravity Sciences and Applications, is carried out primarily through Commercial Space Centers (CSC). The CSC's are consortia of industry, government and academia that conduct space related research with commercial potential. The Centers are located at University or non-profit organizations with responsibility for selection of academic, government, and industrial affiliates, project formulation, and adherence with NASA requirements. All commercial development research projects compete for flight and space aboard the Space Station at the product/project level, as distinguished from the apparatus or program level. Evaluations are conducted by the appropriate NASA field center. Although the consortia structure of CSC's lends itself to accomplishing the

functional tasks of the NGO, their scope and affiliation would need to be greatly expanded in order to meet the rationale for an NGO. Several examples of CSC's are described below for reference.

3.7.2.1. Texas A&M University — Commercial Space Center for Engineering

This CSC, formally established by the Texas A&M University System Board of Regents, is dedicated to working with industry to generate engineering research and technology development projects to be conducted on the space station. As one of NASA's Commercial Space Centers, it along with its business partners merit preferred and low-cost access to space. It represents a one-stop-shop for spacecraft technology developers, providing expert technical support, simplified ISS integration, and business planning services.

3.7.2.2. BioServe Space Technologies

Bioserve Space Technologies is located at the University of Colorado in Boulder. The Center embodies affiliates from the commercial, academic, government and non-profit foundation sectors. BioServe concentrates its efforts in five areas. In the area of bioprocessing/bioproduction development, microgravity is used to foster the commercial development of new bioproducts for use in the human body and unique, commercially important bioprocessing techniques. Another area, physiological modeling in space, uses microgravity to explore changes that occur in living systems. Special emphasis is placed on using space as a unique laboratory to address terrestrial health concerns in ways that are not possible on Earth, and to address health issues that will be of concern to living organisms exposed to microgravity for long duration. Biomolecular electronics, the fourth area of research, uses microgravity to develop new "biocybernetic" materials for use in future computer systems. The fifth area, called enabling device capability, focuses on developing a suite of generic, flight-qualified and flight-proven devices that address the needs of a wide spectrum of life sciences investigators.

4. Objectives and Requirements

Section 2.2 introduced the rationale for adopting an NGO form for the ISS utilization management entity. Section 3 discussed various types of management structures. In this section, the elements of the rationale are examined, as well as other relevant organization requirements, as related to these various management structures in order to predicate metrics which will be useful in comparing them. This analysis will become the basis for establishing strengths and weaknesses for each option; these will be discussed in Section 5.

4.1. Examination of the Rationale