IMPROVING THE JUSTIFICATION FOR SPACE INDUSTRIALIZATION

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Abstract

Space industrialization concerns the practical applications of space such as Energy Services, Information Services, Products, and People in Space. Many of the spacecraft aspects may be technically feasible but there are some problem areas. NASA-sponsored studies appear to be overly optimistic regarding economic and political feasibility while the social, costing, and management problems seem to be underestimated. It is concluded that some space industrialization programs have potential; however, it is premature to embark upon the ambitious schemes suggested by certain advocates. Many of the problems which could accrue from a major space industrialization effort are expected to be the same as those faced by the Shuttle and the present applications satellites. Hence, the Shuttle and its payloads could be used to resolve the conflicts sooner and generate confidence. It is advisable for NASA to establish a substantial planning and analysis group composed of individuals with economic and marketing skills who understand competitive commercial operations. If the private sector does not choose to fund the equipment and operations for many aspects of space industrialization, consideration might be given to making NASA an operational agency as well as an R&D agency.

Categories of Benefits

The potential benefits of space industrialization may be grouped in various ways. A convenient arrangement, as suggested by Science Applications, Inc., [1] is Energy Services, Information Services, Products, and People in Space. The SAI report is comprehensive and gives good breakdowns of the prospects showing the largest expected revenues from a solar power satellite ($200-$600 billion), then the information services at $340 billion, the products at $64 billion, and, finally, the tourism at $1.5 billion. The revenues are cumulative over the period 1985 to 2010. The four largest items in the information services are a pocket telephone at $100 billion, teleconferencing at $90 billion, electronic mail at $90 billion, and national information services at $40 billion.

Analytical Deficiencies

Economic Analysis Deficiencies

While it is not intended to focus on the Science Applications report, their work does illustrate some of the problems encountered by NASA-sponsored studies of economic and applications benefits. The basic limitations or deficiencies are summarized in Figure 1. Rather than elaborate on the deficiencies, a more constructive approach is taken here to indicate how the criticisms might be overcome.

1. JOBS AND TAXES
   - UNCERTAINTIES IN LAG TIME.
   - NOT DIFFERENT FROM OTHER SPENDING.
2. "REVENUES" VERSUS "BENEFITS"
   - DEFINITION AND CONCEPT.
   - CAPITAL REQUIREMENTS IN A TIGHT ECONOMY.
   - LONG PAY-OFF TIME (9-19 YEARS).
   - FRAGMENTED MARKETS.

FIG. 1 ECONIMIC ANALYSIS DEFICIENCIES

Economic analysis of the impact of R&D expenditures on jobs and taxes is a sophisticated art.[2] Sector analysis seems preferable to the use of aggregated measures like gross national product, particularly if it is desired to distinquish R&D from other types of federal funding.[3]

Benefits can be examined from several perspectives. SAI stresses the generation of revenues in the public, private, and international sectors. However, in justifying federal expenditures, it is important to note the specific benefits to the U.S. taxpayers. One approach is that the governmental return should be adequate to cover the taxpayers' outlays, i.e., users pay full costs as in the case of toll bridge charges. Another view might be that the reduction in costs or the avoidance of costs should exceed the taxpayers' outlay.

The large capital requirements, long pay-off times, and fragmented markets for many of the services are not attractive to the private sector. Perhaps some types of guarantees or other incentives from the government would make participation more palatable.

Political Deficiencies

SAI and others have recognized that there could be problems and delays from domestic and political-legal barriers. Figure 2 lists some of these.

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A. DOMESTIC

1. FREQUENCY ALLOCATIONS.
2. LACK OF EXCLUSIVE RIGHTS.
3. DEFENSE VS. CIVIL AGENCIES.
4. SATELLITE SECURITY.

B. INTERNATIONAL

1. FREQUENCY ALLOCATIONS.
2. SPACE LOCATION RIGHTS.
3. ACCESS TO SATELLITES.

FIG. 2 POLITICAL DEFICIENCIES

As an illustration, the allocation of enough U.S. frequency channels for the various satellite services direct to the public could prove very time consuming. Citizen band radios did not blossom until the mobile radio sector won a long battle against the broadcasters in order to obtain more frequencies from the Federal Communications Commission.

Heretofore NASA has taken the position that the data produced by their satellites is in the public domain so profit-making organizations have not seen fit to put up large sums of money. The Navy has gone to the private sector for their communications so that avenue may be fruitful. It is planned that LeaSat will be owned by Hughes and the Navy will buy services. Perhaps NASA could consider such a method for its data relay satellite and better comply with the national science policy:

> "Wherever possible, Federal policy and practice should reinforce and help perfect private market forces rather than substitute for them. There is a growing body of evidence that governments have a tendency to carry such activities too far or stay involved too long. This frequently leads to Government R&D funding substituting for private investment, and discouraging rather than complementing or encouraging it."(3)

Before some of the benefits may accrue, it will be necessary to settle some defense issues. Already there is concern between the Defense Department and civil agencies regarding the management of navigation systems.(4) Decisions regarding peacetime and wartime control of the DOD Global Positioning System could affect the expected benefits from personal navigation sets and vehicle/package locators.

Previously, the Defense Department was overruled on SeaSat when it tried to keep the radar altimeter data classified. On the other hand, it prevailed on the early LandSats because, effectively, a limit was placed on the resolution of the civilian photographic instrumentation. The President's space message (5) described a study group which would consist of NASA, DOD, and NOAA for a combined meteorological satellite so progress in cooperation seems to be indicated. In a larger sense, the whole matter of the safety and security of the U.S. applications satellites and space stations should be reviewed in the light of possible capture or kill by an unfriendly nation.

On the international scene, frequency allocation is an even more acute problem. It takes years to obtain WARC/ITU approval. As the European nations expand their satellite capabilities, it may be increasingly difficult for the U.S. to obtain channels. Much of Europe is in competition with the U.S. so the economic return may be considerably less than if they were more anxious to cooperate.

Also, if Europe and the Less Developed Countries expand their horizons, we may expect more confrontations, e.g., who owns the geosynchronous parking spaces? There are problems concerning access to satellites, as for example, Arab countries tuning into an observation satellite to obtain photographs of Israel and vice versa. Under what rules will observation overflights be permitted?

Social and Psychological Deficiencies

Some of the studies with an economic emphasis do not consider the social and psychological importance of space industrialization. The idea of a challenge was important in the Kennedy/Johnson era. Such an approach has been discussed by Mr. Cousins of the Saturday Review Magazine.(6) Nevertheless, in spite of the considerable publicity by space visionaries, researchers, contractors, professional societies, and some Congressmen, there does not seem to have been a major ground swell to embark on another glorious decade of space as we did in the 1960's with Apollo.

The U.S. societal trend toward individualism cannot be overlooked. Will a public which objects to mandatory seatbelts accept remote safety inspection? Will the public put up with an alleged invasion of privacy even if the transmitter device is free?

There are several problems with the suggested Vehicle Location Service. Several years ago DOT/UMTA funded a radio vehicle locator system and tried to secure support from truck, taxi, and bus companies. The trucking companies were not interested because the locator system did not prevent theft and the same money could be used better in other ways. The taxi companies and the bus company (Chicago Transit), which was used as a trial case, ran into trouble from unions which did not want management checking so closely on their performance.

Of course the environmental aspects have to be considered. This is particularly applicable to the suggested solar power satellite, whether the energy is sent down by microwave or laser methods.

Costing Deficiencies

Costing estimates are heavily dependent upon the design of the operational space and earth-based portions as well as the building blocks needed to put up, build, and operate the stations. Various sources have provided estimates of key subsystems in terms of size, weight, power, and initial operating capability date.[1,7] Sometimes costs for the space portion are estimated but little evidence is furnished as to how the figures were obtained.

An illustration of the difference between future estimates and present costs is in order. SAI outlined a 16,000 pound personal communications satellite in geosynchronous orbit (GEO) with an IOC cost of $300 million. The LandSat and SeaSat unit program costs are expected to be about $70-$150 million for satellites weighing in the neighborhood of 2,000 pounds in low earth orbit (LEO).[8,9] SAI indicates a transportation cost of $11 million per satellite in GEO. For the Shuttle, NASA estimated life-cycle launch unit costs on the order of $30 million while there are indications that the total program cost may be over $120 million per flight in LEO.[10] Hence, it appears that the future spacecraft and transportation costs are substantially underestimated.

Further, several types of costs are frequently omitted: civilian ground equipment, costs for the space building blocks, and R&D costs for the satellite, building blocks and ground systems. It is apparent that much more sophisticated costing is needed.

Management Deficiencies

SAI recognized the "institutional implications." These have been a continuing problem for the multi-purpose satellites such as LandSat and SeaSat - who should manage the operational systems?[9] The Departments of Interior, Agriculture, and Commerce have not had funds to do it and NASA is not permitted by law. The President's policy statement postponed such decisions by establishing coordinating committees, e.g., for remote sensing.

A key part of management decision-making concerns who will set the charges and on what basis. Pricing has been reasonably tidy in the communications satellite areas but it is unresolved in the cases of LandSat and the Shuttle. Agriculture, Interior, and NOAA each sell LandSat photographs at different prices, none of which appear to be fully costed. NASA has proposed that the Shuttle charges be uniform so that the early users pay less than actual costs and the later users pay more. It is unresolved as to who will pay how much for the ground terminals associated with the Global Positioning System (NavStar) navigation system.

SAI recommended that "an office for space industrialization planning, integration, and implementation reporting to the NASA Administrator" be established. This has some merit but, in the past, NASA has had some problems. Their engineers are excellent at technical planning but the political planning (e.g., getting Interior, Agriculture, and Commerce to provide operational funds) has been weak. In addition, their economic planning (getting industry to furnish substantial funds) has been limited. If NASA does establish a larger planning group, it should include some experienced business people (not aerospace contractors) who know the commercial competitive scene as well as some micro-economists who are skilled at directing outside consultants and contractor studies.

Conclusions and Recommendations

This short review has revealed deficiencies in economic and political feasibility, as well as in management and costing aspects. Basically, it appears that the economic benefits tend to be overstated and the other problems underestimated. It does not seem wise to undertake grandiose programs costing many billions before the fundamental issues are resolved for the ongoing programs.

The specific recommendations are summarized in Figure 3.

1. BUILD CAPABILITY GRADUALLY.
2. USE SHUTTLE AND PAYLOADS TO SOLVE SOCIO-POLITICAL PROBLEMS.
3. ESTABLISH A QUALIFIED PLANNING GROUP AT NASA.
4. SEEK PRIVATE FUNDING FIRST.
5. FAILING PRIVATE FUNDING, CONSIDER MAKING NASA AN OPERATIONAL AGENCY.

FIG. 3 RECOMMENDATIONS

1. While space programs have considerable potential, it is premature to embark upon very ambitious schemes. As the President's policy statement [5] and the AIAA position paper[11] have indicated, such programs should be built up gradually.

2. Many of the non-technical problems which could accrue from a major space industrialization effort are expected to be similar to the problems faced by the Shuttle and the present applications satellites. Hence, it would be advisable to use the Shuttle and its payloads to resolve the conflicts sooner.

3. It is advisable for NASA to establish a substantial planning and analysis group composed of individuals with economic and marketing skills who understand competitive commercial operations.

4,5. If the private sector does not choose to provide major funding, consideration might be given to making NASA an operational agency as well as a research and development agency. This is because the multi-purpose space industrialization efforts do not fall conveniently into any of the regular government agencies.

References

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3. National Science Foundation, "Science and Technology: Annual Report to the Congress," August 1978, Chapter 4.

4. U.S. General Accounting Office, "Navigation Planning - Need for a New Direction," March 21, 1978, LCD-77-109.

5. Carter, President Jimmie, Fact Sheet, "U.S. Civil Space Policy," October 11, 1978.

6. U.S. Congress, Congressional Record, September 27, 1978, p. S-16355.

7. AIAA, series of articles on "High-Power Laser Applications," Astronautics and Aeronautics, March 1979.

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10. U.S. General Accounting Office, "Cost-Benefit Analysis Used in Support of the Space Shuttle Program," June 2, 1972, B-173677.

11. American Institute of Aeronautics and Astronautics, "Solar Power Satellites - An AIAA Position Paper," Astronautics and Aeronautics, January 1979, pp. 14-17.

Q. Do you feel that it's a proper role of government to fund space industrialization studies such as the SAI and Rockwell efforts in order to figure out the intricacies of the decision-making process that relates the economic, political, and social implications of applied technology? If so, what is holding things up in Washington to get that kind of money moving?

A. We should fund the deserving studies. But many people on the Hill get upset; Senator Proxmire's Golden Fleece Award is perhaps the most flagrant example. Finally, the shuttle overrun will almost certainly eliminate any budget prospects for new efforts.

Q. Is that because we have a fixed-budget attitude at NASA?

A. Absolutely. Extra funds have to come out of someone else's pocket. OMB's point of view is, "Don't study things that you think you'll never start." It's possible, however, that a certain degree of intensive and calculated pressure applied to the right places at the right time could modify OMB decisions.

Q. Could corporations funnel more money into education to develop an educated constituency for the future? The young people are going to be the voters of tomorrow.

A. I'm skeptical as to whether that would produce any real impact.