REVIEW OF SPACE STATION REQUIREMENTS

Interim Report
Jan 25,1989

Brinkman
Crawley
Lemkey
Moser
McElroy

Objective

The panel has two successive objectives:

1. To review the program requirements, to insure that they are sound (in view of past history and future realistic expectations of funding), so that the space station constructed will have on board the necessary capabilities and facilities to make it an effective platform for research, technology development, and early space infrastructure functions.

2. To review the process by which users will gain access to the station, to ensure that a system is being planned which provides the maximum access to the capabilities with the minimum "overhead."

This interim report is a preliminary response to the first objective.

Approach

Critically review the existing requirements documents, and comment the following perspectives:

Physical and observational science	Brinkman
Life science	Moser
Micro gravity science	Lemkey
Communication and commercial user	McElroy
Technology development and space infrastructure	Crawley

Come to a panel internal consensus on documents (This interim report)

Then meet with program personnel, for clarification of specific issues, prior to final report at next meeting.

Documents Reviewed

Program Approval Document (PAD)

High level programmatic objectives which are under the control of the Administrator (level zero). 10/21/88 draft reviewed.

Program Requirements Document (PRD)

Specific program objectives and concise requirements which are under the control of the Associate Administrator (level one). Approved by the Associate Administrator on Feb 24, 1988, but with some remaining important TBD's. In revision due to outcome of PRR.

Documents not reviewed include:

The level two Program Definition and Requirements Document (PDRD), which is massive and under major revision as a result of the PRR last summer.

The level three requirements documents.

What were we looking for?

Positive attributes

Errors of commission

Specified errors of omission

Unspecified errors of omission

Did not focus on programmatic and management, or evolution issues, since these were the responsibility of other panels, but rather looked at the requirements from the perspective of a potential user.

Review of PAD

A high level document, which is general enough to enable almost all possible possible uses of the station, but which require almost none.

A few specific requirements are reflected:

- Crew of 8, 75Kw of power
- Mandated assembly sequence:
  - FTS first
  - MTC before PMC
  - US before internationals
- Launch rate, and use of ETR and WTR
- Facility use, management and procurement plans.
- Schedule, cost and civil service allocations

Generally positive response, no significant recommendations.

Review of PRD

Section	Reviewed	Not Reviewed
1 Intro	X	
2. Objectives	X	
3. Program		
3.1-3.7	X	
3.8 Product assurance		X
3.9 Safety		X
3.10 Evolution		X
4. Management		X

General Observations

Interests of the users are looked after well in general. SSP is required by PRD to:

Develop procedures for int erfacing that minimize the difficulty of doing business

Develop a single point of contact integration approach

Maximize user freedom, within constraints....

Provide standard user interfaces

Develop a unified verification process (does this include STS launch ?)

But.... most aspect of th e PRD are too general to really understand what will be provided to the users.

Microgravity Material Science

The PRD includes several specific requirements to enable the performance of micro-g research:

A power service of 15Kw at each of six racks

A micro-g vibration requirement of 10^{-6}g at dc, ramping up in frequency, for periods of 30 days.

These requirements, if they can be met, insure the environment for high quality manufacturing research, but potentially place severe restrictions of vigorous activities such as EVA, technology and operations development activities around the station.

Physical Sciences

The requirements for pointing determination and attitude stability are fairly coarse:

Station attitude known to 36 arc sec

Coarse pointer can point to an accuracy of 60 arc sec and a stability of 30 arc sec

With the removal of the upper and lower booms, the number of payload attach points is only 4, with somewhat limited field of view, and in a more contaminating environment

Enthusiasm in the observational science community to Space Station, based in part on these capabilities, is mixed at best.

Life Sciences

Only identifiable requirement in support of life science is the provision for transport to the station of living specimens.

No other explicit requirements in support of space biology initiative, or the 1.8 m centrifuge, which is considered vital by the community, appear in the PRD.

Two requirements appear to somewhat limit the options for using humans as medical subjects:

Establishment of a maximum stay time of 180 days

Specification that on average 6 of the 8 crew will be available for user functions. Does this preclude the acquisition of medical data from all 8 crew?

SPACE STATION REQUIREMENTS
- Commercial Users

✓THE EVOLUTION OF POLICIES FOR COMMERCIAL USERS HAS ONLY BEGUN. NOT SURPRISINGLY, NEITHER THE PAD NOR THE PRD PROVIDES MANY INSIGHTS.

✓THE PRINCIPAL INTERESTS OF THE COMMERCIAL USERS ARE:
- What facilities will I have access to?
- What will it cost to use the Station?
- What ranking will my requirements have versus others?

✓THE ANSWERS TO THESE QUESTIONS CANNOT BE GIVEN UNTIL THE NEW ADMINISTRATION SETS ITS OVERALL POLICIES AND NASA HAS PROGRESSED FURTHER WITH THE STATION DEFINITION AND DEVELOPMENT.

✓WITH THE LACK OF CERTAINTY THAT IS INEVITABLY PRESENT NOW, THE INTEREST OF SIGNIFICANT SPACE USERS (VERSUS FRINGE GROUPS) WILL BE MINIMAL.

✓RECOMMENDATION: NASA SHOULD PROCEED WITH AN OPENESS TOWARD COMMERCIAL VENTURES, BUT SHOULD NOT TORQUE ITS PROGRAM TO SERVE GROUPS THAT CANNOT DEMONSTRATE A POTENTIALLY FAVORABLE NATIONAL ECONOMIC EFFECT. FOR EXAMPLE, NASA SHOULD BE ABLE TO SAY NO TO TRAVEL AGENCIES, SOUVENIR MANUFACTURERS, AND BURIAL IN SPACE ENTHUSIASTS.

SPACE STATION REQUIREMENTS
- Communications

✓THE PHILOSOPHY STATED IN THE PAD AND PRD APPEARS BASICALLY SOUND. IT IS, HOWEVER, INCOMPLETE FROM THE PERSPECTIVE OF A SCIENCE OR APPLICATIONS USER.

✓FIRST, THE PRD STATES THE REQUIREMENT FOR THE SPACE STATION INFORMATION SYSTEM TO PROVIDE END-TO-END SERVICE USING CODE T, CODE S, CODE E, AND OTHER USER FACILITIES. THIS IS APPROPRIATE, AND THE ONLY COST-FEASIBLE WAY TO PROCEED. IT DOES NOT, HOWEVER, PLACE PERFORMANCE REQUIREMENTS ON THE QUALITY OF THE SERVICE TO BE PROVIDED.

✓SECOND, IN THE ABSENCE OF PERFORMANCE REQUIREMENTS, A USER CANNOT ASSESS WHETHER THERE IS AN INTENT TO PROVIDE ANY PARTICULAR CLASS OF SERVICE THAT THE USER MAY DESIRE. FOR EXAMPLE, WHAT ARE THE CAPABILITIES FOR TELESCIENCE? WHAT ARE THE MINIMUM AND MAXIMUM THROUGHPUT CAPACITIES, DELAYS ETC?

✓THIRD, WHAT ARE THE PROCESSES FOR MANAGING THE COMMUNICATION AND DATA INTERFACES AMONG THE 'CODES?' IS THE USER TO CONDUCT THE NEGOTIATION? IS THERE A KNOWLEDGEABLE 'OMSBUDSMAN?' WHAT ARE THE COST TRADE-OFFS, AND WHAT IS THE USER'S RESPONSIBILITY, IF ANY, IN MAKING THEM?

✓FOURTH, IF AN OPERATIONAL USER, E.G., NOAA, SIGNS UP FOR THE SPACE STATION, WHAT PRIORITY IS GIVEN TO THAT USER'S NEEDS?

✓WHILE IT IS EARLY IN THE STATION DEVELOPMENT, IT IS NOT EVIDENT THAT 'TOP LEVEL' REQUIREMENTS ARE BEING LEVIED ON THE PROGRAM TO ENSURE THAT USER NEEDS WILL BE MET. IT MAY BE THAT THEY ARE, BUT IT IS NOT EVIDENT IN THE DOCUMENTS.

Technology Development & Space Infrastructure

Explicit consideration of the requirements of the OAST technology development mission, or of any accommodation of even near term transportation infrastructure, such as the OMV, is absent from the PRD. It seems that there has been a disconnect between the planing organizations in these offices, and the station requirements definition process.

The only requirement will support these activities is the availability of 350 hr/year of station based EVA.

(Tentative)
Recommendations

From the PAD and PRD alone, it is difficult to obtain a clear picture of the process which will lead to effective use of the station. However, based on our review, we would recommend the following:

1. R eview the μg requirements to insure that they do not preclude other envisioned vigorous activities on the station.

2. Consider adding more payload attach points, both inboard and out board of the alpha joint.

3. As much as is practical, consider running all user utilities (data, power, etc.) to all potential experiment sites on the station.

4. Reword crew requirements so that they do not preclude stays of longer than 180 days, and insure that all crew will participate in medical data base experiments.

5. Consider adding 1.8m centrifuge as a PRD requirement.

6. Insure that user requirements for data access and quality will be met. Consider partitioned software and data steams for users, to minimize user communication and software integration difficulties.

7. Encourage and proceed with commercial ventures which produce a net economic benefit.

8. Encourage OAST and transportation planners to verbalize their requirements before it is too late, and if necessary, modify the PDR to reflect these requirements.