US space station

No enthusiasm in Congress

US PLANS for a permanent manned space station, now being pursued enthusiastically by the National Aeronautical and Space Administration (NASA), have failed to impress Congress's Office of Technology Assessment (OTA). In a report on the ambitious plan to be published next month, OTA says it can find no "compelling, objective, external case" either for the space station options now being considered or for the likely cost to the public.

That many industrial companies have expressed an interest in participating in the project has however convinced OTA that there is a "persuasive" rationale for some sort of permanent space infrastructure, which is seen as essential if the United States is to retain its leadership in civilian space activities. The Soviet Union has, it notes, made a commitment to the permanent occupancy of space and has more experience with orbital stations. More than a hundred conceptual uses have been identified which have potential for science, technology and commerce, and individual companies and countries have made clear their desire to play a continuing role in the utilization of the space station's facilities. But, says OTA, there is no need in the near future for all the station elements advocated by NASA.

Among the uses for a space station accepted by OTA are "sophisticated" experiments in life sciences and materials sciences and trials of new instruments and activities. The station would also permit fuel and supplies to be warehoused in low Earth orbit, so allowing more efficient staging of voyages to higher orbits and Solar System destinations as well as repair and maintenance of complex satellites. But OTA is concerned that sufficient resources should be made available for development of these activities, otherwise "the rationale for the infrastructure vanishes". Some of the activities, OTA notes, would certainly need an on-board human workforce, if not a permanent crew: automated facilities for all the activities envisaged are unlikely to be available before the year 2000. But OTA concludes that it is impossible to define exactly what is required until a national consensus has been reached on objectives.

A range of possible objectives considered by OTA produces cost estimates for different options ranging from well below to well above the projected NASA proposals. Although finding sources of finance is unlikely to be a fundamental constraint on the programme, OTA seems to be suggesting that by adopting an "economy model" approach to the space station, the drain on federal funds could be very much reduced. Private companies may well be used to develop the free-flying

platforms envisaged by NASA, for example. NASA's plans are likely to cost \$8,000 million for "initial operating capability" or up to \$20,000 million for the full version.

Besides accusing NASA of not having properly thought out its technical objectives, OTA suggests that NASA's plans have been influenced by the belief that the agency could not long survive in its present form without some new large space programme: a series of less grandiose schemes would, OTA suggests, not have provided NASA with the same guarantee of long-term funding. But OTA wants NASA to stand aside wherever possible for private industry, and concentrate instead on the "very best of space-related science". Rather than a development effort aimed at producing the best designs, OTA wants a pragmatic ethic to dominate the process: programmes should be thoroughly defined in advance and deadlines should not be allowed to slip;

existing technology should be used except when this is clearly impossible.

OTA also has some interesting reflections on policy for international co-operation. It notes that the United States really has no need of such cooperation and could perfectly well develop a space station on its own if this suited. Furthermore, any sort of international cooperation is bound to be a possible source of friction and conflicting interests: the report notes that negotiations with the European Space Agency have already highlighted the potential for differences of opinion over how the project should be managed. Despite the problems, however, a cooperative approach would seem to be advantageous: the United States would prefer to be the dominant partner in space exploitation over the next few decades, and "locking in" its most likely competitors for dominance into a US-led system would go a long way towards achieving this goal.

Tim Beardsley

Telescope for 1990s

Multiple choice on mirrors

Washington

THE United States' premier ground-based optical telescope in the 1990s and beyond, the National New Technology Telescope, is now almost certain to be a multiple mirror instrument. A scientific advisory committee to the National Optical Astronomy Observatories (NOAO) has decided in favour of the multiple mirror option rather than the competing segmented mirror

Apart from producing the mirrors, a major challenge will be in aligning them with sufficient accuracy for use in combined beam mode, for which the light paths have to be identical in length. One factor in the minds of some committee members seems to have been that even if the alignment does prove to be a problem, there is still a lot of science that can be done with the four mirrors separately. If there are comparable problems with a segmented mirror design, however, the result could be an expensive white elephant. Either design is likely to cost more than \$100 million. But Dr Jacques Beckers, who heads NOAO's advanced development programme believes the alignment problem can be overcome.

The multiple mirror design will have a wider field of view than the segmented mirror could reach, and will therefore be better for such uses as multi-object spectroscopy. Wide-field direct imaging, on the other hand, will be less well served. The complex diffraction pattern of a multiple mirror will make disentangling separate faint sources more difficult, and many observations will take longer. The clinching factor, by one account, was that the multiple mirror design produces images that are more compatible with pixels of charge-coupled devices; having too many pixels per star introduces a new kind of error.

After NOAO has formally approved the design concept, work will begin on detailed technical proposals. A submission for funds to the National Science Foundation would follow in a year or two. In the meantime, studies will continue into a possible site for the telescope, likely itself to be a contentious affair. The two possibilities now being considered are Mount Graham, in Arizona, and Mauna Kea in Hawaii.

Tim Beardsley

design and NOAO is expected to approve the choice in August after a full technical report has been completed.

The decision was by all accounts a difficult one. Although either would have been feasible, the multiple mirror design seems in the end to have won primarily because its instrumentation was less likely to be a limiting factor in use. The telescope will have four 7.5-metre mirrors in a square configuration, giving a light-collection rating equivalent to a single 15-metre mirror but a baseline aperture, limiting in infrared observations, of 21 metres. Although the multiple mirror design calls for more detectors, construction of instruments such as spectrographs will be simpler.