

GIVING SPACE THE BUSINESS\$

By DIANE D. EDWARDS

Observers compare federal efforts in space commercialization to the Wright brothers' maiden flight or the first automobile assembly line — full of uncertainty and promise

When the space shuttle Atlantis landed Dec. 4, it brought back videotapes of an unusual construction site. Fitting together a 45-foot tower and a 12-foot pyramid in the shuttle's open cargo bay, two spacewalking astronauts had tested a structural support system planned as part of the U.S. space station — the \$8 billion project set for the mid-1990s that includes visions of industrial parks orbiting the earth.

During his 1984 State of the Union address, President Reagan had directed NASA "to develop a permanently manned space station and to do it within a decade." What followed — despite statements by then-NASA Administrator James M. Beggs that the station is "the next logical step" in the U.S. space program — were attacks from critics of the 40-ton facility calling it unnecessary and too costly (SN: 2/4/84, p. 69). Yet, nearly two years later, NASA officials say they are designing a structure capable of filling a changing cornucopia of needs over the next two to three decades: as a national laboratory, permanent observatory, service and assembly facility, transportation hub and storage depot.

But recent attention on another function — that of a manufacturing facility available for use by private companies — has some observers wondering whether space commercialization is an idea being sold before its time. Although there is speculation about large profits from "made in space" goods, the true extent and feasibility of space industry are still unknowable.

Despite the lure of new products and NASA's sales pitch offering space as the next industrial frontier — and the \$1 billion shuttle as its delivery and service truck — private enterprise has been slow to hitch research budgets to the space station program.

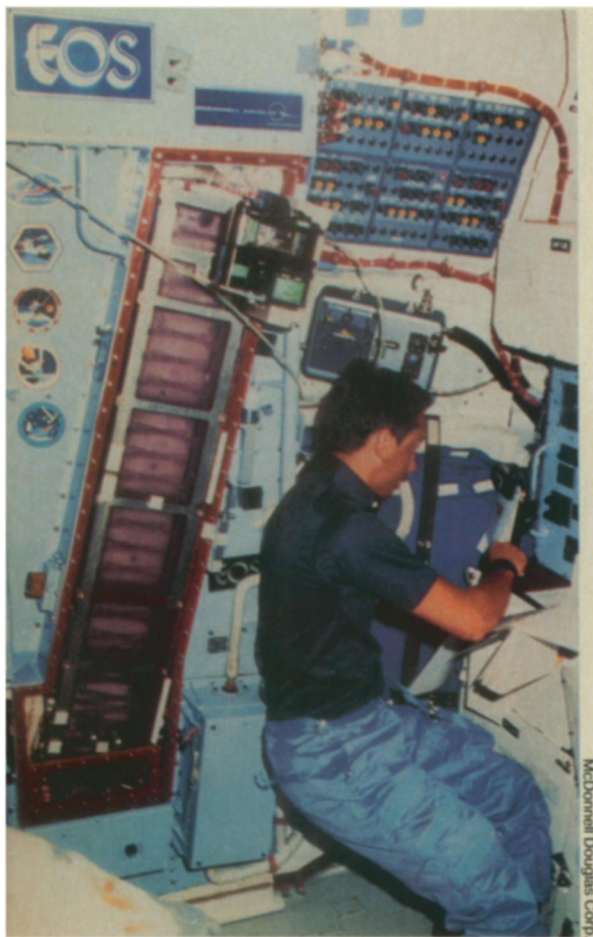
On Nov. 21, the U.S. Congress authorized \$205 million to NASA in fiscal year 1986 for developing a manned space station. That development includes the continuing implementation of a lengthy policy plan "to prepare NASA for expanding its mission in a new direction — the fostering of commercial enterprises in space." In his 1985 State of the Union speech, Reagan had emphasized "new opportunities for free enterprise" generated by the space station, where lifesav-

ing medicines worth as much as \$22 million a pound could be manufactured in 30 days in amounts that would take 30 years on earth. Although it is impossible to determine the exact profit potential of space-based commerce, Rep. Robert S. Walker (R-Pa.), a member of the U.S. House of Representatives' committee on the space station, told SCIENCE NEWS that, by 2010, it may be possible to create a \$1 trillion global economy in space, the equivalent of 35 million jobs. Those figures are based on 25-year growth rates of now-established high-growth industries.

At a press briefing last August, Beggs announced that "one of NASA's top priorities is to expand the economic frontier of space." However, making the station "user friendly" for business has put glitches in space station planning, according to Jim Moore, chair of NASA's Commercial Advocacy Group. "Commercial programs are the major design drivers on the space station," Moore says. "The amount of power, the amount of crew, the amount of pressurized space and gravity levels are all driven by commercial needs. I hope we *do* have commercial participants. It scares me sometimes to think we're basing the space station on a customer we don't know is out there yet."

Because NASA's schedule has construction of prototype components beginning in 1987, Moore says design decisions must be made soon: "In the science and technology areas, it's easier to do than in the commercial area [because] most industrial companies plan only two to three years ahead. We're talking eight to 10 years, so we're well ahead of their schedule. It's a little early yet for companies to step up and say, yes, we want to use the station."

Those who support the space station cite as models the development of highway, airport and railroad systems, as well as the \$2 billion-a-year space communications industry. To encourage this type of cooperation in space, and to attract private funding, NASA launched an extensive outreach effort two years ago that has had variable success in convincing other groups to fly on the station. That effort eventually will include: establishment of industry-related space research institutes, seed-funding for private sector research and develop-



A McDonnell Douglas payload specialist operates the company's electrophoresis chamber ("windows" on left) to purify drugs on the space shuttle.

ment, contract competitions for privately built support hardware and space services, and expedited decisions regarding joint NASA/industry endeavors.

"What we're doing is selling real estate in space," Moore says. "[The space station] is an industrial site in space."

But critics like Walker see NASA's new sales career as less than a meteoric rise

to the top. "My perception is there has not been very much effort put forward by NASA on the commercialization of the space station," he says. "Therefore, the commercial community has been left outside of the planning and is skeptical of what's going on." That skepticism is shared by Diana Josephson, marketing director for Arianespace (the European

company managing the French-built Ariane rocket launcher) and a former top official at the National Oceanic and Atmospheric Administration (NOAA). Awarded a Commerce Department gold medal for her role in the transfer of the remote-sensing Landsat system (see sidebar) from NASA to NOAA, Josephson recently told the Washington, D.C.-based

Making remote sense out of space commercialization

The federal government's announcement Sept. 27 that it had finalized transfer of the 13-year-old remote-sensing Landsat satellite system to a private company, Earth Observing Satellite Co. (EOSAT) of Landover, Md., heralded one of the first private industry/government partnerships headed for space. Paired with the planned launch next month of a rival French-built satellite, the transfer exemplifies space commercialization's promise, competition and uncertainty.

After several years of study, the Reagan administration proposed transfer of the Landsat system to the private sector in 1983 (SN: 3/19/83, p. 181). Disputes over several aspects of the proposal followed, causing delays that critics say gave foreign competition a headstart and frightened U.S. companies interested in space industry. Over objections from the White House Office of Management and Budget that the transition was too costly, this year Congress finally approved \$295 million over the next five years to subsidize Landsat's change of ownership and the deployment of replacement satellites. When the contract was eventually awarded to EOSAT, a joint venture led by RCA Corp. of Highstown, N.J., and Hughes Aircraft Co. of Santa Barbara, Calif., the company was the sole remaining bidder.

Still, the federal government will con-

tinue to finance operation of the two Landsat satellites now in orbit, part of a \$1 billion project that produced only \$11 million in data sales in 1984, according to a National Oceanic and Atmospheric Administration (NOAA) spokesperson. EOSAT, through aggressive marketing, plans to broaden the commercial market for remote sensing — an industry that could generate as much as \$18 billion in annual revenues by the year 2000 (based on figures from the Center for Space Policy, Inc. in Cambridge, Mass.). In the event EOSAT does not earn 60 percent of its projected annual revenues (ranging from \$20 million in fiscal 1986 to about \$55 million in the 1990s), an "escape clause" would release the firm from some of its Landsat obligations. NOAA would take back control of marketing and operations, but EOSAT must still provide two new satellites and a ground-operations system.

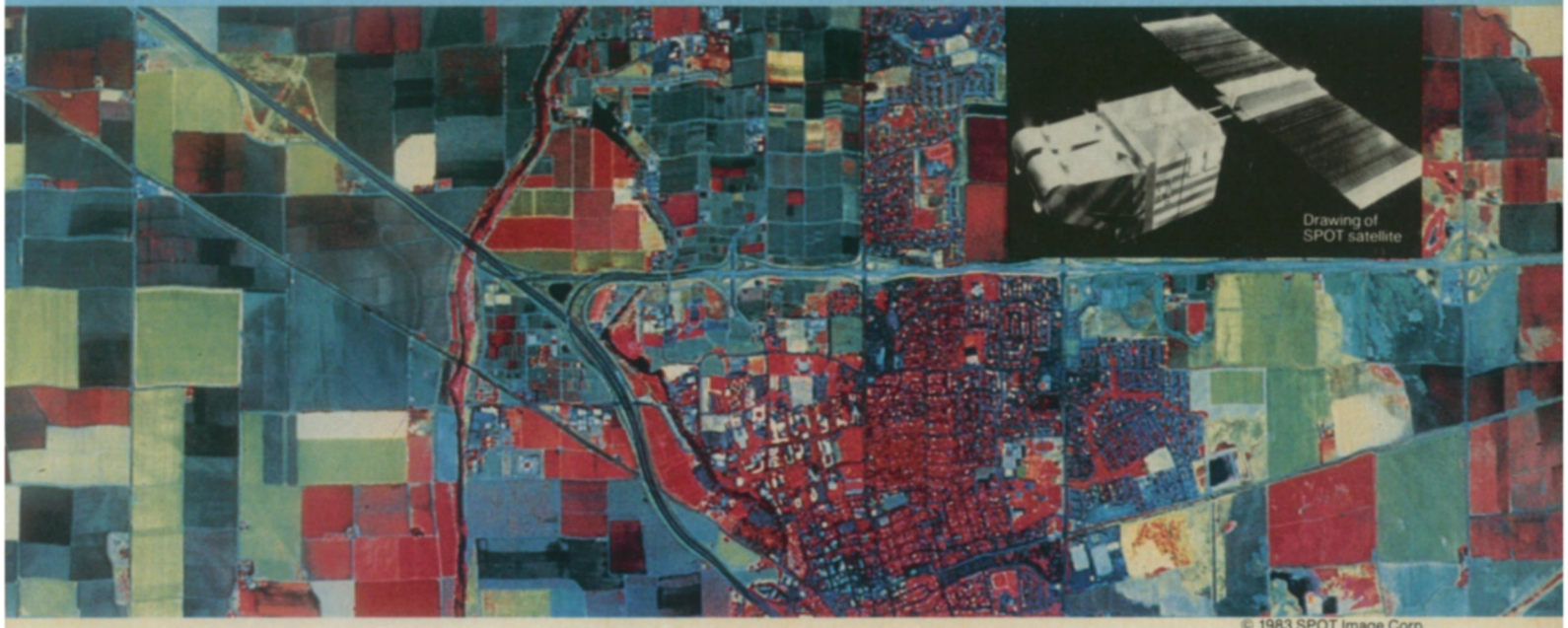
Landsat data include mapping of minerals, vegetation patterns and land use — the same offered by the French-designed SPOT satellite system, expected to give EOSAT stiff competition because of its superior resolution capabilities. Studies of SPOT's 10-meter resolution (compared with Landsat's 30-meter resolution) show SPOT imagery overall to be "decidedly more interpretable," according to a report in the August 1985 PHOTOGRAMMETRIC ENGI-

NEERING AND REMOTE SENSING. Since the first SPOT satellite hasn't been launched, researchers used computer-simulated SPOT imagery (see image of Yolo County, Calif., below).

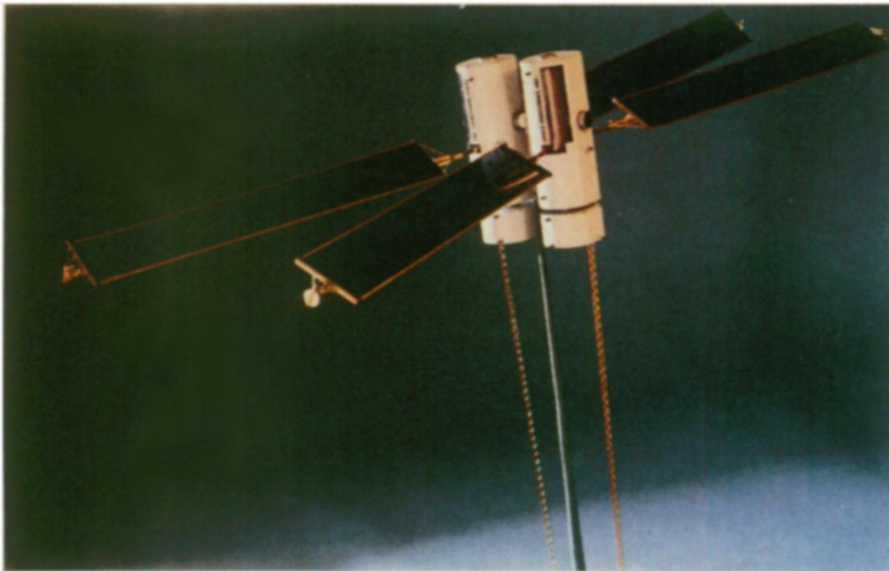
Data will be made available to users initially through the U.S. Department of Interior's EROS Data Center in Sioux Falls, S.D., under a nondiscriminatory policy set forth in the Land Remote Sensing Commercialization Act of 1984. During a hearing Nov. 13 in Washington, D.C., witnesses told members of the Senate subcommittee on science, technology and space that the definition of "nondiscriminatory" has strong commercial implications and needs further refinement. Who has access to what data could affect the commercial value of Landsat images, they said. For example, how does the government, which has provided research groups with free data in the past, avoid undercutting EOSAT's market? Representatives from NASA and NOAA warned a "gray market" for data could develop.

As NASA official Shelby Tilford told the subcommittee: "Any federally supported community has to sign a release saying all results will be made available to the public. That is extremely hard to enforce [in the EOSAT case]. To make sure EOSAT can survive, we will have to find some way to do that."

— D.D. Edwards



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Space Industries Inc. plans to launch industrial-use modules (model above) in 1989.

Women in Aerospace group that NASA's "tunnel-vision" approach to selling space "suffers from the difficulty . . . of no one there having commercial experience."

Nonetheless, NASA's inexperience in marketing is accompanied by the titillating success of space-based experimentation showing industrial potential. Work by crew members on Skylab, launched in 1973, and on space shuttle flights beginning in 1981 suggested commercial applications of microgravity and the superior vacuums attainable in space. Over the years, such research has shown industry new ways to process materials, produce drugs and build electronic equipment — without promising them commercial success.

Private investing would mean "big bucks" over a long period, and the risks would be sky-high. Stanley Weiss, a vice-president of the Burbank, Calif.-based Lockheed Corp., pointed out at a hearing Sept. 18 of the Reagan-appointed National Commission on Space in Washington, D.C., that "until undue risks are eliminated and markets and minimum returns on investment assured, government must provide the nurturing basis for commercial business [in space]." Josephson, who supports federal development of products with commercial potential, feels the "real nuclear problem" will be technology transfer.

For NASA, however, attracting companies with investment capital is not easy. "We're competing with the shopping center and other things with a high return [on investments]," Moore explains. "So [a space-made product] has to have a very high return. The transportation costs are horrendous." According to Fairfield, Conn., space investment analyst William Claybaugh, transportation costs will have to fall below \$100 a pound before NASA starts "tapping into the real mass market of space travel," and to \$50 a pound before materials processing in space is cost-effective.

Setbacks already have hit the nascent

"space industry" touted by NASA and the administration. NASA asked recipients of space station design contracts let last April to include alternative designs for a station only occasionally visited by astronauts. Rep. Walker, who is involved in the funding process, says he has "serious reservations" about the station's design in terms of commercial users, such as the amount of power that will be available. Both Moore and Claybaugh doubt that materials processing will be conducted on the original space station. And NASA officials acknowledge that much of the microgravity research can be accomplished using ground-based drop tubes and towers, or U2 and C135 aircraft, instead of spacecraft.

But the biggest blows probably came with the decision in September by Ortho Pharmaceuticals Co. to drop out of a drug-processing project aboard the space shuttle, and the failure of Fairchild Space Co. to get its commercial space platform off the ground.

The Ortho Division of Johnson & Johnson in New Brunswick, N.J., had an agreement with McDonnell Douglas Astronautics Co. of St. Louis to process drugs aboard the space shuttle using electrophoresis. But, based on bio-engineering advances, Ortho decided it could produce its proprietary drugs less expensively on the ground. According to a report in the Sept. 30 AVIATION WEEK & SPACE TECHNOLOGY, McDonnell Douglas officials expect Ortho to sell its ground-processed drug 12 to 18 months before McDonnell Douglas markets the same drug (erythropoietin, a red-cell-production stimulant), which McDonnell Douglas still processes aboard the shuttle.

Johnson & Johnson spokesperson Bob Kniffin told SCIENCE NEWS that Ortho continues to view space as "a very practical approach to manufacturing." But NASA sees the Ortho pullout as serious, signaling the possibility that a company may find a better industrial workplace than space, Moore says. It also appears that

McDonnell Douglas will be able to process its erythropoietin entirely on the shuttle, without flights on Fairchild's platform as originally conceived.

The Germantown, Md.-based Fairchild Industries signed an agreement with NASA two years ago to develop an unmanned space platform, the Leasecraft, which the Fairchild Space Co. would lease to commercial and government users for a variety of purposes (SN: 10/8/83, p. 231). At the time, no one knew exactly who would use the \$100 million craft; for now, it appears the answer is "no one."

Fairchild, which hoped an entire fleet of its platforms would be flying by the 1990s, has shelved the entire project and discontinued talks with NASA, according to the Nov. 11 AVIATION WEEK. Compounding Fairchild's woes were the inability to obtain insurance covering its program, and NASA's refusal to completely reimburse any losses caused by possible shuttle failure.

Add to these problems the unsolved mysteries of patent rights in space, the handling of proprietary information, the allocation of limited payload areas — and private enterprise clutches its pocketbook. Although NASA has received more than 100 inquiries about space commercialization, a spokesperson there told SCIENCE NEWS that only about two dozen companies have any sort of agreement with the federal agency. However, those include services like space shuttle bookings, in-flight filming and instrumentation to measure station environments. Moore sums up private industry's response as "the best we could expect — very good, if we count the shuttle."

At present, the brightest stars in NASA's plan are 3M Corp. of St. Paul, Minn., McDonnell Douglas and Space Industries Inc. (SI) of Houston. Because of their commitment to the space station, they have lower-cost or deferred-payment use of the shuttle to evaluate the commercial aspects of space. 3M expects to sign a "commercial use of space agreement" with NASA by the end of 1985, according to 3M spokesperson Henry Owen. The 10-year agreement would reserve 3M space on 72 shuttle flights for payloads with space station potential.

"We expect to be on the space station," Owen says. "At this point, I can't tell you how or with what. We're at the stage of where the Wright brothers have just flown at Kitty Hawk." He adds that it's "much too early" to sign space station agreements. But 3M engineers are working on station laboratory design, and the Nov. 27 shuttle carried 3M's third payload using microgravity to grow superior crystals.

Also aboard that shuttle, for the seventh time, was McDonnell Douglas's electrophoresis chamber, which separates drug samples into various components

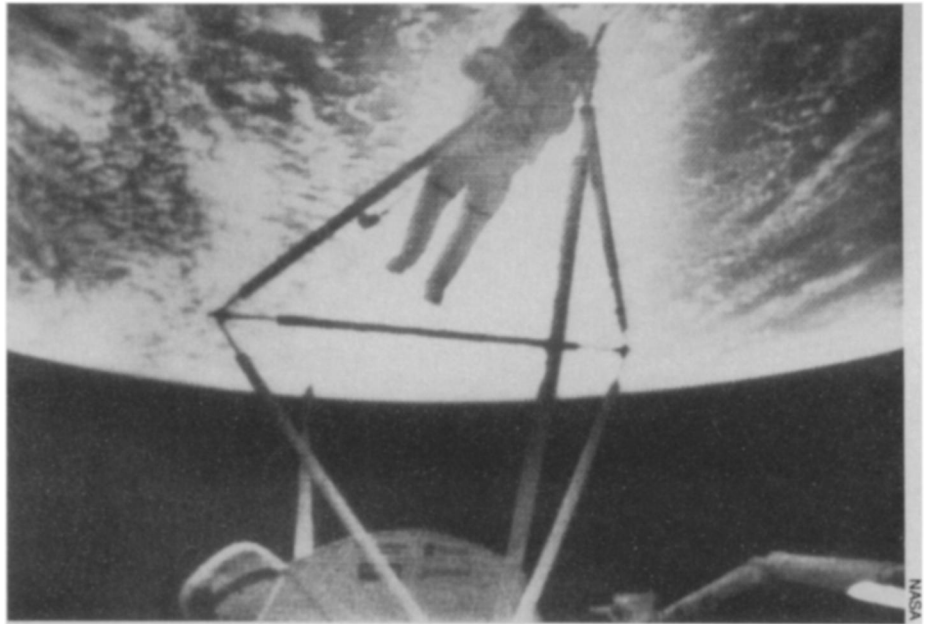
much more efficiently without gravity's interference (SN: 7/2/83, p. 4). Erythropoietin produced on the Nov. 26-Dec. 4 flight will soon be used in animal tests. Sales of the anti-anemia drug, planned for 1988, could make it the first "made in space" product to be sold by private industry. Worth millions of dollars, it will reduce the need for transfusions, and will be marketed by a division of 3M that replaces Ortho. Although Ortho may win the race to market the drug, McDonnell Douglas officials say the space-processed drug will be purer.

With its own shuttle payload specialists, McDonnell Douglas plans to enter into contracts with various companies to manufacture their products in space, according to its space station program manager Robert Thompson. He equates industry's dilemma over investing in the station with "the turn of the century, talking about the automobile." He says 200 to 300 McDonnell Douglas employees are working on a space station design under NASA contract, and eventually will plan a facility the company can operate within the NASA station, or on its own. Both Owens and Thompson told SCIENCE NEWS their companies also would consider utilizing the Industrial Space Facility (ISF) that SII plans to place in earth-orbit by the end of 1989.

If the Houston company meets its deadlines, the ISF will be the first habitable commercial platform in space, several years ahead of NASA's own space station. In August, SII signed unique agreements with NASA that provided for exchange of design information, as well as for deployment of the ISF from the space shuttle. When he announced the cooperative agreements, Beggs said his agency hoped many such private platforms would be built to "complement the permanently manned space station and lead eventually to an industrial park in space."

Founded in 1982 by Maxime Faget, former head of engineering at NASA's Johnson Space Center, SII will receive, on a deferred-payment basis, the launch of two ISF modules and a maintenance flight to the first. NASA will be repaid from revenues SII expects to generate by manufacturing in space. According to SII Executive Vice-President Joe Allen, a NASA astronaut for 18 years, SII plans to start construction in 1987. "We can kind of clone [the ISF modules] and couple them together like train cars as needed," he says. "Ultimately, ISF will be flying in formation with the space station. In that sense, we're kind of like a little temporary building outside a skyscraper."

Allen says funding will be private venture capital from individuals and companies. Officials at NASA and SII refuse to comment on the amount of money involved, but Claybaugh estimates the initial ISF budget to be between \$250 million



This pyramid, built in the cargo bay of the shuttle, tested space station design.

and \$500 million, making the project one of the largest start-ups in U.S. history. The SII plan is still far cheaper than NASA's, Allen explains, because the 35-by-14-foot module equipped with two solar panels will be built from parts that already exist, and because SII will depend primarily on space station research to "push techniques out of the nest" into facilities like ISF.

Will the relationship between SII and NASA be symbiotic or competitive? "That's a very good question," Allen told SCIENCE NEWS. "There will be a perceived competition. I think much of that . . . will be incorrect." But he adds that there could be competition if NASA succeeds in renting to manufacturers. Others agree that industrial tenants in space will be complementary, not competitive.

However, competition for international, private and non-NASA federal participants apparently exists. In October, NASA had to lower its fees to convince NOAA to consider launching its meteorological satellites on the shuttle, starting in 1989, rather than on expendable Air Force Titan 2 missiles. The 66-percent-privately-owned Arianespace (SN: 3/10/84, p. 150) has lured foreign customers from NASA's shuttle launch business.

"[The United States] has to accept that the U.S. monopoly in space is disappearing," Josephson says. "The second reality is that the competition isn't going to disappear. The net result is, should the taxpayers pay, or should the commercial companies pay?"

The use of public funds raises questions about NASA's interest in foreign participants. Actively seeking international partners with hopes of attracting \$2 billion to \$4 billion in foreign funding, the space agency has met again with Canada, Japan and the European Space Agency to negotiate design agreements. In the same spirit of "noncompetition," the Oct. 30 space shuttle mission chartered by

West Germany carried the first payload almost completely controlled by a foreign government (SN: 11/16/85, p. 308). But will this type of cooperation create a competitive environment harmful to U.S. industry? A Japanese organization of 87 companies, the Society for Commercial Uses of the Space Station, recently sent representatives to talk business with U.S. companies. "These are the people we're competing with," a NASA official, who asked not to be identified, told SCIENCE NEWS. "We may be supplying the Japanese and Europeans with our crew and station for them to make their own products. We can't discourage foreign companies, but . . . we don't want to spend our taxpayers' money to give foreign companies an edge over our manufacturers."

Despite the problems, the promises remain. The opportunity to slip the bonds of earth has enthusiastic proponents talking of innovation and unfettered opportunity. "The progress [of the space station] has been slower than the hype," Claybaugh concedes. "But that shouldn't be a surprise to anybody. We're not talking about one new field. We're talking about a dozen new fields." In his opinion, "some of the next-generation fortunes will be made in space."

The results of a market survey of potential users conducted for SII are proprietary, but Allen says they show there will be a market for the ISF. Whether to utilize such space-based industrial facilities, and when, will be budget questions asked by more and more companies, according to Thompson, who says the questions must be asked in a "hard-nosed business atmosphere."

"I wouldn't sell American industry short prematurely," he says. "I can appreciate that you shouldn't necessarily be the first one there. The first one won't necessarily last. You have to evaluate the potential of the space station with somewhat of a visionary thrust." □