Rebuilding our road to the stars

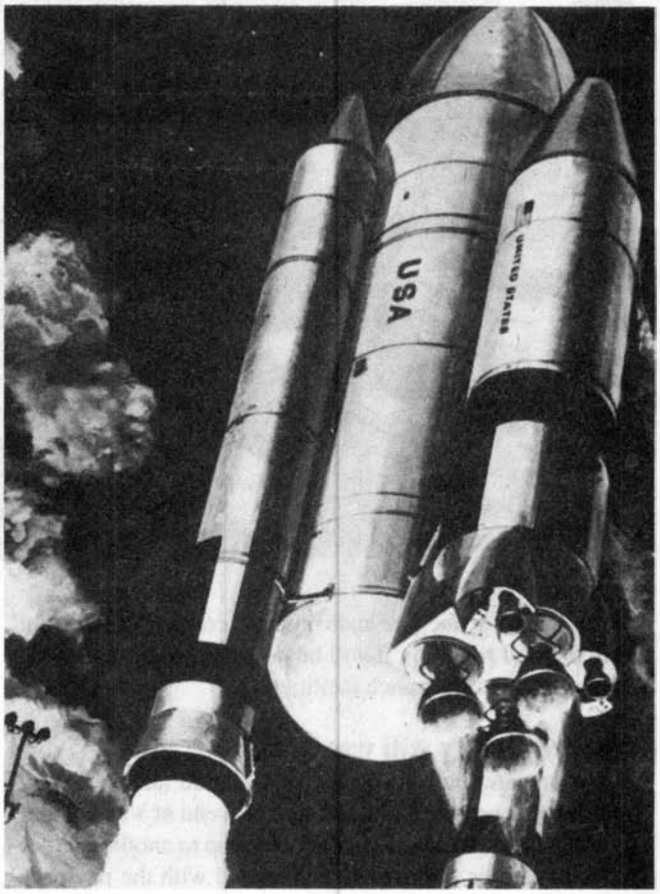
Robert Gallagher reports on the necessity of realizing NASA's plans for building "an airline to space."

The United States will successfully rebuild its space launch capability if it develops, in parallel, a fleet of completely reusable space vehicles for access to Earth orbit, and a nuclear-powered interplanetary rocket for space travel beyond the Moon.

An ideal, completely reusable system, like the proposed liquid-fueled aerospace plane, would have many advantages over vertical rocket launches and the existing Shuttle system, from the standpoint of physical economy. Its "turnaround time" between flights would be measured in hours or days, not weeks or months as in the present Shuttle system. It would not require the manufacture of external tanks and the refurbishment and complicated refueling of boosters with solid fuel, rehauling over 50% of the Shuttle launch system, in order to make the next flight possible. Liquid fuel could be pumped into the aerospace plane almost as easy as gas into a car. Nor would it require the enormous staff of 6,000 people that launches the Space Shuttle. An aerospace plane would provide the sort of immediate and unquestioned manned access to space required by the Strategic Defense Initiative (SDI) program.

It was NASA's original plan to build such a true airline to space, which can only function if we streamline manned launch systems, eliminate all the features that do not make launches routine, and shift heavy cargo to unmanned vehicles. The U.S. Congress and Office of Management and Budget killed NASA's original Shuttle design in which the spacecraft would be boosted to orbit by a manned fly-back reusable liquid rocket booster. Despite this congressional sabotage, NASA did produce an excellent spacecraft in the Shuttle proper, of which the nation can be proud. The Russians have yet to deploy a vehicle which can repeatedly fly back from space at 26 times the speed of sound.

Development of the aerospace plane is no substitute for rebuilding the nation's launch capability over the next few years. While the aerospace plane is under development, the nation must take the following actions originally planned under NASA's Shuttle program, and required to meet national launch requirements, including deploying the space station mandated by President Reagan and developing and deploying a strategic defense over the next decade. As documented in *EIR*, U.S. launch requirements in 1992 will require the



An artist's conception of the Heavy Life Launch Vehicle currently under study by NASA for heavy, bulky payloads projected for the "Space Industrializtion and Large Structures era."

equivalent of a fleet of 8 shuttles, according to official estimates. If we accelerate the SDI program towards initial deployment in 1992, an equivalent launch capacity of 12-15 Shuttles is required.

1) Construction of five additional Space Shuttle orbiters must be undertaken immediately. Together with this, must be built production facilities for fabricating 50 external tanks and 20 rocket boosters per year, assuming each booster is safely usable for at least five flights.

2) A "crash program" must be initiated to develop new

TABLE 1

Payload capability of U.S. and Soviet rockets

Launcher	Payload to LOE[1] (lbs.)
U.S. vehicles	
Delta	5,000
Atlas Centaur	8,000
Titan 34D	10,000
Shuttle	65,000
Soviet vehicles	
A-2 (Soyuz)	16,500
Proton D-1	44,000
Proton D-1-h (Salyut)	49,500
U.S. Apollo-era vehicles	
Saturn-1B	40,000
Saturn-V	300,000

[1]Low Earth Orbit = 300 miles. The Titan 34D can launch 27,000 lbs. to a 100-mile orbit.

Note: Vehicles rarely ever launch their maximum payload, including the Shuttle.

TABLE 2

Launch vehicles the U.S. can lift now to launch heavy payloads

System	Payload to LOE[1] (1,000 lbs.)
Single shuttle solid rocket booster	30
"Big dumb booster"	70-80
Shuttle with liquid boosters	100
"Side-mount" cargo vehicle	
a) with SRBs	130
b) with LRBs	165
"In-Line" Cargo vehicle with SRBs	80-130
GD cargo vehicles	
1) Liquid rocket with small SRBs	70
2) Liquid rocket With liquid booster	200
3) Liquid rocket with 2 liquid boosters	400

Source: NASA

vehicles based on Shuttle hardware to launch heavy payloads into space. These vehicles can be unmanned. In 1982, NASA and its contractors produced designs for using Shuttle launch system hardware to quickly manufacture such a heavy lift capability.

3) Until this expanded capacity begins to come on line in 1990 with the delivery of the first heavy lift launch system, production of additional Titan, Atlas-Centaur, and Delta rockets will be necessary.

Some may question the economy of manufacturing eight Shuttles and various cargo vehicles, not to mention expendable rockets, as we develop the aerospace plane for flight in the 1996-2000 time period. This is not "cost-effective," they might argue. It is precisely the influence of such arguments over policy, that has placed the United States in the midst of the current strategic crisis and produced the collapse of our launch capability. Gen. Bernard Schriever's successful Air Force ballistic missile development program of the 1950s, enabled the U.S. to place 1,000 ICBMs in silos in the early 1960s and produce the workhorse space launch vehicles, the Atlas, Titan, and Delta.

By contrast, congressional and OMB "cost-effectiveness" cuts corners, produces marginal launch systems, leaves the nation without a capability in the event of an accident, and kills astronauts. "Cost-effectiveness" has led to a situation where with the Shuttle grounded, the Russians have an overwhelmingly superior capability to deliver payloads to Earth orbit, and, even with the Shuttle operational, present U.S. capabilities are no match for the capacity we had under the Apollo program, a capability that has passed out of existence. **Table 1** compares the payload capacity of the Shuttle, existing expendables, the Apollo rockets, and the Russian proton boosters.

New heavy lift vehicles

One of the first steps that can be taken to rebuild our launch capability will be to extend the capabilities of our Shuttle fleet by replacing the Shuttle solid rocket boosters with liquid fueled ones. NASA originally preferred to use liquid boosters in the present Shuttle configuration, but was forced to adopt solid rocket boosters because of budget cuts. With liquid boosters, the Shuttle would be able to orbit 50% more payload.

A joint NASA/Defense Department task force, the National Space Transportation and Support Study, reported at a National Space Club conference June 18 that liquid rockets: 1) reduce turnaround time since they are tremendously easier to refuel than solids; 2) reduce launch operations; 3) last longer; and 4) decrease the weight of the Shuttle system during assembly since with liquid boosters, all the fuel is put into the Shuttle system on the launch pad. Liquid rockets have the additional safety advantage that they can always be shut off in the event of an emergency; solid rockets always must burn their fuel to completion.

In other words, the Shuttle solid rocket boosters are an example of the policy of "cost-effectiveness" in action. Bu get cuts forced NASA to use them because they were cheaper to develop than liquid boosters. However, the chickens come home to roost: The SRBs are more expensive to operate.

Below we present excerpts from a NASA document that

FIGURE 3
Single rocket SRB-X

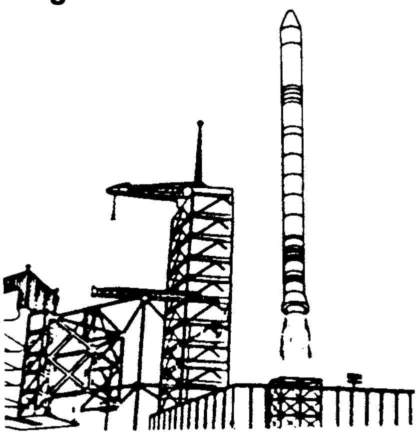


FIGURE 4
Three rocket SRB-X

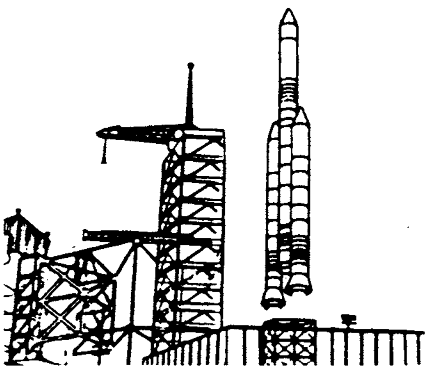


FIGURE 5
Side-mount cargo vehicle

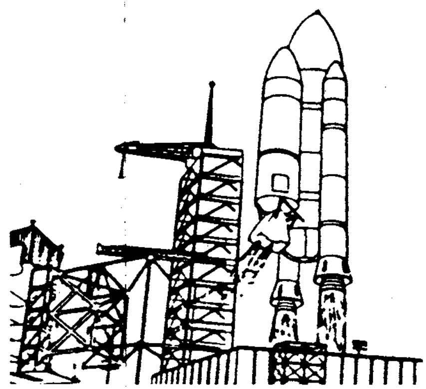


FIGURE 6
In-line cargo vehicle

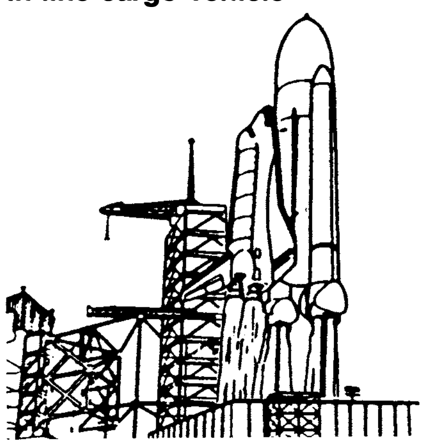
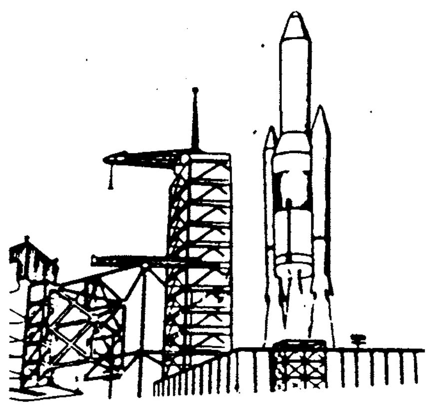


FIGURE 7
Liquid rocket booster



At least five Shuttle-derived vehicles would use the same engines as the Shuttle, and could be developed in six to seven years under existing government "cost-effective" regulations. NASA officially projects that the SRB-X launch vehicle based on three Shuttle solid rocket boosters would take three years to develop.
Source: NASA

describes the several manned and unmanned systems that can be built from Shuttle hardware to meet the launch needs of the early 1990s.

According to a source at NASA, existing government policy slows the pace of development of launch vehicles so that 9 to 10 years are required to develop a launch vehicle with new engines, such as the proposed Shuttle liquid rocket booster. A Schriever-style effort can cut this time down to 4 to 5 years.

Several Shuttle-derived vehicles would use the same engines as the Shuttle (**Figures 3-7**). According to the same NASA source, such vehicles could be developed in six to seven years under existing government "cost-effective" regulations, and in half that time with a Schriever-style effort. NASA officially projected that the SRB-X launch vehicle based on three Shuttle solid rocket boosters would take three years to develop.

Table 2 compares the payload capability of the Shuttle-derived vehicles. The last three vehicles listed are from a General Dynamics design study performed for the NASA/DOD Task Force.

General Dynamics has also prepared a design for an aerospace plane that maximizes the payload that such a vehicle could lift to orbit. A simple "one-stage" aerospace plane would have to carry to orbit the weight of all the tankage required to hold its fuel, even after that fuel is expended. The virtue of multistage rockets is that they maximize payload to orbit by releasing the weight of expended stages as they climb to orbit. In the General Dynamics design, an aerodynamic orbiter rides atop a rocket plane which takes off from a runway and boosts it close to orbit. The orbiter's own engines do the rest of the work.

The development of multimegawatt lasers under the SDI, has made possible other advanced vehicles in addition to the aerospace plane. One such system would be a transatmospheric cargo vehicle propelled to orbit by the thrust created from the vaporization of a liquid mass carried on the vehicle, by a laser based on the ground. Lawrence Livermore National Laboratory is exploring a design for an Earth-to-orbit cargo vehicle based on this concept.

Documentation

Shuttle-derived vehicles

The following is excerpted from NASA Marshall Space Flight Center Fact Sheet 24F282:

Now that the Space Shuttle has opened the way to routine access of space, planners at the Marshall Space Flight Center are looking at the adaptability of the Shuttle propulsive elements to meet potential future launch requirements for the nation.

Called "Shuttle-derived vehicles," these next-generation cargo carriers for space would utilize Shuttle systems in different arrangements to provide additional cargo capability or more economical operation.

The current Shuttle system features four major integrated parts: the Orbiter, which is the winged vehicle that carries up to 65,000 pounds of payload into space and returns to land like an airplane; the External Tank, which holds liquid hydrogen and liquid oxygen as fuel and oxidizer; the Orbiter's Space Shuttle Main Engines, which burn fuel from the External Tank; and the Solid Rocket Boosters, containing high-thrust solid fuel that provides much of the Shuttle's thrust at launch and early in flight. The boosters are recoverable; the External Tank is not.

Several classes of Shuttle-derived vehicles are currently under active study at the Marshall Center—The SRB-X, the "side-mount" and "in-line" cargo vehicles, the Liquid Rocket Booster. . . .

The first concept is the SRB-X, so named because it would be developed by primarily using the Shuttle's Solid Rocket Booster, commonly known by its acronymn "SRB." Two configurations have been proposed: one features a single rocket of numerous stages which carries a payload at the top (see **Figure 3**), as did traditional expendable rockets; the other would use the single rocket design just described with two Solid Rocket Boosters, as its first stage, strapped to its sides (see **Figure 4**). These unmanned vehicles could carry about 30,000 and 70,000 pounds of payload, respectively, to low Earth orbit. The central payload-carrying rocket would consist of an entire Solid Rocket Booster, plus additional smaller solid or liquid rockets as required. As with the Space Shuttle, the first stage Solid Rocket Boosters would be recoverable. The single-rocket SRB-X would carry less payload weight than the Shuttle, but would offer the advantage of economy to a user desiring to put less than a full Shuttle load into an orbit that would preclude sharing payload bay space with another user. The three-rocket configuration would carry approximately the same weight as the Shuttle to low Earth orbit; however, this configuration would have a much greater payload capability to geostationary orbit, which the Shuttle is unable to reach. One big advantage to the SRB-X is that it would use hardware already in use in the Shuttle program.

The second concept is the "side-mount" cargo vehicle, in which the Shuttle Orbiter would be replaced by an unmanned cargo cannister fitted with a Space Shuttle Main Engine module (see **Figure 5**). The current External Tank and boosters would be retained. This Shuttle-derived vehicle would carry approximately 130,000 pounds of cargo into orbit, or roughly double the capacity of the current Shuttle. In comparison to the 15- by 60-foot design of the current Shuttle"s Orbiter bay, the payload bay of the "side-mount" vehicle's cannister could be as large as 25 feet wide and 90 feet long, providing room for cargo that is too large to be flown aboard the Orbiter. Once the cannister reaches orbit, the reusable part of the vehicle, the engines would either return and land on their own in a module or be retrieved from orbit by a subsequent Shuttle mission.

Another possible derivative is the "in-line" cargo vehicle. This version would have no Orbiter, but would instead have one or two Space Shuttle Main Engines positioned below the External Tank (see **Figure 6**). Two Solid Rocket Boosters would be employed as the first stage. Depending upon the number of engines used, such a configuration would allow about 80,000 to 130,000 pounds of cargo to be carried into space in a payload bay mounted atop the External Tank.

The fourth concept, the Liquid Rocket Booster, envisions a design in which the current solid rocket boosters would be replaced with reusable ones using liquid fuel (see **Figure 7**). These liquid rockets could be sized for as much as a 50% increase in Shuttle lift capability and enable the Orbiter to carry up to 35,000 pounds more cargo. Furthermore, they may be more economical to operate than solids: liquid Boosters cost less to check out and load with fuel, which is pumped into the rockets on site at the launch pad. Fuel for solid boosters, on the other hand, must be loaded at and fully transportable from the factory. Like the solid rockets now used in the Shuttle, the liquid boosters would be reusable. Proposed designs would have them recoverable from the ocean—as solid boosters are now—or would have them build in a winged configuration that could fly back to land at the launch site.

A possible variation of this design would combine both the Liquid Rocket Boosters and the "side-mount" cannister to yield a vehicle capable of lifting about 165,000 pounds into orbit. This is nearly three times the weight-carrying capacity of the present Space Shuttle.

An attractive feature of the unmanned Shuttle-derived vehicles is that they would free the Shuttle to fly only those missions requiring a manned presence or the return of payloads to Earth.