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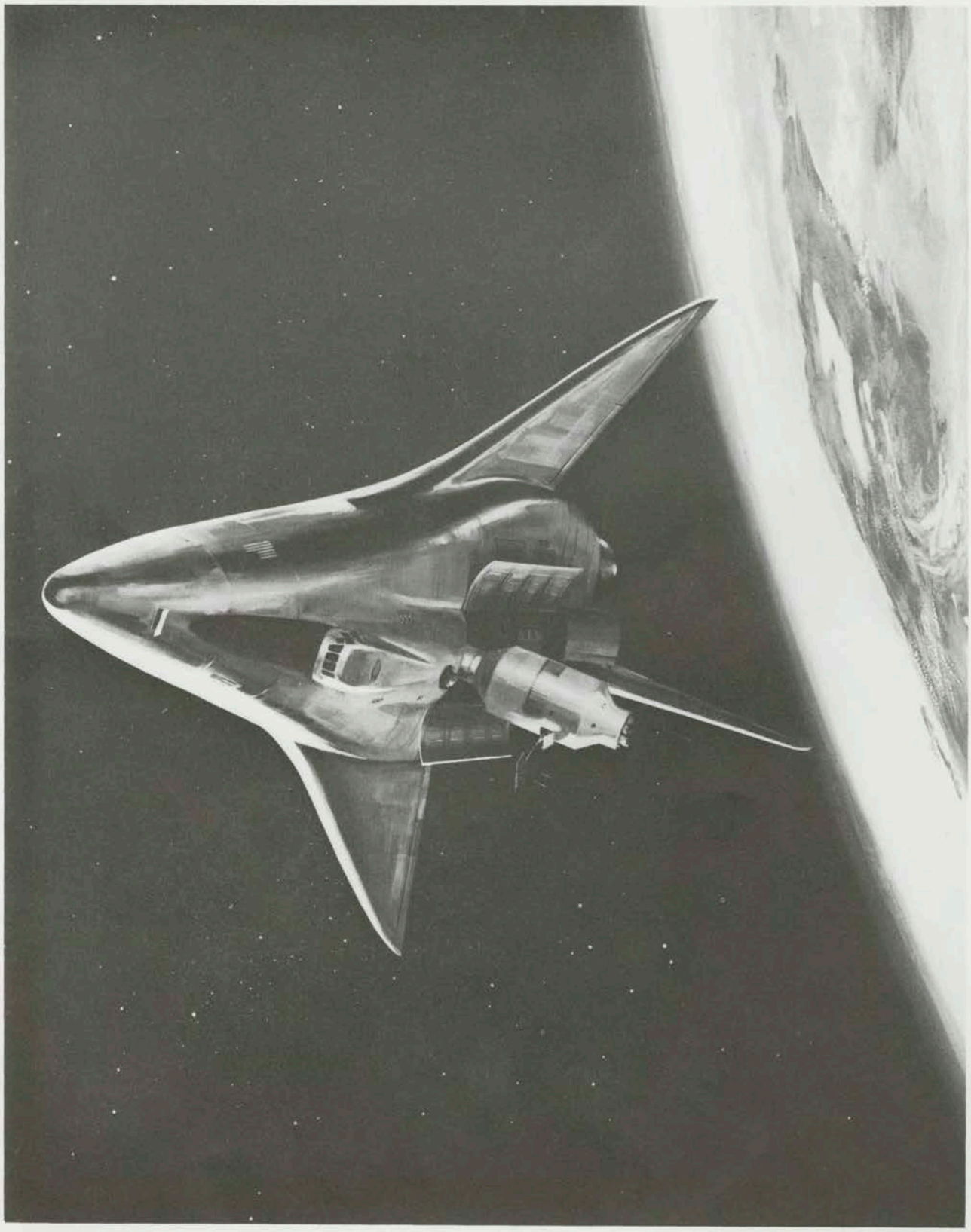

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Space Division
North American Rockwell

12214 Lakewood Boulevard
Downey, California 90241

SP-17

Moon, Earth's closest neighbor in space, has been a source of wonder to man since he first turned his eyes to the heavens.

Apollo took man to the lunar surface and has made a start at unraveling the mysteries of that celestial sphere. In the next year, Apollo will return to Earth increasing amounts of lunar material to enhance man's knowledge of that relatively unspoiled body and, even more important, to further man's understanding of his own world and its environment.

In 1973, the same Apollo will play a major role in Skylab--the next step in the U. S. space program and the first major project aimed at learning more about Earth. Skylab also will provide man the opportunity to learn more about his ability, and that of his equipment, to work and operate in space for extended periods.

This knowledge and experience is geared at making man and machine fully operational in space, and at reorienting the space program from one of experimentation to one of exploitation and utilization--at enabling man in space to work for man on Earth.

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The cornerstone for attaining this goal is to make space operations economically feasible. A major step in bringing this to realization is the development of the Space Shuttle, a highly versatile space "truck" that can meet the nation's space requirements of the coming decades at a price that will move space from the realm of exploration to practical necessity.

Space Shuttle is a fully reusable space transportation system that is aimed at reducing the cost of space operations. Space Division currently is performing an 11-month, Phase B design development study of the system under contract to NASA's Manned Spacecraft Center.

The current average cost of transporting a pound of payload into Earth orbit is approximately $2,000. Goal of the Space Shuttle program is to develop a system that will reduce this cost by about 90 per cent, or to between $100 and $200 per pound.

With its capabilities, shuttle will be able to eliminate the need for the numerous families of launch vehicles now used for various U. S. space missions, and their accompanying facilities.

The basic shuttle mission is to carry cargo and passengers to orbit. This includes:

A. Placing civilian and military satellites in space. (Lessens need to have current, expensive long-life reliability; payloads can be bigger and heavier, up to any size and shape that will fit shuttle's 15 by 60-feet cargo bay.)

B. Retrieving malfunctioning satellites and repairing them on-orbit or returning them to Earth. (This capability assumes particular importance with the predicted growing future requirements for additional weather, communication, and navigational satellites. No longer will it be necessary to "write-off" a multi-million-dollar satellite due to a malfunction following launch.)

C. Carrying sections of spacecraft to orbit for assembly or for launch in space, such as a space station or planetary probes.

D. Carrying fuel to orbit for satellites and spacecraft.

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E. Use in space rescue missions.

F. Delivering crewmen and supplies to an orbiting space station.

G. Taking experiments into orbit for periods of up to 30 days. (With shuttle's flight characteristics, almost any physically-fit person will be able to go into space, not just astronaut-trained persons. This could be the world's leading agriculturist, geologist or minerologist, who could go up, do his particular experiment, and return to Earth to put the data to immediate use.)

Experiments that can be performed aboard shuttle range from astronomy, to man-in-space and Earth services. The Earth services experiments are an example of how the shuttle craft can bring direct and almost immediate returns to the public.

Sensors and equipment can be flown aboard shuttle for such things as weather observation and prediction, pollution detection and environmental studies, mineral and water resources studies, and crop and forest surveys. Because the shuttle will be ready for flight in about two hours, it also can be utilized for spot assignments dealing with checking earthquake damage, tidal waves, hurricanes or tornadoes, or storm fronts.

An immediate question is why do this with shuttle if satellites are already in being or planned that can provide the same services.

First, with its versatility and the payloads it will be able to carry, shuttle can supplement existing systems and possibly eliminate some of the satellites in the planning stage.

Secondly, with shuttle, experiments or surveys can be flown to obtain specific data during a normal mission, such as surveying the entire corn crop in Iowa to determine if there is any indication of blight. And this can be done with one photograph that can be processed and analyzed immediately on the shuttle's return to Earth.

With a satellite, the data must be obtained, run through the onboard processor for relay to Earth, then separated from the flow of normal information, reconverted or processed on Earth into a usable format, and then be interpreted for use.

There is equipment available now, or on the drawing boards, that can be put aboard the shuttle orbiter to obtain data or supplement satellite systems in areas including:

Weather

The National Academy of Sciences estimates that improved weather forecasting and observation can save builders, farmers, and property owners $2.5 billion annually. How would you like to have an hours-old weather forecast before starting on your fishing trip or planning your weekend golf game?

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Agriculture

In the U. S. alone, losses caused by plant disease are estimated at $3.7 billion annually, and losses caused by pests add approximately $3.8 billion a year. In addition, the Agriculture Research Service spends $3 million annually to detect plant disease and insect outbreaks. There are sensor systems available that can tell:

The type of crop in each field, the size of the field, the vigor of the crop, the probable yield, and the identity of any damaging agents--such as blight or insect infestation--in most cases long before they can be detected from the ground.

Information of this nature can be invaluable to nations such as India and those in Southeast Asia where they have periodic famines.

Forestry

America's woodlands are a storehouse of raw materials, and the wood products industry is a major segment of our economy. The Department of Agriculture's Forest Service keeps a continuing inventory of the status of this natural resource for national and local planners and legislators. But, some of its data is as much as nine years old before it is reported.

From space, more can be learned about the type and vigor of vegetation in each area, the identity of damaging agents or organisms, and the potential yield of timber or forage per acre. In the case of diseased timber alone, annual U. S. losses are estimated at about $82.6 million, while pest-caused losses recorded in 1965 were $579 million.

Hydrology

Hydrologists emphasize that water already has become the most limiting and valuable resource in some parts of the world and that in many areas inadequate fresh water supplies may soon limit food production and even human occupancy. Numerous photographs taken by both Gemini and Apollo astronauts have indicated how photos from space can be helpful to hydrologists in more ably managing water resources, in providing information on surface and subsurface flows of water and in determining site suitability for constructing dams and for holding and collecting water.

In addition, repeated observations from shuttle can be made visually and with infrared and microwave devices of the snow packs, glaciers and ice accumulations from space on a much broader scale than is possible by conventional means to more accurately predict annual runoffs. This information can be vitally important for flood control, irrigation, and power production management programs.

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Geology and Mineral Resources

Scientists say that man has used more of his "non-renewable" mineral and petroleum resources in the last three decades than in all the years since the dawn of civilization.

The chief tool for the geologist in discovering and mapping mineral resources are geologic maps. In the past, large-scale maps of this type were the product of years of surface exploration. Now, one picture from space can be used to determine the features of an area, an entire region, or a country. Gemini V photographs led geologists to new oil deposits in Central Australia, and Dr. Monem Abdel-Gawad, a scientist from North American Rockwell's own Science Center, analyzed and interpreted photographs from Gemini flights to pinpoint potential new oil fields in Egypt and Saudi Arabia.

Oceanography

The greatest and least tapped natural resource on the Earth is the ocean. The Bureau of Commercial Fisheries, in cooperation with the Naval Oceanographic Office, already is investigating how remote sensing from space can be used to survey ocean resources. Points of interest are ocean surface temperatures, current patterns, biological productivity, sea state, sea ice, and shoaling processes. Satellite infrared surveys of the Gulf Stream have confirmed the possibility of detecting differences in water temperature from space and of relating temperature distributions to current patterns. The data has shown a correlation between ocean temperatures and the location of large schools of fish, which can prove highly lucrative to the fishing industry and sport fishermen.

Cartography

Current and accurate maps are always needed. As an example of what photographs from space can do, a Gemini crew photographed almost 80% of Peru in just three minutes. In addition to being more accurate, scientists say the photograph provides more information than any map available. Imagine what city, county and state planners can do with information of this type just in California with its constant population increase.

Environmental Quality

Space sensors can be used both in detecting air and water pollution, and in helping to determine the source. For example, infrared scanners easily detect such things as oil, sewage, or thermal pollution in water both day and night. Conventional photographs from the air show discoloration and patterns of water flow invisible from the ground that can be used to map and compute large-scale mixing patterns in bodies of water for tracking and controlling pollutants.

In the case of air pollution, sensors can monitor the atmosphere to obtain information on large regional distributions and cross-country movements of polluted air to help determine the source and spread, and possibly provide clues that will help control the pollution.

Shuttle will not be a cure for all evils. However, it will be able to reduce the cost of space operations by a significant amount, and it can result in some direct, tangible benefits to the public--the you and me who are paying for the space program.

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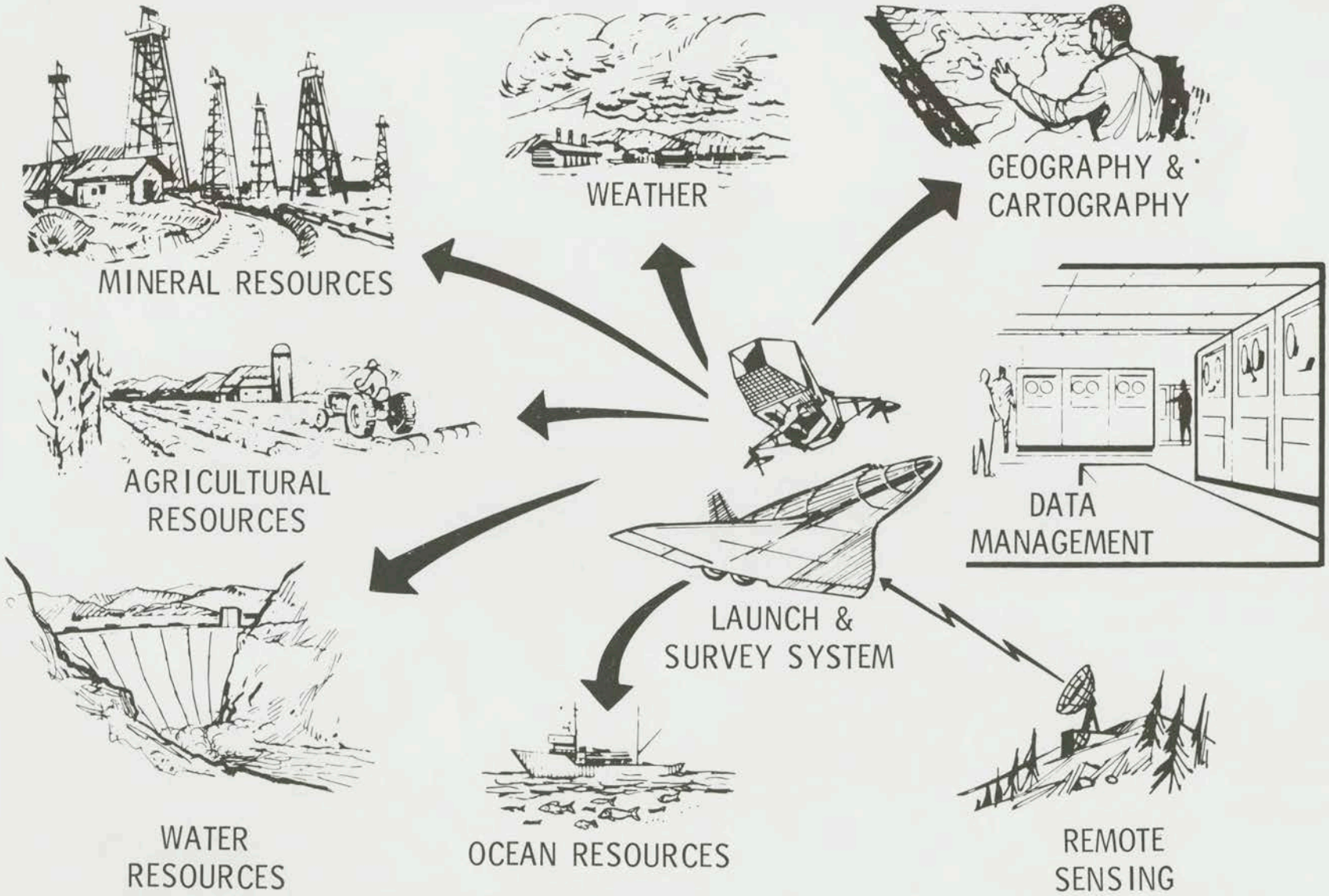
OPERATIONAL EARTH RESOURCES SERVICES



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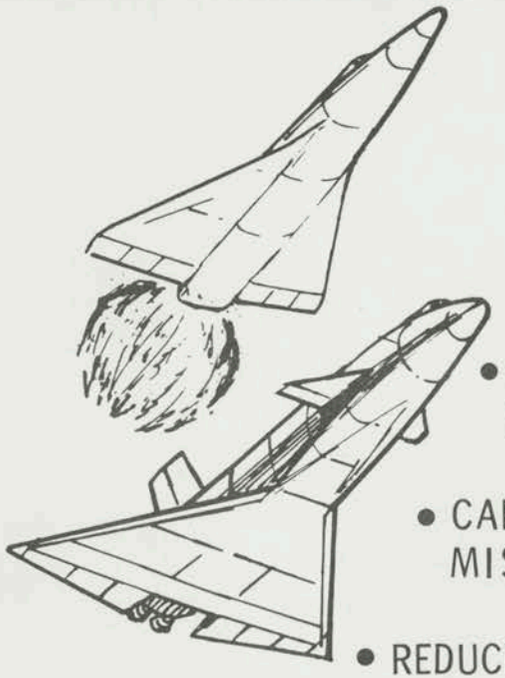
SHUTTLE WILL BE LOW COST MULTI-PURPOSE SYSTEM



SHUTTLE OBJECTIVES

• CAPABLE OF AT LEAST 100 USES	⇨ COST REDUCER
• REPLACE EXISTING LAUNCH VEHICLES	⇨ COST REDUCER
• CARRY PAYLOADS UP TO 15 FT DIA & 60 FT LONG	⇨ MISSION FLEXIBILITY
• CAPABLE OF MEETING DOD & NASA LAUNCH MISSION NEEDS	⇨ MISSION FLEXIBILITY
• REDUCED BOOST LOADS & ENVIRONMENTS	⇨ COST REDUCER
• TWO WEEK GROUND TURNAROUND	⇨ COST REDUCER
• CAPABLE OF SEVEN DAY ORBIT MISSION	⇨ MISSION FLEXIBILITY
• CARRY SPACE CARGO AND/OR PASSENGERS	⇨ MISSION FLEXIBLITY

REDUCE COST OF SPACE MISSIONS BY FACTOR OF TEN

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* Your 1970 Federal Tax Dollar

Here's How It Was Spent

** "More than 22 cents of every dollar you pay in Federal Income and Social Security taxes goes to finance the benefits and welfare of others, an all-time record and heading relentlessly higher....

*** A not-so-obvious point is how small a segment of your tax dollar is taken by controversial programs. If you eliminated space entirely, you'd have only 2 cents more left....!"

Quotes from columnist Sylvia Porter in "Your Money's Worth"

AREN'T YOU GLAD YOU PUT IN YOUR TWO CENTS WORTH?

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News From

Space Division
North American Rockwell

12214 Lakewood Boulevard
Downey, California 90241

FOR IMMEDIATE RELEASE

S-34 (Rev. 3-11-71)

SPACE SHUTTLE
(Fact Sheet)

The shuttle is a two-stage, fully-reusable space transportation system whose upper stage--the "orbiter"--can provide flood and forest fire warnings, detect crop disease, monitor smog and seek out dwindling petroleum and ore deposits.

Designed to take off vertically and land horizontally, the space shuttle is a launch vehicle for all payloads. It will replace almost all existing launch vehicles for commercial, military and scientific missions by NASA, the Air Force and foreign nations.

Because it is reusable--100 flights per craft--shuttle can reduce the expense of space travel to less than one-tenth that of today's cost.

The proposed shuttle transportation system has two vehicles--a booster and an orbiter.

The booster carries its cargo-filled craft called "orbiter" piggyback to the fringe of space, then drops away and lands like any jet airliner. The orbiter, with its payload, continues on its way to complete its mission, which might include the routine transportation of astronauts, supplies, and other equipment to and from earth orbit.

Space shuttle's many potential uses include resupply of orbiting space stations, carrying university laboratory experiments into orbit, placing military or communications satellites into space, retrieving satellites and delivering maintenance men to satellites that need repair.

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Shuttle's benefits to man in the 1980's will include the accurate plotting of weather and smog patterns, detecting new oil fields, evaluating earthquake and volcano damage, estimating crop yields and locating wheat rust ahead of the farmer. A shuttle can be readied in two hours for a space rescue mission.

Space shuttle craft will be capable of flying every two weeks with minimum maintenance, and like today's jet airliners will require minimum ground support and checkout.

North American Rockwell's (NR) Space Division, Downey, Calif., is one of two firms conducting preliminary design studies of the two-stage reusable space shuttle.

Space Division is teamed with General Dynamics Corporation's Convair Division, San Diego, on the Phase B contract. Space Division, team leader and prime contractor, is developing the orbiter and is responsible for integration of the system, while Convair is concentrating on development of the booster.

IBM Corporation's Federal Systems Division is responsible for integrated electronic data systems. Honeywell is developing the stabilization and control and guidance and navigation.

American Airlines is providing its knowledge and experience in jet aircraft maintenance techniques and the ground handling of crews and cargo.

The shuttle represents a program of the same technology challenge that Apollo represented to Space Division when it was awarded early in the 1960's. It's successful execution will require a team of experts in all fields similar to that on Apollo.

As part of the contract, the Space Division shuttle team is:

> Developing preliminary designs of the two-stage shuttle system and performing numerous tests on the dynamic characteristics of the vehicles

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- Testing structures and the thermal protection system that must resist high temperatures experienced during reentry from an orbital mission
- Providing detailed plans on how the shuttle would operate, how it should be tested and space qualified
- Suggesting methods of manufacturing, crew training, cargo handling and economic analysis of the shuttle compared with expendable systems being flown today

If the program progresses on the schedules that NASA has currently developed, the shuttle will be flying on routine missions into orbit by about 1979.

Space Shuttle Facts

Objective and characteristics	Low cost, economical space transportation system; airline-type operation for passengers and cargo transport; capable of ferry flights between airports
Fully-reusable two-stage vehicle	Booster (first stage) and orbiter (second)
Crews	Booster and orbiter each have two-man flight crews. Booster could land unmanned. Orbiter carries 12 passengers in addition to flight crew.
Size (both stages mated for launch)	293 feet (approx.)
Orbiter Facts	Delta wing; 210 feet long; 124-foot span; empty weight, 243,900 lbs; main tank propellant load, 604,500 lbs; launch weight, 850,000 lbs; mission duration, 7 days, and can be extended to 30 days.
Booster Facts	Delta wing; 267 feet long; empty weight, 621,400 lbs; main tank propellant load, 3,114,000 lbs; launch weight, 3,750,000 lbs; total rocket engine thrust, 6,480,000 lbs; mission duration, 90 minutes.
Weight (at launch)	4.8 million pounds

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Flight characteristics	Vertical takeoff and horizontal landing (both stages land like today's jet airliners on 10,000 foot runways)
Propellants (main engines)	Liquid hydrogen and liquid oxygen
Number of flights per vehicle	100 missions (including refurbishment and maintenance)
Launch rates	Minimum of 25 to maximum of 75 per year
Launch sites	Kennedy Space Center, Western Test Range or an inland site
Launch range	Orbiter capable of flying distance of 1,265 miles to air strip through atmosphere
Atmosphere	Shirt sleeve, two-gas (oxygen and nitrogen)

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