SHUTTLE HISTORY

- 1952 FULLY REUSABLE LAUNCH VEHICLE CONCEPT DISCUSSED
- 1962 FULLY REUSABLE VEHICLE SERIOUSLY CONSIDERED
- AIR FORCE STUDIED PROJECT DYNASOAR, WHICH WAS CANCELLED IN 1969
- 1969 NASA ADOPTED THE IDEA OF A FULLY REUSABLE SPACE SHIP

TOP LEVEL REQUIREMENTS

- FULLY REUSABLE
- 14 DAY TURN AROUND TO NEXT FLIGHT
- DEPLOY AND RETRIEVE PAYLOADS
- DESIGN, DEVELOPMENT, & TEST PHASE ESTIMATED TO BE 5.1B IN 1971 DOLLARS
- ORIGINAL COST PER FLIGHT FOR 65,000 POUNDS WAS 10.5M PER FLIGHT IN 1971 $ FOR A FLIGHT RATE OF 60 PER YEAR

SHUTTLE STUDIES

- PHASE “A” STUDIES WERE CONDUCTED TO DETERMINE BASIC REQUIREMENTS AND THEIR EFFECT ON DESIGN IN 1969
- PRINCIPAL ISSUES:
  - SIZE AND WEIGHT OF PAYLOAD
  - CROSS RANGE OF THE ORBITER
  - HEAT-RESISTANT STRUCTURE OR REUSABLE INSULATING MATERIAL

SHUTTLE STUDIES

- PRINCIPAL ISSUES:
  - HYPERGOLIC REACTION CONTROL SYSTEM OR LIQUID OXYGEN/HYDROGEN
  - FLY- BY-WIRE FLIGHT CONTROL SYSTEM
  - WIND TUNNEL TESTS TO DETERMINE WING SIZE AND CONFIGURATION
  - AIR BREATHING ENGINES WERE CONSIDERED FOR FLY BACK; LATER WERE DETERMINED TO BE TOO HEAVY

SHUTTLE STUDIES

- PRINCIPAL ISSUES:
  - ENTRY TECHNIQUES
  - LANDING SPEED
  - APPROACH PATTERN

SHUTTLE STUDIES

- PHASE “B” STUDIES WERE PERFORMED IN MID 1970’S TO DETERMINE A PRELIMINARY DESIGN
- RESULTS:
  - FULLY RECOVERABLE ORBITER
  - DISPOSABLE FUEL TANK
  - PARACHUTE-RECOVERABLE SOLID ROCKET BOOSTERS
  - HIGH PERFORMANCE HYDROGEN-OXYGEN ENGINES PLACED IN THE ORBITER TO BE RECOVERED

RESULTS OF STUDIES

- FULLY REUSABLE WITH FLY-BACK BOOSTER WAS GREATER THAN 5.1B.
- MANY CONFIGURATIONS WERE STUDIED (EXAMPLES)
- TURN AROUND TIME REQUIRED LANDING A WINGED VEHICLE ON A RUNWAY
- PAYLOAD DEPLOYMENT AND RETRIEVAL REQUIREMENT DETERMINED LOCATION OF ORBITER ON LAUNCH CONFIGURATION

MAJOR SHUTTLE CONFIGURATION DECISIONS

- HYDROGEN/OXYGEN MAIN ENGINES
- THIS SIZED THE LIQUID OXYGEN/HYDROGEN TANK, WHICH IS NOT REUSABLE
- SOLID ROCKET BOOSTERS PROVIDED THE ADDITIONAL PROPULSION REQUIRED TO GET THE ORBITER INTO EARTH ORBIT
- SOLID ROCKET BOOSTERS DESIGNED TO BE RECOVERED AND RE-USED

ORBITER DECISIONS

- ORBITER ENTRY CROSS RANGE REQUIRED DELTA WINGS
- DELETION OF AIR BREATHING ENGINES FOR MOVING ORBITER REQUIRED THE BOEING 747 TO CARRY THE ORBITER
- FO/FS GUIDANCE, NAVIGATION, AND CONTROL SYSTEM
- FLY- BY- WIRE WITH A DIGITAL AUTO PILOT

ORBITER DECISIONS

- SIZE OF PAYLOAD BAY 60 FEET LONG BY 15 FEET DIAMETER
- SIZE OF CREW CABIN DEFINED TO BE OVER 2600 CUBIC FEET
- PAYLOAD 65,000 POUNDS AT LIFT OFF AND 35,OOO POUNDS AT LANDING
- THE ORBITER IS A LAUNCH VEHICLE, A SPACE CRAFT, AND AN AIRCRAFT

HARDWARE SUB-SYSTEMS

- THERMAL PROTECTION SYSTEM
- STRUCTURES
- SPACE SHUTTLE MAIN ENGINES
- HYDRAULIC, AUX POWER, FUEL CELLS. OMS, & RCS SYSTEMS
- GUIDANCE, NAVIGATION, AND CONTROL
- ENVIRONMENTAL CONTROL & LIFE SUPPORT IN CREW CABIN
- LANDING & MECHANICAL SYSTEMS
- COMMUNICATIONS
- ELECTRICAL POWER

ORBITER SUB-SYSTEMS

- MAJOR ISSUES
  - FUNCTIONS THAT ARE REQUIRED TO BE PERFORMED (FUNCTIONAL REQUIREMENTS)
  - PERFORMANCE THAT IS REQUIRED (PERFORMANCE REQUIREMENTS)
  - WEIGHT
  - INTERFACES
  - AVAILABLE TECHNOLOGY
  - SCHEDULE
  - COST

ANALYTICAL STUDIES

- AERODYNAMICS
- AEROTHERMODYNAMICS