

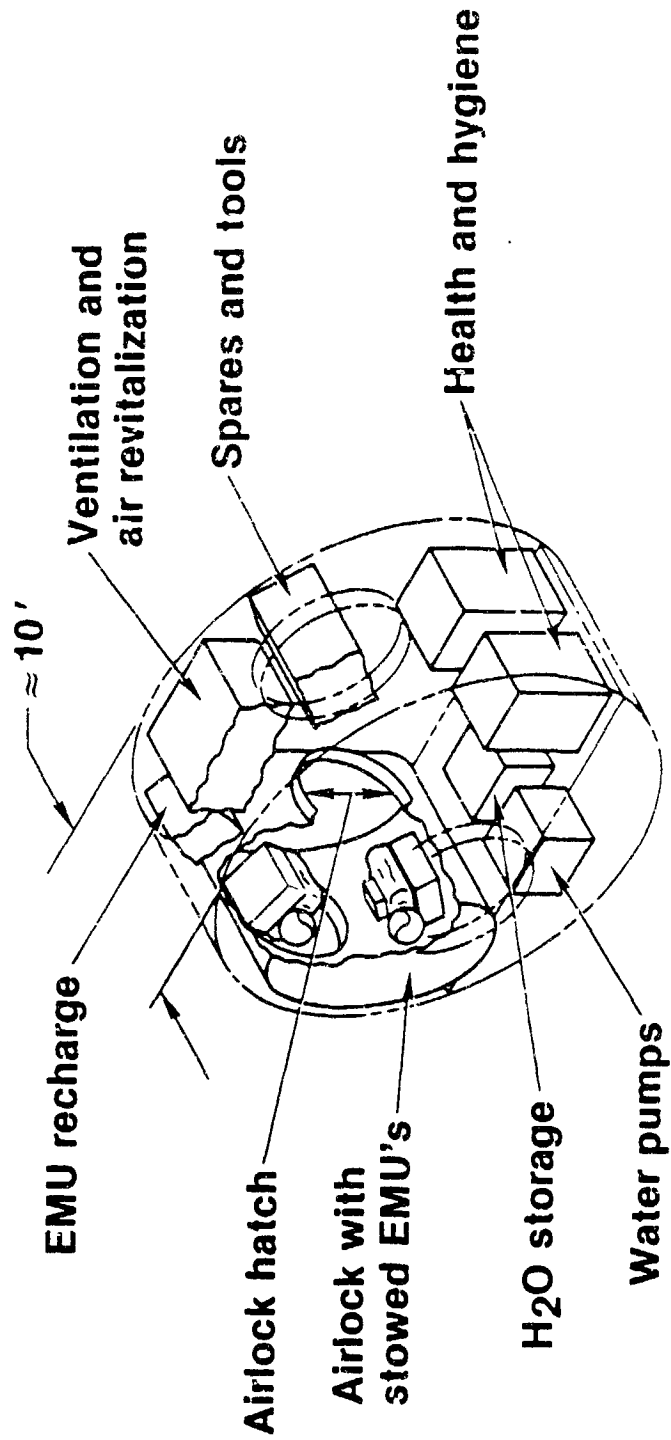
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HUMAN FACTORS IN SPACE STATION ARCHITECTURE:

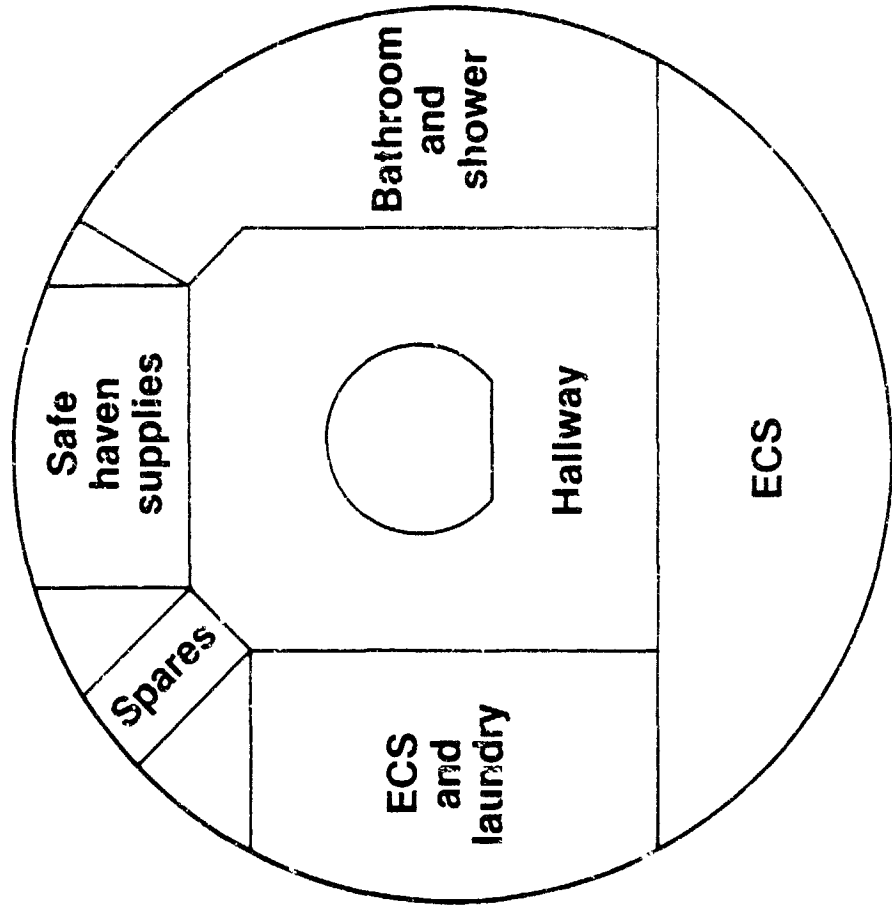
THE ECLSS MODULE CONCEPT

Prepared for: Space Station Human Productivity Working Group
1 March 1984

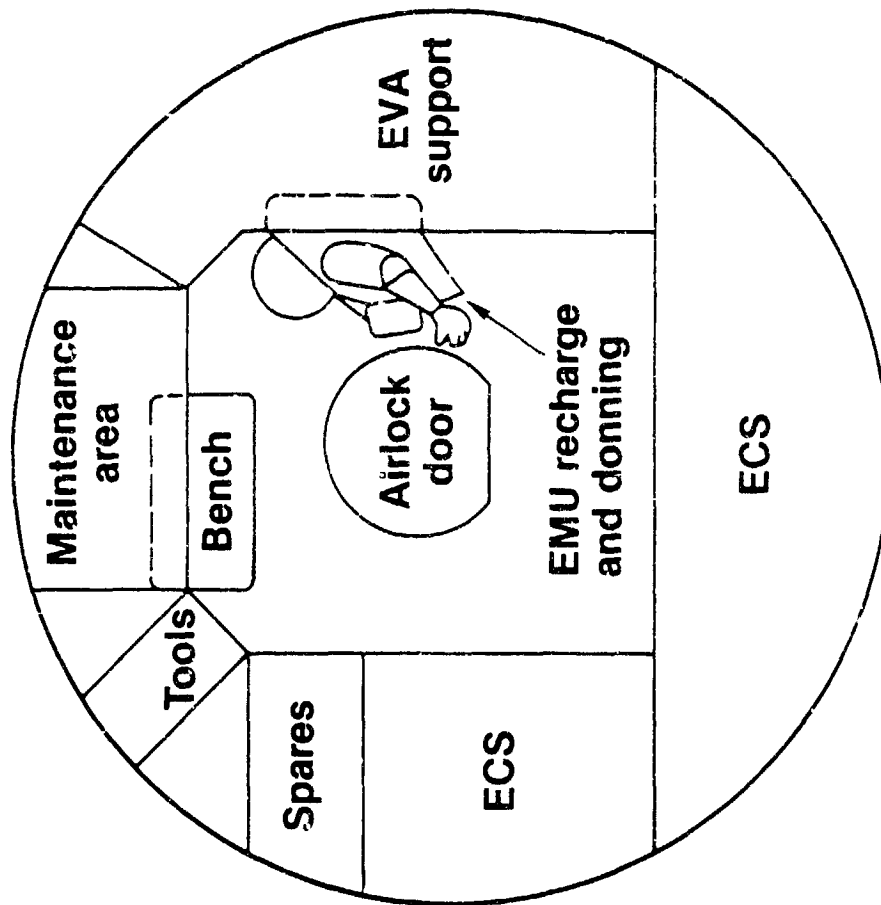
INITIAL ETCLS MODULE WITH AIRLOCK



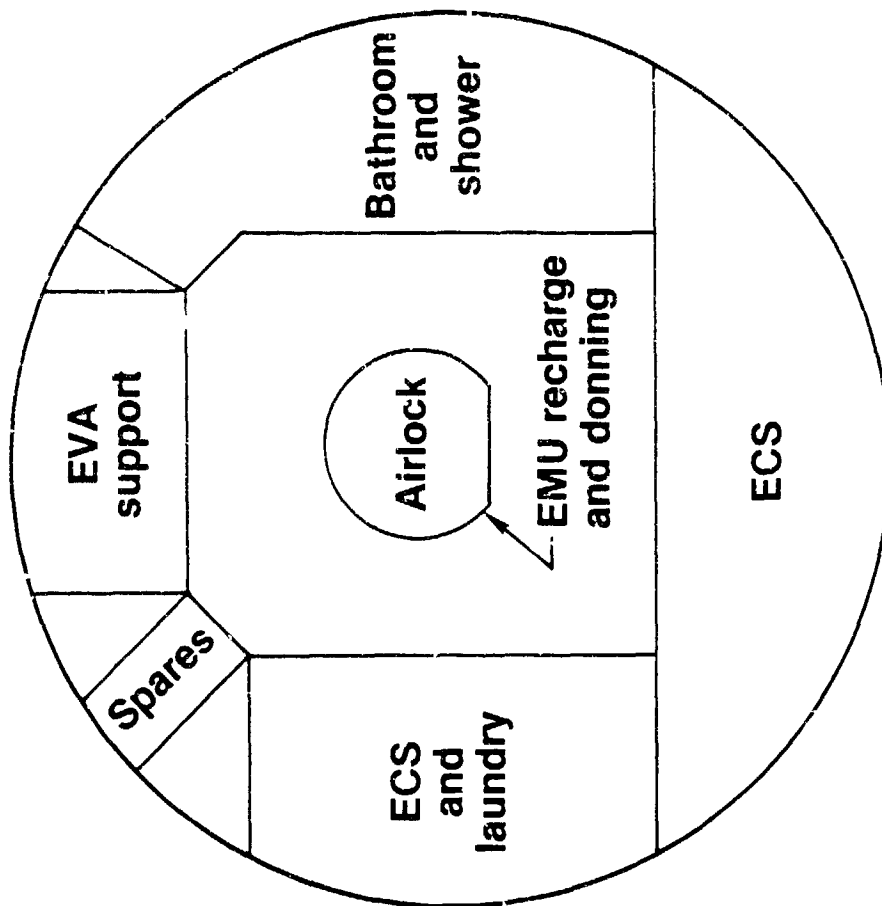
POTENTIAL ECLS MODULE EQUIPMENT GROUPING (ECS/Hygiene/Laundry)



POTENTIAL ECLS MODULE EQUIPMENT GROUPING (ECS/EVA Support)



POTENTIAL ECLS MODULE EQUIPMENT GROUPING (ECS/Hygiene/Laundry/EVA Support)



NOISE IS REDUCED

Sources of Noise in the Primary Vehicle Module

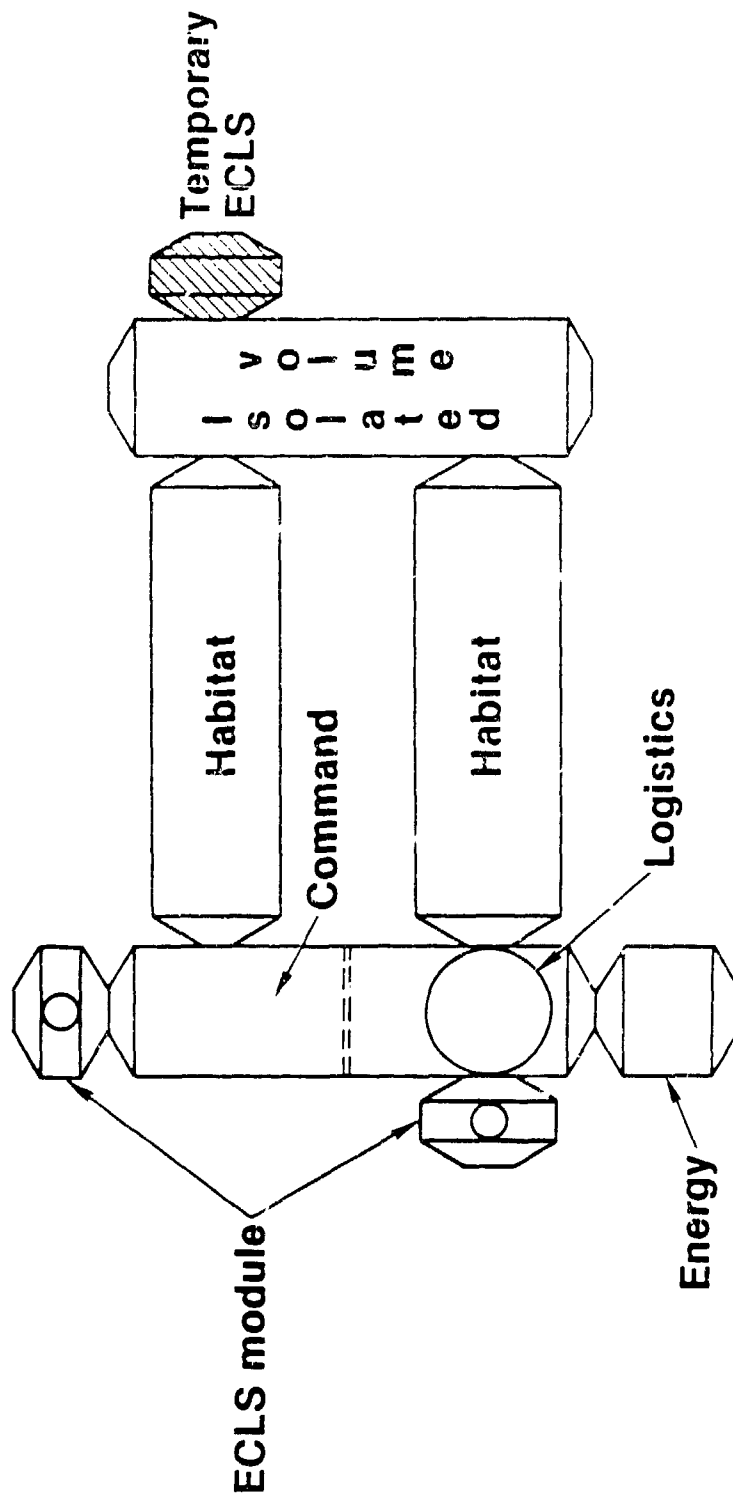
Distributed ECLS

- Ventilation fans
- Process air fans
- Fluid pumps
- Compressors
- Water processor
- Toilets
- Shower
- Trash compactor
- Clothes washer/dryer
- EMU operations
- Valves

ECLS Module

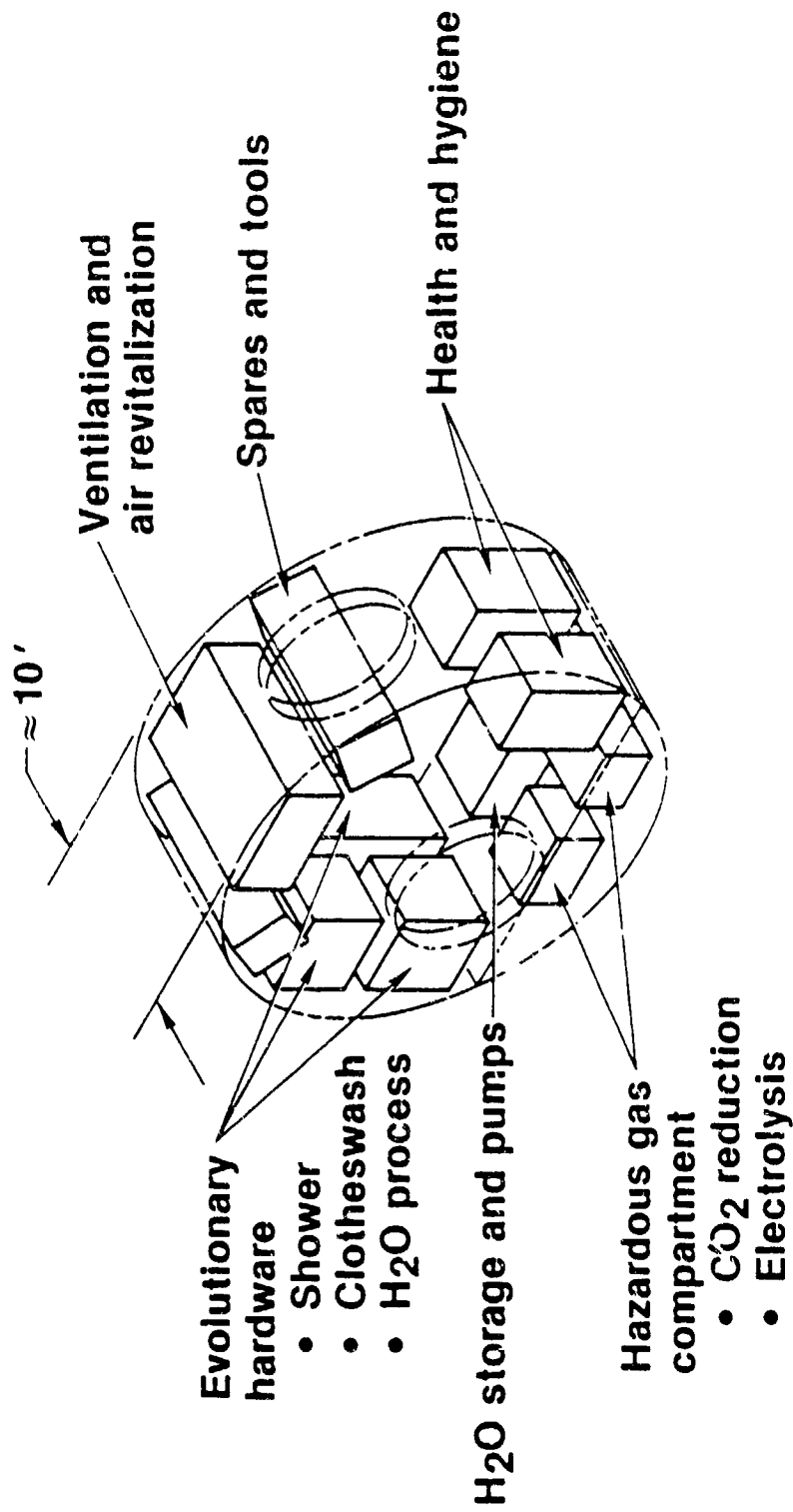
- Ventilation fans

AN ECLS MODULE PROVIDES OPERATIONAL FLEXIBILITY



Scenario: Temporary animal experiments

"CLOSED LOOP" ETCLS MODULE



MODULE-TO-MODULE BULKHEAD INTERFACES

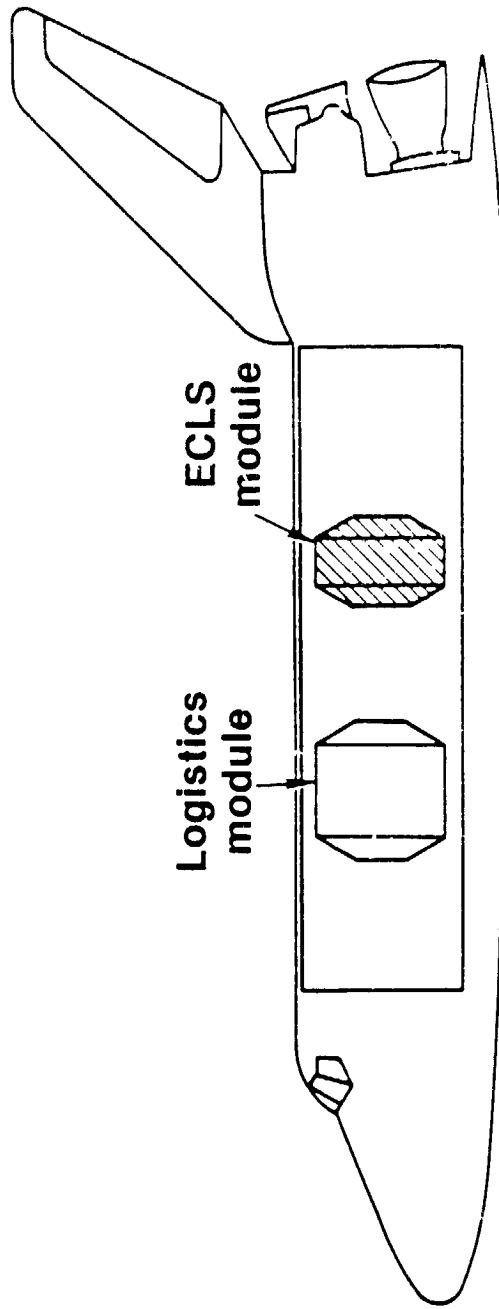
- Air
- Oxygen
- Nitrogen
- Carbon dioxide
- Coolant water
- Potable water
- Condensate
- Wash water
- Wastewater
- Power bus
- Data bus

COMMON BULKHEAD DESIGN CONSIDERATIONS

Advantages/disadvantages

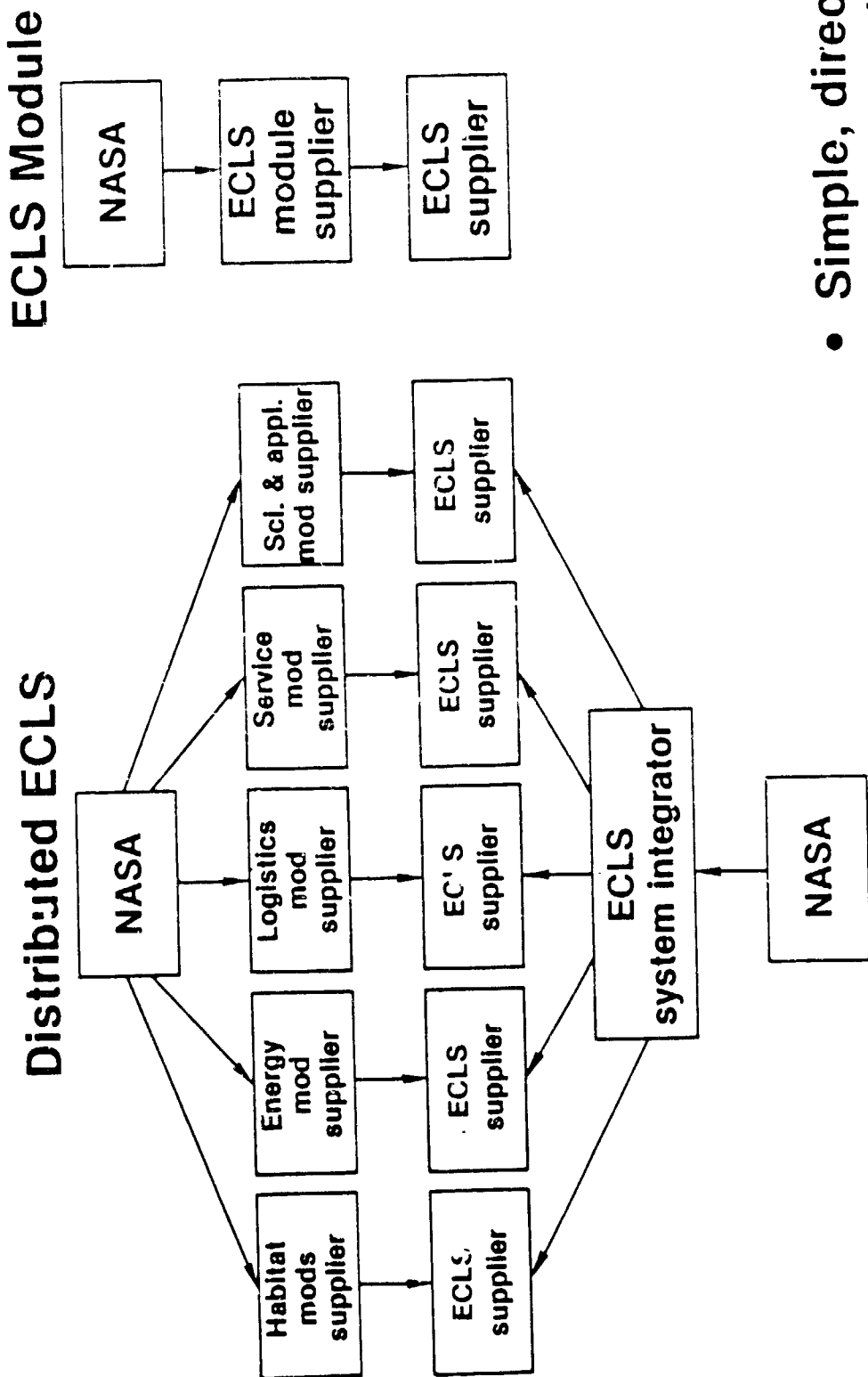
- **Space Station**
 - **Design**
 - **Configuration**
- **Facility/facility services**
- **GSE**

AN ECLS MODULE PROVIDES OPERATIONAL FLEXIBILITY



Scenario: Return to earth for retrofit/refurbishment

ECLS MANAGEMENT BECOMES MORE EFFECTIVE



• Costly, complex management

• Simple, direct management

SEPARATE ECLS MODULE ADVANTAGES/DISADVANTAGES

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- + CENTRALIZED ECLS BENEFITS
 - ° ECLS BECOMES NON-ISSUE FOR OTHER MODULES
 - ° LESS ECLS EQUIPMENT/COST
 - ° REDUCED LOGISTICS MODULF ECLS WEIGHT/VOLUME
 - ° FACILITATES TWO BATHROOMS
- + MOVABLE/RETURNABLE/GROWABLE/ISOLATABLE
- + FACILITATES NASA PROCUREMENT
- + ISOLATES NOISE
- + FACILITATES TWO AIRLOCKS
- + FACILITATES RETAINING TWO SEGMENT COMMON MODULE
- + USES COMMON STRUCTURE - SINGLE SEGMENT
- + FACILITATES SHUTTLE MANIFESTING AND SPACE STATION ASSEMBLY
- ? PROBABLY AN INITIAL LAUNCH PENALTY
- ? COST ADVANTAGE/DISADVANTAGE - PROBABLY EQUAL FOR IOC
ADVANTAGE FOR GROWTH STATION

IMPACT OF THE ECLS MODJLE ON HUMAN PRODUCTIVITY

- 0 MANAGEMENT OF ECLS IMPLEMENTATION BECOMES MORE EFFICIENT
- 0 OPERATIONAL CHECKS AT KSC ARE SIMPLIFIED AND DRAMATICALLY REDUCED
- 0 RETROFIT/REFURB MAY BE MORE EASILY PERFORMED ON THE GROUND BY EXPERTS
- 0 INTERRELATED FUNCTIONS ARE LOCATED TOGETHER
- 0 INTERMITTENT NOISES AND ODORS ARE ISOIATED
- 0 LESS HARDWARE SIMPLIFIES MAINTENANCE
- 0 ON-ORBIT SERVICING DOESN'T INTERFERE WITH PRODUCTIVE ACTIVITIES