FISHER

MOCKUPS AND HUMAN PRODUCTIVITY STUDIES

Presentation To

SPACE STATION

HUMAN PRODUCTIVITY WORKING GROUP MEETING

5-19

NASA AMES

2 MARCH 1984

THE MAGIC OF MOCKUPS
AND
THE MYSTIQUE OF HUMAN PRODUCTIVITY

Presentation To

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HUMAN PRODUCTIVITY WORKING GROUP MEETING

5-20

NASA AMES

2 MARCH 1984

SPACE STATION PROGRAMS

OBJECTIVE

TO PRESENT IDEAS FOR GROUP CONSIDERATION/DISCUSSION

RELATIVE TO:

- MOCKUP CANDIDATES
- MOCKUP UTILIZATION
- MOCKUP DEVELOPMENT SCHEDULES/SEQUENCE

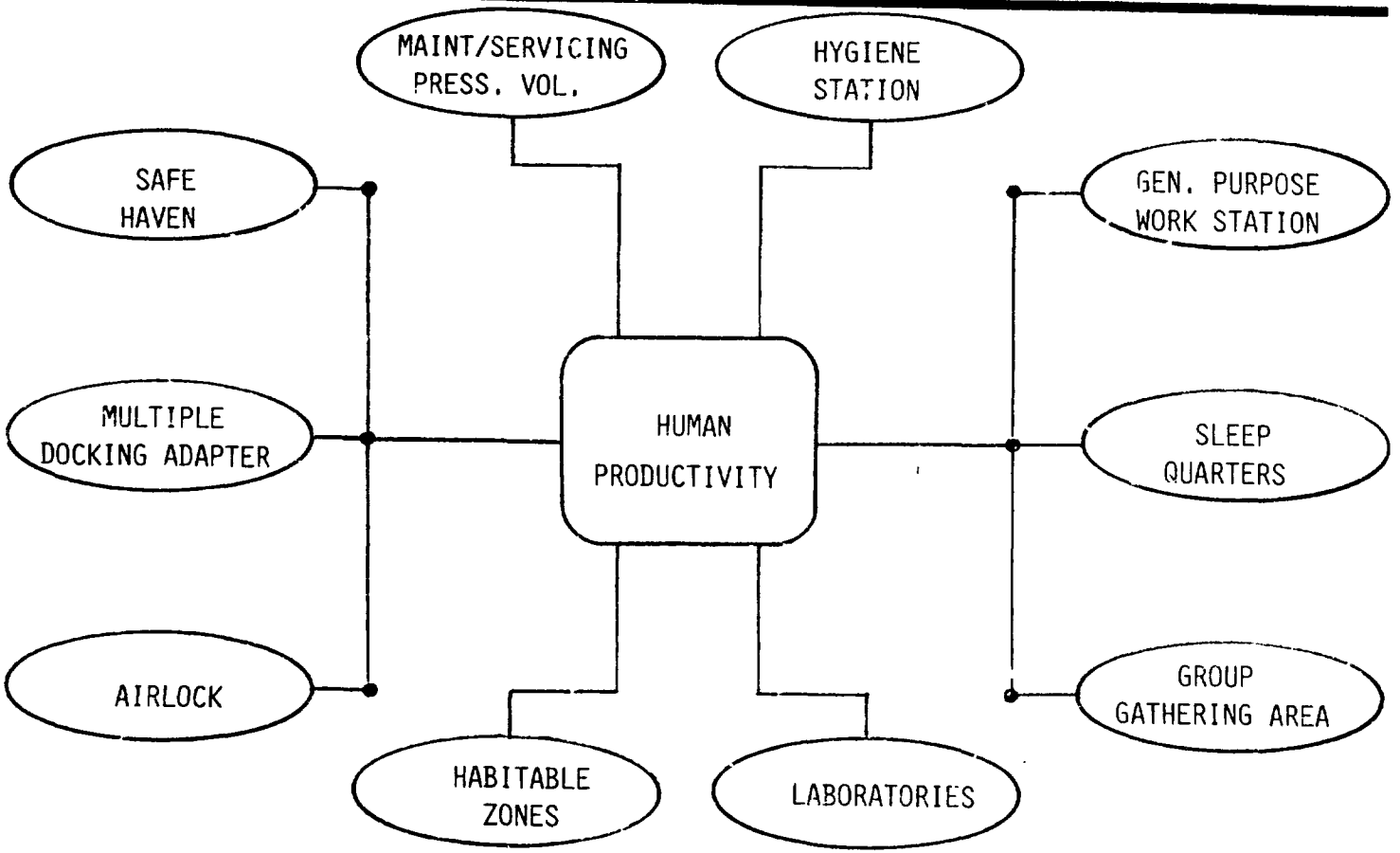
NASA AMES* SUGGESTED MOCKUP TOPICAL COVERAGE

1. VOLUME
2. ORIENTATION
3. CIRCULATION
4. PRIVACY
5. GROUP GATHERING
6. VISUAL SYSTEMS
7. LIGHTING
8. VIBRO/ACOUSTICS
9. FUNCTIONAL ORGANIZATION
10. OTHER

* Mr. Marc Cohen - ARC

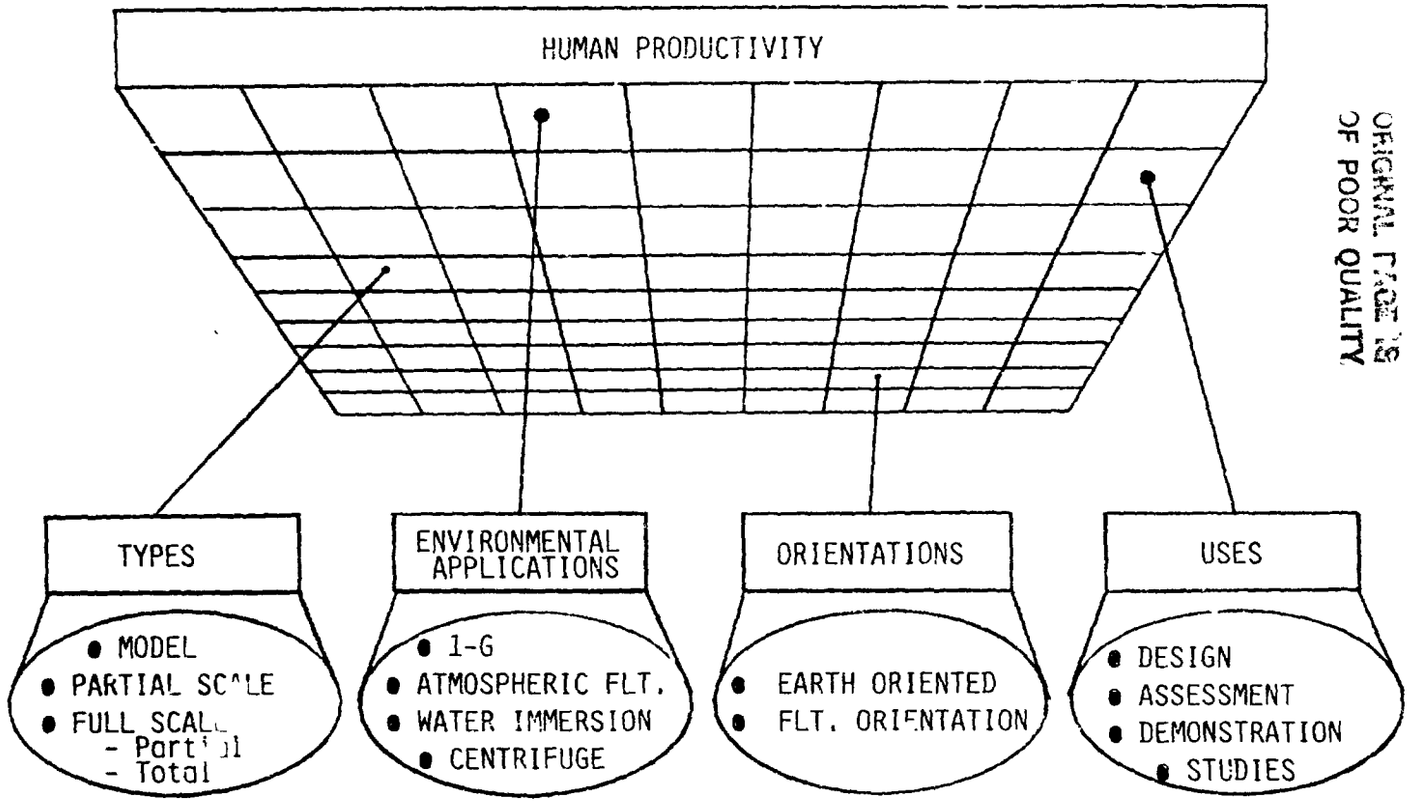
MOCKUP CANDIDATES WHICH AID IN HUMAN PRODUCTIVITY INVESTIGATIONS AND ASSESSMENT

SPACE STATION PROGRAMS



SPACE STATION PROGRAMS

MOCKUP CONSIDERATIONS



MOCKUP CANDIDATES AND USES

SPACE STATION PROGRAMS

SAFE HAVEN ZONE(S)

1. ACTIVITY VOLUMETRICS
2. EMERGENCY ECLSS ITEMS & CONTROL/MONITOR
3. 'ZONE' VOLUMETRICS FOR UP TO X CREW
4. RESCUE INTERFACES
5. RESCUE DEVICES STOWAGE
6. EMERGENCY EQUIPMENT STOWAGE/ACCESS
7. COMMUNICATION PANEL/DEVICE LOCATION
8. VIEW PORT(?)
9. FOOD PREPARATION, STOWAGE & WASTE
10. HYGIENE CONDUCT & WASTE HANDLING
11. CONTAMINATION CONTROL
12. EMERGENCY SLEEP PROVISIONS
13. VENTILATION & ODOR CONTROL
14. PERSONNEL ACCOUTREMENTS
15. PRIVACY
16. GENERAL STOWAGE & ACCESS
17. EMERGENCY ITEM CHECK & ACCESS
18. MEDICAL & FIRST AID SUPPLIES/STOWAGE
19. OTHER

GENERAL PURPOSE WORKSTATION(S)

1. DESIGN FOR 0-G FEATURES/USE
2. RE-LOCATION POTENTIAL
3. BASIC STATION RECONFIGURABILITY
4. SIZE & LAYOUT
5. UTILIZATION VOLUMETRICS
6. ANTHROPOMETRIC UTILIZATION- POPULATION (?)
7. AMBIENT ILLUMINATION IMPACT
8. SEE-OVER VS DECK-TO-CEILING/OVERHEAD
9. MAINTENANCE ACCESS - OPTIONS
10. CABLE RUN(S) AND INTERFACES
11. COOLING/VENTILATION & DUCTING INTERFACES
12. MODULARITY & COMMONALITY
13. BASIC DISPLAY/CONTROL LAYOUT
14. INTRA-STATION D&C COMMONALITY
15. CREW USER EASE & SIMPLICITY
16. 'ISOLATION' FEATURES AS REQUIRED
17. STATION STATUS INDICATION
18. EMERGENCY WARNING & COMMUNICATION
19. OTHER

MOCKUP CANDIDATES AND USES

MAINT/SERVICING (PRESS.) AREA

SLEEP QUARTERS AREA

1. ACTIVITY VOLUMETRICS
2. PACKAGE TRANSFER - IV TO EV OR EV TO IV
3. SPACECRAFT ELEMENT ENTRY/EXIT VOLUME
4. SPACECRAFT ORU ENTRY/EXIT VOLUME
5. INTERNAL LAYOUT/ARRANGEMENT/ARCHITECTURE
6. INTERFACE TO AIRLOCK
7. AREA SUB-ZONE LAYOUT
8. I/F TO SPARES/STOWED ITEMS
9. STOWED ITEM VOLUMETRICS
10. CREW WORK STATION(S)
11. CREW WORK STA. MAINTENANCE ACCESS
12. CONTAMINATION MANAGEMENT
13. EMERGENCY PROVISIONS & STOWAGE
14. UNIQUE WORK STATION FEATURES
15. TOOLS/AIDS STOWAGE/ACCESS & CLEANING
16. ITEM PROTECTION OR ISOLATION
17. SPECIAL ITEM HANDLING DEVICES/ITEMS
18. EQUIPMENT/ITEM/ORU TRANSFER DEVICES
19. EMERGENCY ECLSS PANEL ACCESS & WARNING
20. SAFE HAVEN INTEGRATION (?)
21. OTHER-MANY!

MOCKUP CANDIDATES AND USES

SPACE STATION PROGRAMS

MULTIPLE DOCKING ADAPTER

1. VOLUMETRICS
   - PKG & MODULE PASS-THRU
   - S/C ELEMENT PASS-THRU
   - ACTIVITY VOLUMETRICS
   - SUIT DON/DOFF VOLUME (8 CREW?)
   - ITEM TRANSFER DEVICES VOLUME
2. CREW FUNCTIONS
3. INTERNAL ORIENTATION LAYOUTS
4. INTERNAL ACCOUTREMENTS
5. ILLUMINATION
6. HATCH SWING & STOWAGE
7. WINDOW LOCATIONS
8. CONTROL PANEL LOCATIONS
9. EMERGENCY PROVISIONS/DEVICES
10. CONTAMINATION CONTROL TECHNIQUES
11. EMERGENCY ECLSS
12. OTHER

AIRLOCK

1. VOLUMETRICS
   - PKG & MODULE PASS-THRU
   - S/C ELEMENT PASS-THRU
   - ACTIVITY VOLUMETRICS
   - SUIT DON/DOFF VOLUME (8 CREW?)
   - ITEM TRANSFER DEVICES VOLUME
   - EVA TOOLS & AIDS STOWAGE
2. CREW FUNCTIONS
3. CREW TRANSFER - ABLE & INCAPACITATED
4. INTERNAL ORIENTATION LAYOUTS
5. INTERNAL ACCOUTREMENTS
6. ILLUMINATION
7. HATCH SWING & STOWAGE
8. WINDOW LOCATIONS
9. CONTROL PANEL LOCATIONS
10. EMERGENCY PROVISIONS/DEVICES
11. CONTAMINATION CONTROL TECHNIQUES
12. EMERGENCY ECLSS
13. ALTERNATE USES
    - o HYPERBARIC CHAMBER & SUB-AIRLOCKS
    - o SAFE HAVEN

MOCKUP CANDIDATES AND USES

SPACE STATION PROGRAMS

HYGIENE STATION

1. ACTIVITY VOLUMETRICS
2. TOILET CONFIGURATION
3. CLEANSING FEATURES
   - SHOWER
   - WASH BOWL
4. ACCESS VOLUMETRICS
5. MAINTENANCE ACCESS VOLUME
6. CONTAMINATION CONTROL/CONTAINMENT
7. WASTE PRODUCT HANDLING
8. WASTE PRODUCT 'STOWAGE' & TRANSFER
9. WET ITEM HANDLING/MANAGEMENT
10. VENTILATION
11. VIBRO/ACOUSTICS (DIFFICULT IN M/U)
12. AESTHETICS
13. PRIVACY
14. COMFORT & CONVENIENCE
15. ARRANGEMENT ALTERNATIVES-GROWTH
16. ODOR CONTROL/MANAGEMENT
17. ITEM(S) STOWAGE - VARIOUS
18. OTHER

FOOD STATION

1. ACTIVITY VOLUMETRICS
2. FOOD/DRINK PREPARATION ACCESS
   - EASE OF PREPARATION (FULL MEAL/SNACK)
   - MULTIPLE CREW ACCESS(?)
   - ZONE DIFFERENTIATION
   - OTHER
3. STATION ARRANGEMENT
4. AESTHETICS & PLEASANTNESS OF SURROUND
5. MULTIPLE CREW ACCOMODATIONS
6. EATING FACILITY ACCOUTREMENTS
7. CONTAMINATION CONTAINMENT/CONTROL
8. ODOR CONTROL & VENTILATION
9. COMFORT FEATURES
10. VIBRO/ACOUSTRICS (DIFFICULT IN M/U)
11. WASTE PRODUCT HANDLING
12. WASTE PRODUCT 'STOWAGE' & TRANSFER
13. FOOD STOWAGE VOLUME & ACCESS/LOGISTICS
14. WASTE COMPACTING(?)
15. BACTERIAL CONTROL/MANAGEMENT
16. GENERAL ITEMS STOWAGE/ACCESS
17. OTHER - MANY!

MOCKUP CANDIDATES AND USES

SPACE STATION PROGRAMS

HABITATION ZONE(S)

1. ACTIVITY VOLUMETRICS
2. TRAFFIC PATTERNS & FLOWS
3. ORIENTATION
4. ENTRY/EXIT FROM 1 ZONE TO 2ND(TRANSITION)
5. ACCESS VOLUMETRICS
6. MAINTENANCE ACCESS VOLUMETRICS
7. TRANSLATION AIDS
8. UNIQUE CREW ACCOMODATION ACCOUTREMENTS
9. ILLUMINATION
10. EMERGENCY ECLSS PANEL ACCESS & WARNING
11. RECONFIGURABILITY
12. ATTRACTIVE 'FURNISHINGS' & DECOR
13. COLOR & AESTHETICS
14. WINDOW(S) &/OR VIEW PORTS
15. CONTAMINATION CONTROL/MANAGEMENT
16. SAFE HAVEN INTEGRATION(?)
17. BASIC STATION COMMUNICATIONS ACCESS
18. OTHER

GROUP GATHERING AREA

1. ACTIVITY VOLUMETRICS
2. GROUP I/F AND INTERACTION LAYOUT
3. ACCOMMODATIONS/FURNISHINGS/ACCOUTREMENTS
4. BASIC LAYOUT/ARCHITECTURE & ORIENTATION
5. WINDOWS OR VIEW PORTS
6. ITEM STOWAGE, SET-UP & TEAR-DOWN
7. TRAFFIC PATTERNS & FLOWS
8. PARTITIONING/RE-PARTITIONING
9. ISOLATION/PRIVACY
10. AESTHETICS
11. ILLUMINATION
12. VIBRO/ACOUSTICS(DIFFICULT IN M/U)
13. VENTILATION
14. EMERGENCY ECLSS PANEL ACCESS
15. COMMUNICATION PANEL ACCESS & WARNING
16. MULTI-PURPOSE UTILIZATION FEATURES
17. OTHER

MOCKUP CANDIDATES AND USES

SPACE STATION PROGRAMS

LABORATORIES

1. ACTIVITY
2. INTERNAL LAYOUT
3. LAMINAR FLOW WORK BENCH (TYP)
4. EXPERIMENTS INTEGRATION
5. EXPERIMENT RACKS INSTALL/LAYOUT
6. CONTAM. PROTECT/MGMT/ISOLATION
7. SAFETY PRECAUTIONS
8. EMERGENCY PROVISIONS
9. EQUIPMENT/SUPPLIES STOWAGE
10. SAMPLE CHANGEOUT FACILITIES
11. EXPERIMENT REPLENISHMENT
12. OBSERVATION PROVISIONS
13. ILLUMINATION LOCATION/INTENSITY
14. WORK STATION LAYOUT/LOCATION
15. CONTROL PANEL LOCATION/LAYOUT
16. BODY POSITION RESTRAINTS
17. TRANSLATION/TRANSFER DEVICES
18. MAINTENANCE ACCESS PROVISIONS
19. COMMUNICATIONS (STD/EMERGENCY)
20. INTERNAL ACCOUTREMENTS
21. EXTERNAL WINDOW ARRANGEMENT
22. RECONFIGURABILITY
23. UTILITIES INTERFACES
24. VIBRO/ACOUSTICS
25. PERTURBATIONS IMPACT
26. OTHER

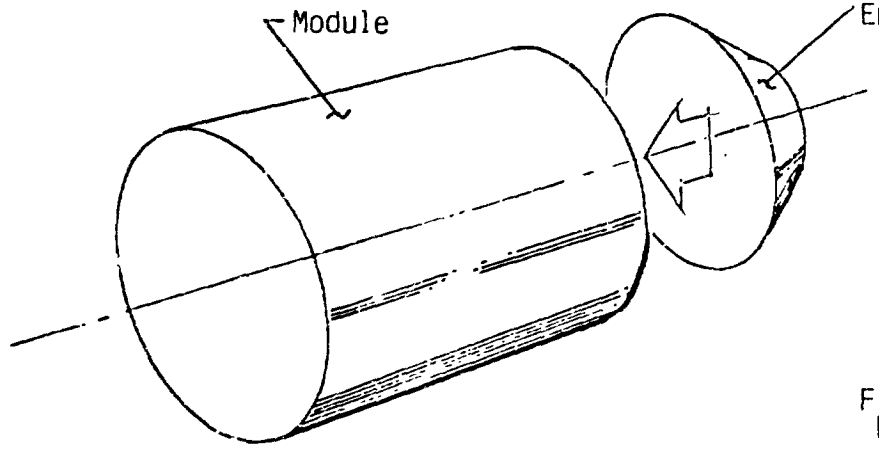
SPACE STATION PROGRAMS

MOCKUP FIDELITY

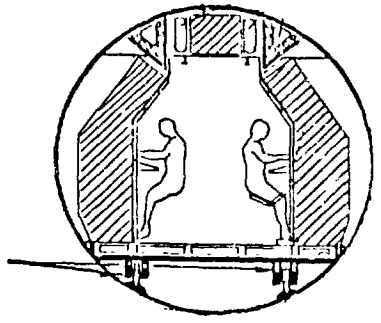
	MATERIALS				
	SOFT FOAMCOR	FOAMCOR/ WOOD	WOOD OR FIBERGLASS	METAL	COMBINATIONS
1. GEN. PURPOSE MODULE SHELL					
• 9 FT. LENGTH			X	X	
• 18 FT. LENGTH			X	X	
2. SAFE HAVEN		X	X		USE ITEM 1 (REMOVE/REPLACE)
3. MAINT/SER PRESSURE VOL.		X			" " " " "
4. HYGIENE STATION	X	X	X	X	" " " " "
5. MULTIPLE DOCKING ADAPTER		X	X	X	
6. AIRLOCK		X	X		
7. GEN. PURPOSE WORK STATION	X	X			" " " " "
8. SLEEP QUARTERS	X	X			" " " " "
9. HABITABLE ZONES	X	X			" " " " "
10. GROUP GATHERING AREA	X	X			" " " " "
(11) LABORATORIES		X	X	X	UNIQUE

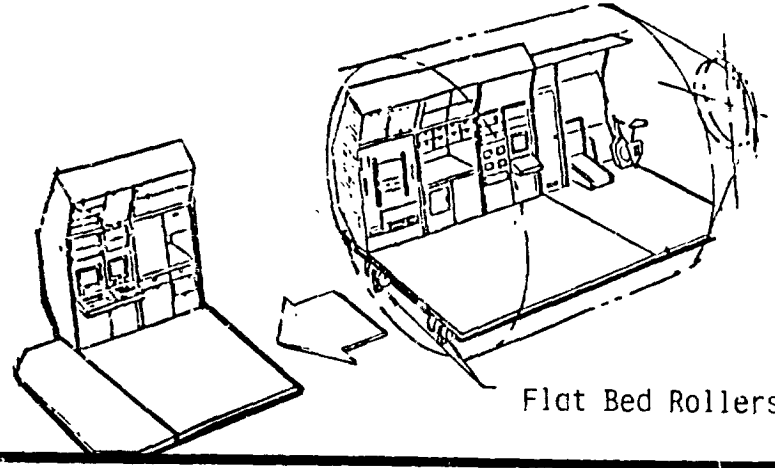
SPACE STATION PROGRAMS

INTERIOR PALLET MODULAR INSERTION/REPLACEMENT



Cross Sectional View

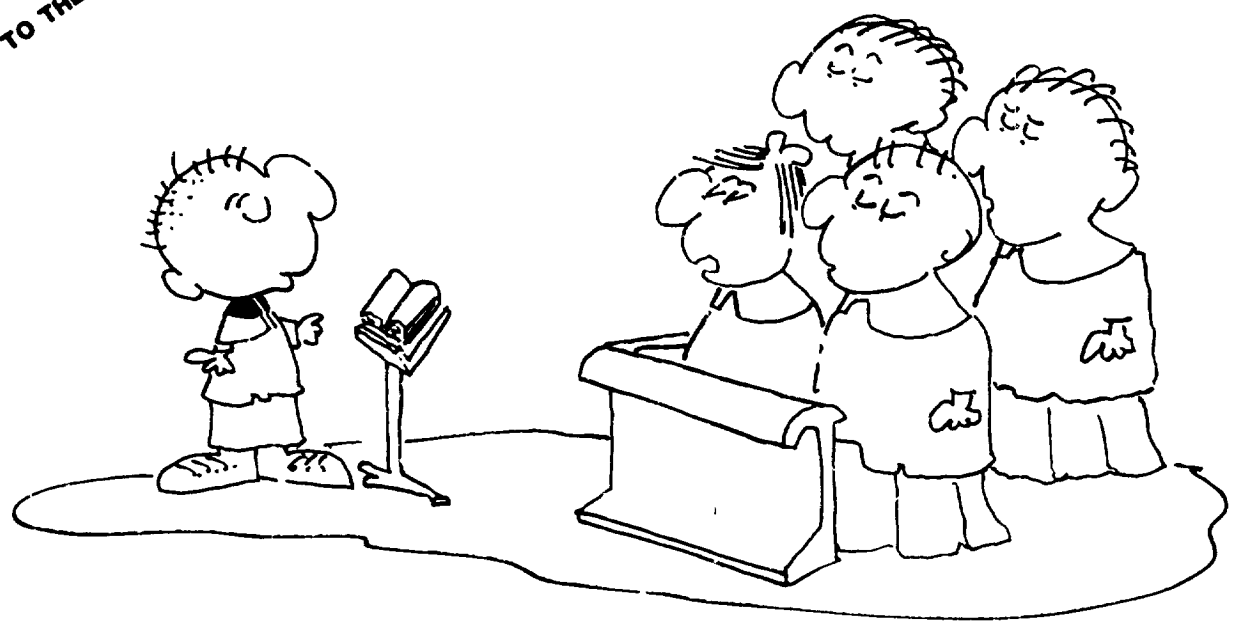




SPACE STATION PROGRAMS

WHAT VALUE MOCKUPS

(PREACHING TO THE CHOIR)



SPACE STATION PROGRAMS

AESTHETIC CONCERNS IN HUMAN PRODUCTIVITY

1. CAN THE EFFECTIVENESS OF THE CREW BE INCREASED BY ENVIRONMENTAL FACTORS SUCH AS:

   - DECOR
   - MATERIALS SELECTION
   - ENVIRON. VARIABILITY
   - COMFORT
   - CLEANLINESS
   - FEELING OF SPATIAL FREEDOM

2. IT IS THOUGHT THAT INTRODUCING ASETHETIC & COMFORT FACTORS INTO THE SPACE STATION ENVIRONMENT MAY RESULT IN:

   - INCREASED EFFICIENCY
   - POSITIVE ATTITUDE MAINTENANCE
   - INCREASED OUTPUT
   - FEWER ERRORS

3. IT IS SUGGESTED THAT THE IMPACT OF THESE FACTORS ON HUMAN PRODUCTIVITY OVER A 90 DAY PERIOD IN A CONFINED ENVIRONMENT (E.G., MOCKUP/SIMULATOR) WARRANTS NEAR-TERM CONCENTRATED NASA STUDY

SPACE STATION PROGRAMS

GENERAL MOCKUP UTILIZATION

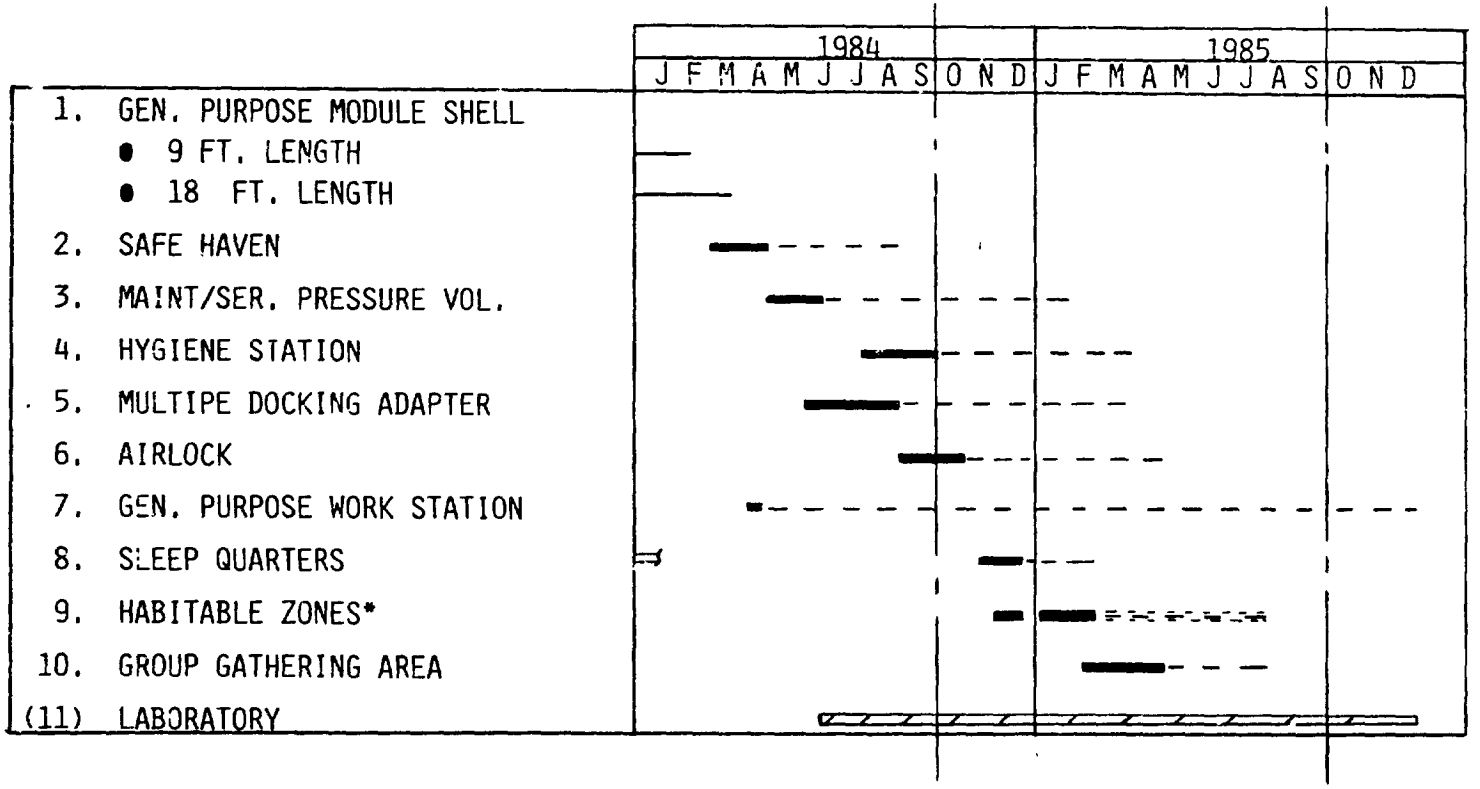
1. MANAGEMENT VISIBILITY IDENTIFICATION
2. 3-DIMENSIONAL "SOLID" REPRESENTATION
3. DESIGN VERIFICATION TOOL
4. CUSTOMER/CONTRACTOR COMM EVAL. TECHNIQUE
5. PUBLIC RELATIONS FACILITY
6. DESIGN ENGINEERING EVALUATION TOOL
7. FORM & FIT ANALYSES
8. ALTERNATE LAYOUT ASSESSMENTS
9. MAINTENANCE ACCESS EVALUATIONS
10. EQUIPMENT ARRANGEMENT STUDIES
11. CABLE RUN PATH ANALYSES
12. CABLE LAY-UP MOCKUP DEVELOPMENT
13. ILLUMINATION FIXTURE LOCATION STUDIES
14. LIGHTING (SPOT/FLOOD) EXAMINATION
15. ANTHROPOMETRIC ASSESSMENTS
16. MAN-MACHINE INTERACTION EVALUATIONS
17. MULTI-ACTIVITY INTERACTION ANALYSES
18. INSTALLATION/REMOVAL TASK STUDIES
19. LOGISTICS ITEM TRANSFER DEMONSTRATIONS
20. RE-CONFIGURE/SHAPING - INTERNAL
21. SUB-COMPARTMENT RE-ARRANGEMENT ANALYSES

SPACE STATION PROGRAMS

GENERAL MOCKUP UTILIZATION (con't)

22. STOWAGE COMPARTMENT LAYOUT STUDIES
23. SUIT DON/DOFF VOLUMETRIC ANALYSES
24. EMERGENCY ITEM ACCESS
25. FUNCTION TIME-LINE ANALYSES
26. EMERGENCY PROCEDURE CONDUCT DEMOS
27. TRANSLATION AID ASSESSMENT
28. COLOR/DECOR EVALUATIONS
29. TRAFFIC FLOW EXAMINATION
30. HATCH SWING & STOWAGE STUDY
31. LAYOUT ORIENTATION EVALUATIONS
32. BODY ORIENTATION ASSESSMENTS
33. CREW ENTRY-EXIT ANALYSES (INTERNAL)
34. WINDOW/VIEW-PORT SIZING/LOCATION
35. FURNISHINGS ARRANGEMENT & LAYOUT
36. WORK STATION INSTALLATION EXAMINATION
37. CONTAM. MGMT. & TECHNIQUE HANDLING STUDY
38. SAFE HAVEN INTEGRATION EVALUATIONS
39. MAXIMUM CREW LOADING VOLUME ANALYSES
40. BODY POSITION/RESTRAINT DEVICE LOCATION
41. CREW FUNCTION SIMULATION
42. OTHER

CANDIDATE DEVELOPMENT SCHEDULE



* Potential Longer Duration Study

SPACE STATION PROGRAMS

CONCLUSIONS

1. MOCKUPS PIVOTAL TO INVESTIGATION, RESEARCH, DESIGN & INTEGRATION
2. CERTAIN ELEMENTS OF HUMAN PRODUCTIVITY CAN BE ASCERTAINED
3. EARLY MOCKUP DEVELOPMENT WILL SUBSTANTIALLY AID IN STATION REQTS. DEVELOPMENT AND CONFIGURATION EVOLUTION
4. PRIMARY VOLUMETRICS FOR BASIC INTERNAL STATION NOT YET ESTABLISHED
5. IT IS CRITICAL TO ESTABLISH (EARLY) SAID VOLUMETRIC REQTS. FOR THE STATION 'LEST ENGINEERING DOES IT FOR US' AND WE 'LOSE AGAIN'
6. WILL THE MOCKUP STUDIES RESULT IN VOLUMETRIC ALLOCATIONS EXCEEDING THE CURRENT SPACE STATION CDG ESTIMATES/LIMITATIONS ?
7. A COMBINED INDUSTRY MOCKUP STUDY DATA BASE CAN'T BE IGNORED
   - 'OLE B.C.' MIGHT BECOME THE I/F BATTLE GROUND TO BRING THIS TO THE FORE
   - REASONABLE COOPERATION/INTERACTION BY THE COMBINED STATION INTERESTED AEROSPACE COMMUNITY COULD RESULT IN A STRONG POSITION
8. INDUSTRY DEVELOPED MOCKUPS USUALLY HAVE A DEGREE OF PROPRIETARY FEATURES WHICH MAKES OPEN SHARING DIFFICULT
9. NASA MOCKUP DEVELOPMENT & USE WILL PERMIT CERTAIN LONG-TERM INVESTIGATIONS TO BE UNDERTAKEN WHICH ARE VERY IMPORTANT TO THE PROGRAM