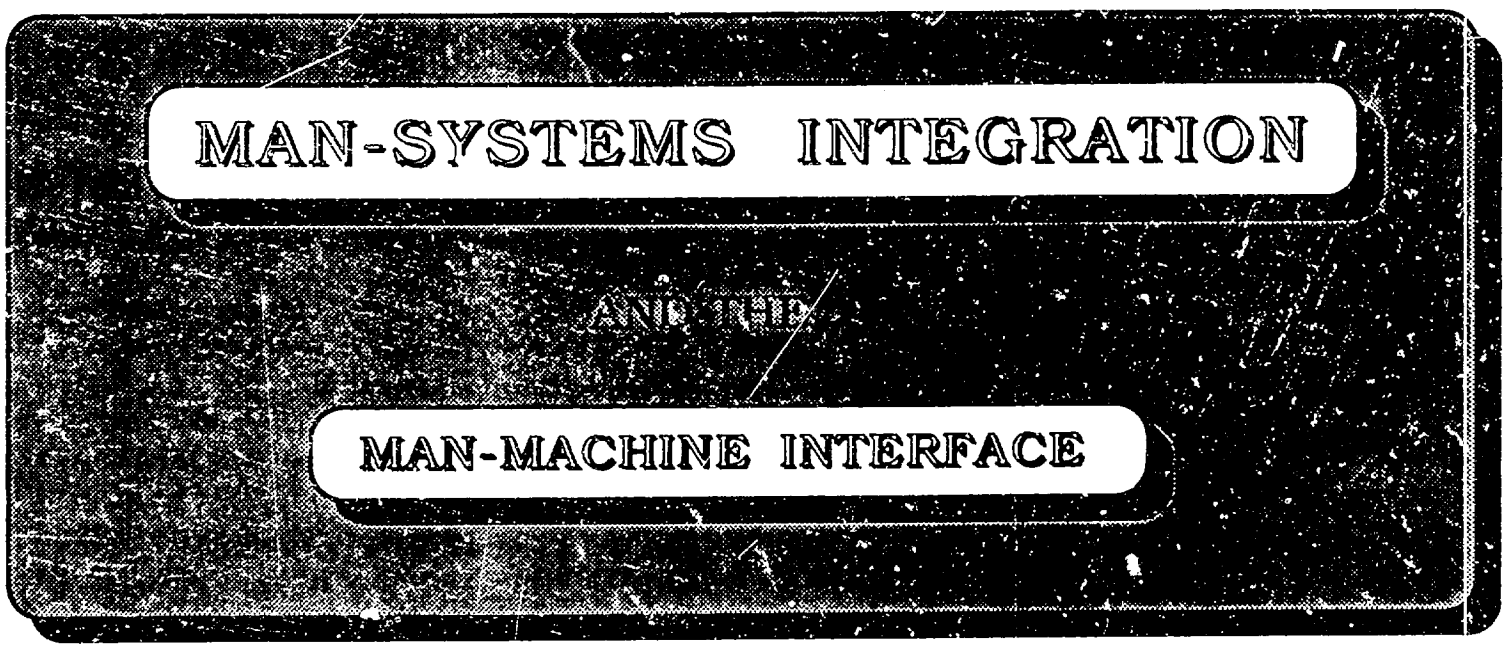
TECHNOLOGY FOR SPACE STATION EVOLUTION

A WORKSHOP



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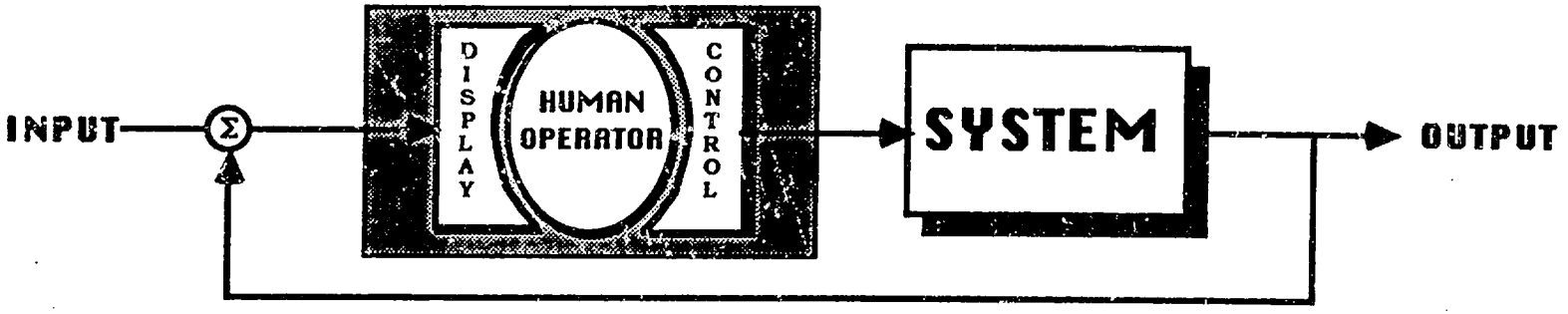
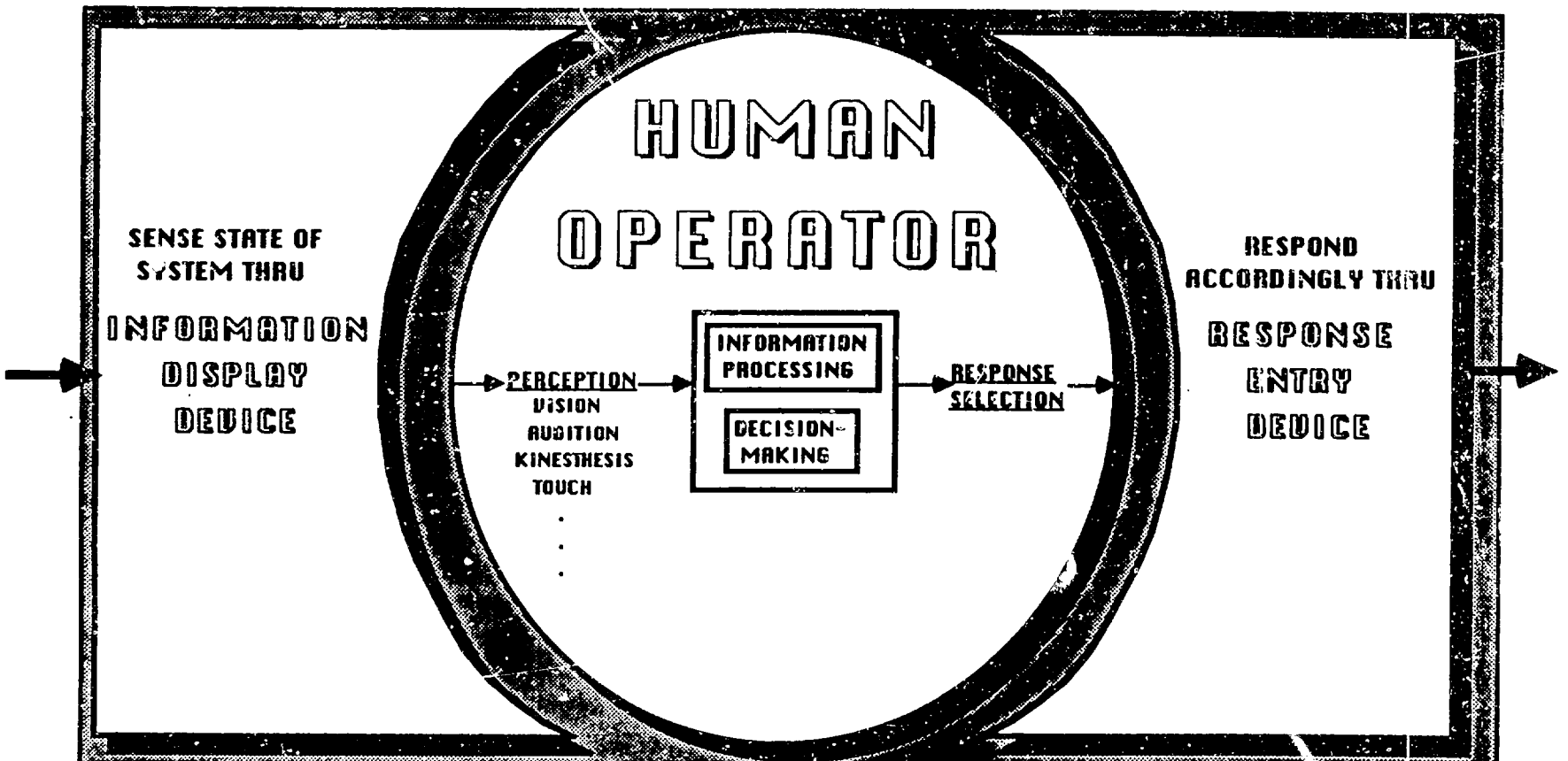
Man-Systems Integration applies the systems' approach to the integration of the user and the "machine" to form an effective, symbiotic **Man-Machine System (MMS)**. A MMS is a combination of one or more human beings and one or more physical components that are integrated through the common purpose of achieving some objective. In this concept, the human is considered a component or subsystem of the larger system. These components interact within the system environment to bring about, from given inputs, some desired output. The human operator interacts with the system through the **Man-Machine Interface (MMI)**. The operator must sense, or perceive, the state of the system and environment; then process that information, make a decision, and select a response; before inputting that response into the system. The perception and response components are accomplished through the MMI. Proper attention to the MMI can facilitate the information processing, decision-making, and response selection components, thus enhancing total system performance.


INPUT
Σ
DISPLAY
HUMAN OPERATOR
CONTROL
SYSTEM
OUTPUT


HUMAN OPERATOR
SENSE STATE OF SYSTEM THRU
INFORMATION DISPLAY DEVICE
PERCEPTION
VISION
AUDITION
KINESTHESIS
TOUCH
INFORMATION PROCESSING
DECISION-MAKING
RESPONSE SELECTION
RESPOND ACCORDINGLY THRU
RESPONSE ENTRY DEVICE

THE HUMAN OPERATOR

CONDUCTS/ EXECUTES →

- DATA/INFORMATION MANAGEMENT
  - -ACQUISITION
  - -RETRIEVAL
  - -PROCESSING
  - -STORAGE
  - -DISPLAY
- COMMANDS AND CONTROLS
- TROUBLESHOOTING/FAULT DIAGNOSIS
- TELEOPERATION

TO PERFORM/ UNDERTAKE →

- SPACE STATION OPERATIONS
- PAYLOAD OPERATIONS
- CREW SUPPORT & HEALTH MAINTENANCE
- PROXIMITY OPERATIONS
- MAINTENANCE/SERVICING OPERATIONS
- ON-BOARD PROFICIENCY/REFRESHER TRAINING

VIA → THE MAN-MACHINE INTERFACE (MMI)

MMI INTERFACES INCLUDE

ELECTRICHL POWER SYSTEM
THERMAL CONTROL SYSTEM
DATA MANAGEMENT SYSTEM
COMUNICATIONS & TRACKING
ECLSS
MAN/SYSTEMS

THE REMAINDER OF THIS PRESENTATION WILL FOCUS ON SELECTED MMI TECHNOLOGY REQUIREMENTS FOR:

DATA/INFORMATION DISPLAY

TELEOPERATION

DATA/INFORMATION DISPLAY

EMPHASIS IS ON ACTIVITIES AND OPERATIONS WHERE:

- DATA/INFORMATION MUST BE
  - READILY ACCESSIBLE
  - FREQUENTLY CONSULTED
- OTHER FACTORS CONSTRAIN:
  - WEIGHT
  - VOLUME
  - "PORTABILITY"
  - RECONFIGURATION

EXAMPLES:

- IN SITU MAINTENANCE/SERVICING OPERATIONS
- PROXIMITY OPERATIONS (CUPOLA)

DATA/INFORMATION DISPLAY

PRESENT MONITORS

FLAT PANEL	MASS	VOLUME (WxHxD)	POWER	COUNT PORTABLE(2)	COUNT CUPOLA(2)
15"	<20lbs.	13"x10"x5"	<150W	0x2	2x2
9"	<15lbs.	7.2"x5.4"x5"	<75W	1x2	4x2

REQUIRED PHYSICAL IMPROVEMENTS

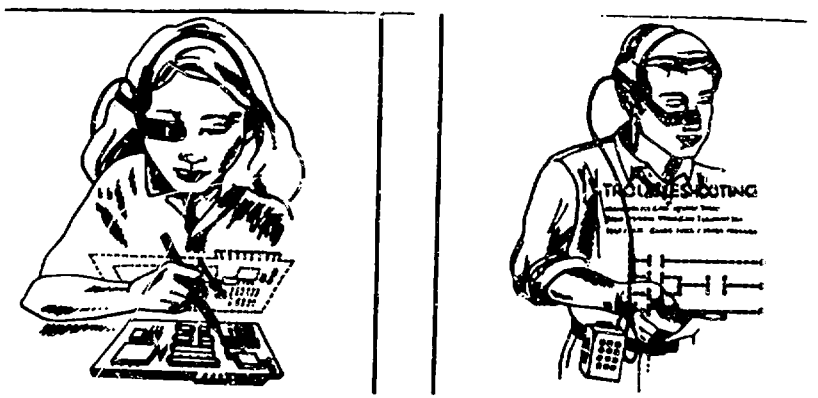
- -LIGHTER
- -SMALLER
- -MORE "PORTABILITY" (PORTABLE WORKSTATION)
- -MORE EASILY RECONFIGURED (CUPOLA)

→ WEARABLE

DATA/INFORMATION DISPLAY

CURRENTLY UNDER EVALUATION:

"PRIVATE EYE"
- <2 oz.
- 1.1"x1.2"x3.2"
- 0.5W at 5 volts
- 720x280 PIXELS
- MONOCHROME
- STATIC DISPLAYS



REQUIRED PERFORMANCE IMPROVEMENTS

- GREATER RESOLUTION
- COLOR
- DYNAMIC/VIDEO DISPLAYS

TELEOPERATION

EMPHASIS IS ON ACTIVITIES AND OPERATIONS WHERE:

- THE HUMAN OPERATOR REMOTELY OPERATES TELEROBOTIC ARM(S) AND END EFFECTOR(S)
- OTHER FACTORS CONSTRAIN
  - -WEIGHT
  - -VOLUME
  - -OPERATOR'S DYNAMIC WORK ENVELOPE

PRESENT CONTROLS STILL UNDER STUDY

TELEOPERATION

REQUIRED IMPROVEMENTS

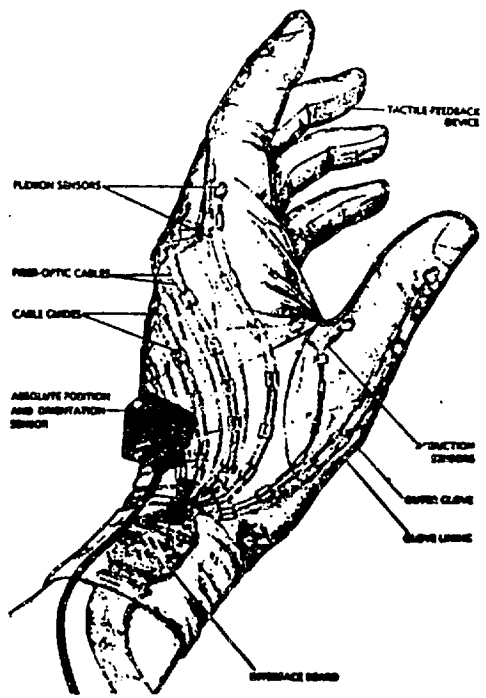
LIGHTER
SMALLER
REDUCED DYNAMIC WORK ENVELOPE
ENHANCED PERFORMANCE
- -MORE "INTUITIVE" OPERATION
- -ANTHROPOMORPHIC

TELEOPERATION

CURRENTLY UNDER EVALUATION:

"DATAGLOVE"
- SENSES HAND
  - GESTURE
  - POSITION
  - ORIENTATION
- 5 OZ.
- HANDSIZE

WEARABLE



REQUIRED IMPROVEMENTS

FORCE-REFLECTIVE FEEDBACK
INCREASED RESOLUTION AND ACCURACY