

TECHNICAL SYMPOSIUM

N87-29161

SPACE STATION FOCUSED TECHNOLOGY

"ELECTRONIC CONTROL/DISPLAY INTERFACE TECHNOLOGY"

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The objective of this effort is to achieve, through an orderly process of assessment, analysis, design, development and test, a representation of an advanced workstation for inclusion in the Space Station Data Management Test Bed. The workstation will use presently available technological elements and will be adaptive to future evolutionary technologies, advanced architectures, and enhanced software. The effort will be nurtured by the advanced control/display and human factors technology emanating (past, present, and future) from the NASA Aeronautical R&T Base program in Crew Station Technology, which provides a firm basis for consolidating, automating, and integrating the interface between man/machine.

Promising technologies to be considered for inclusion in the workstation are: high-performance all-rastergraphic pictorial display generation, advanced display media (including flat panel displays), interactive multifunction controls (including touch and voice), advanced workstation processors, and interactive video disc hardwares, as well as the software base, methodologies, and techniques for their integration into advanced workstation concepts. Image management technologies for the storage, retrieval, and routing of computer-generated data, live imagery, video disc imagery/data, and combinations of these in windowed displays will be emphasized.

The program plan (i.e., to achieve the objectives of providing innovative and flexible user options which support clean, uncluttered workstations that fulfill space station requirements) consists of three phases. The initial phase provides for the determination of the control/display information and functional requirements to furnish such capabilities as systems monitoring/control, office automation functions, resource management, and data base management, as well as a survey of the available devices and systems technologies (display generators, workstation processors, display medias, multifunction controls, etc.). The second phase deals with the evaluation, through an interim workstation, of the architectural options, the implementation strategies, and the space station applications for technology demonstration that will be incorporated into the final workstation. The final phase consists of assembling the deliverable workstation and interfacing it to the Data Management Test Bed at Johnson Space Flight Center.

In summary, this effort will produce a representative workstation for the Space Station Data Management Test Bed that provides man/machine interface design options for consolidating, automating, and integrating the space station workstation, and hardware/software technology demonstrations of space station applications. The workstation will emphasize the technologies of advanced graphics engines, advanced display/control medias, image management techniques, multifunction controls, and video disc utilizations. In addition, the effort will contribute to the overall knowledge base of man/machine interface design methodologies.

COMPUTER SCIENCES AND DATA SYSTEMS
TECHNICAL SYMPOSIUM

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SPEAKER

J. HATFIELD

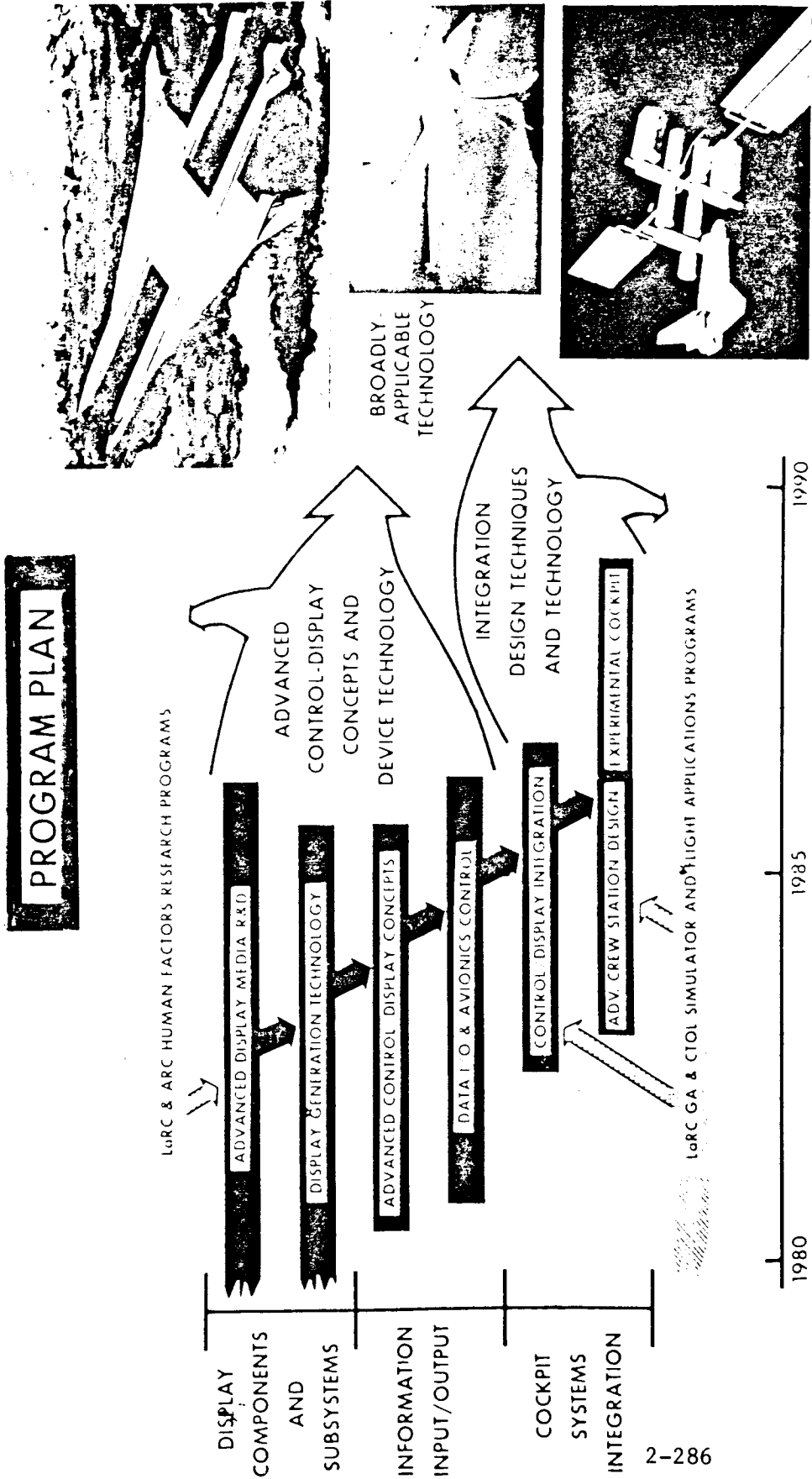
PRESENTATION CONTENTS

- o R & T AVIONICS PROGRAM BACKGROUND
- o SPACE STATION ELECTRONIC CONTROL/DISPLAY
INTERFACE TECHNOLOGY EFFORT
 - OBJECTIVES/BENEFITS
 - PROGRAM PLAN
- o CURRENT STATUS
- o RESOURCES
- o SUMMARY

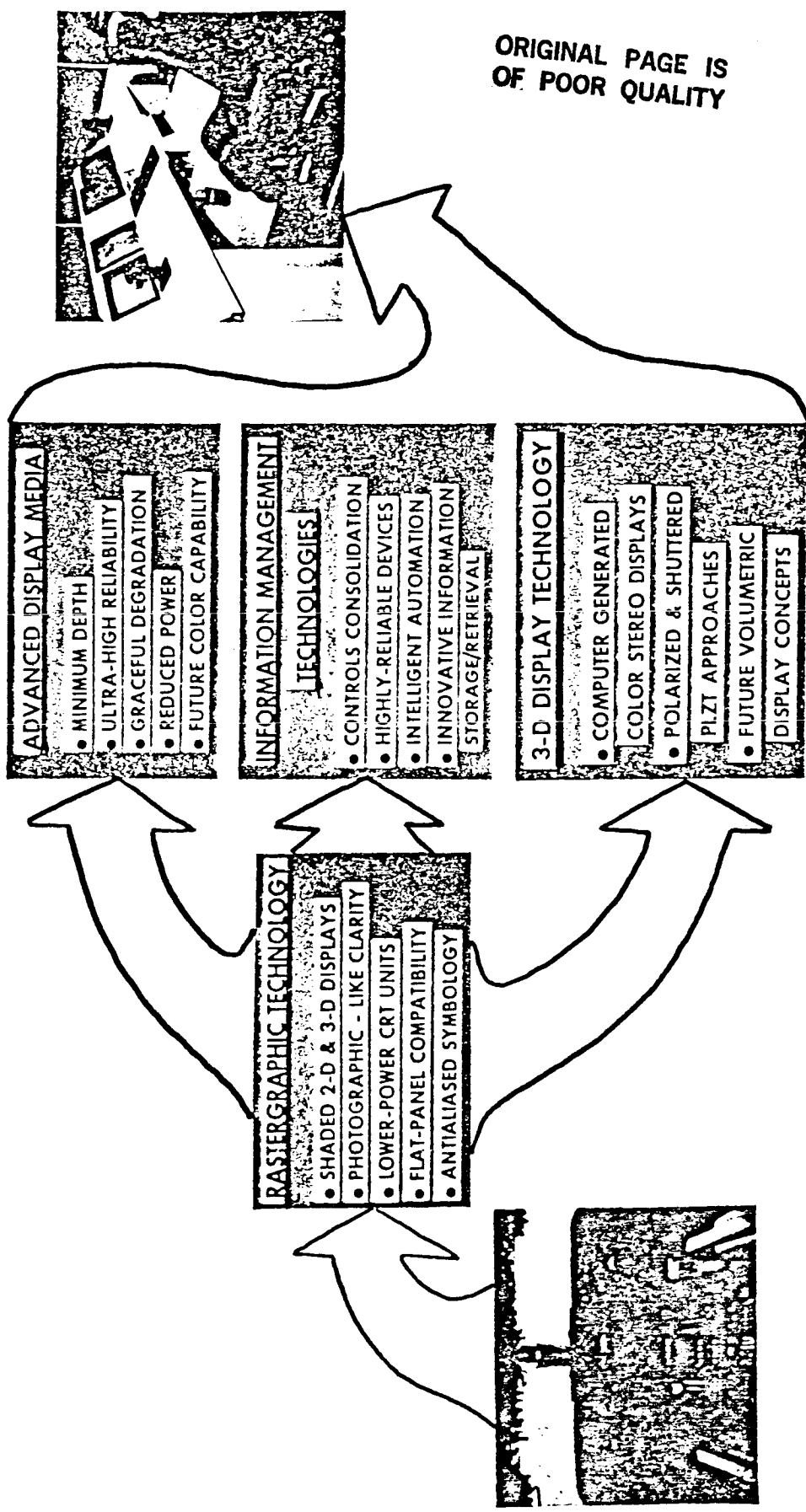
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ADVANCED NAVIGATION, GUIDANCE, AND CONTROL PROGRAM CREW STATION ELECTRONICS TECHNOLOGY ELEMENT

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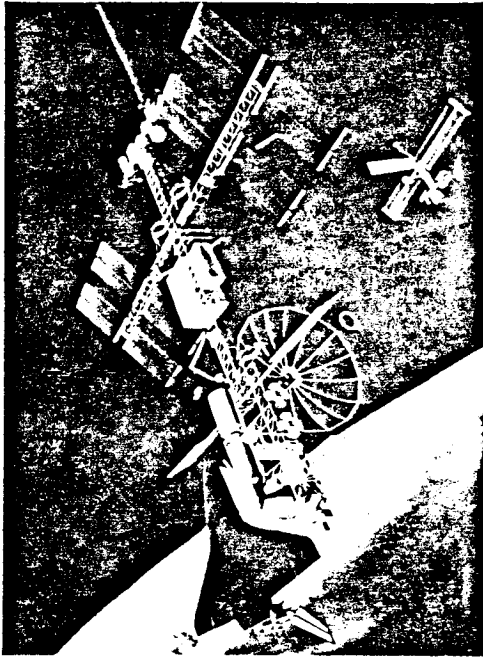


RESEARCH THRUSTS IN CREW STATION TECHNOLOGY



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AREAS OF CONTROL/DISPLAY R&D



GENERIC SPACE
WORKSTATION REQUIREMENTS

INTERACTIVE
WORKSTATIONS FOR
MONITORING & CONTROL
SPACE STATION

IMAGE GENERATION
IMAGE STORAGE/RETRIEVAL

LaRC

■ R&T BASE

■ FOCUSED TECHNOLOGY

TECHNOLOGIES FOR

- CONSOLIDATING
- AUTOMATING
- INTEGRATING

MAN/MACHINE INTERFACE

MULTI-FUNCTION
CONTROL DEVICES

ADVANCED DISPLAY
MEDIA

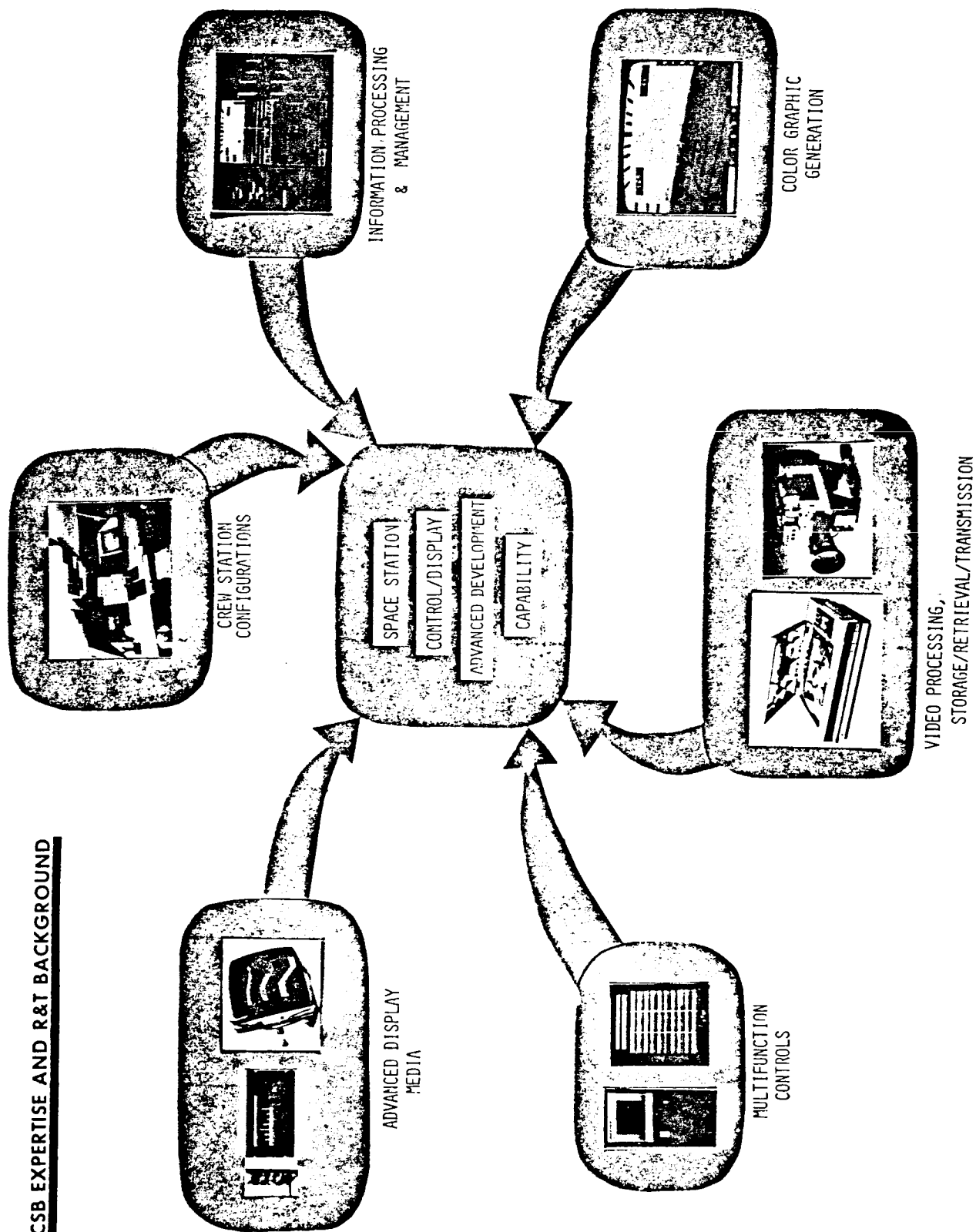
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INTEGRATION
METHODOLOGIES

ADVANCED INTERACTIVE CONTROL AND DISPLAY TECHNOLOGIES

FOR SPACE STATION APPLICATIONS

CSB EXPERTISE AND R&T BACKGROUND



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ELECTRONIC CONTROL/DISPLAY INTERFACE TECHNOLOGY

OBJECTIVE

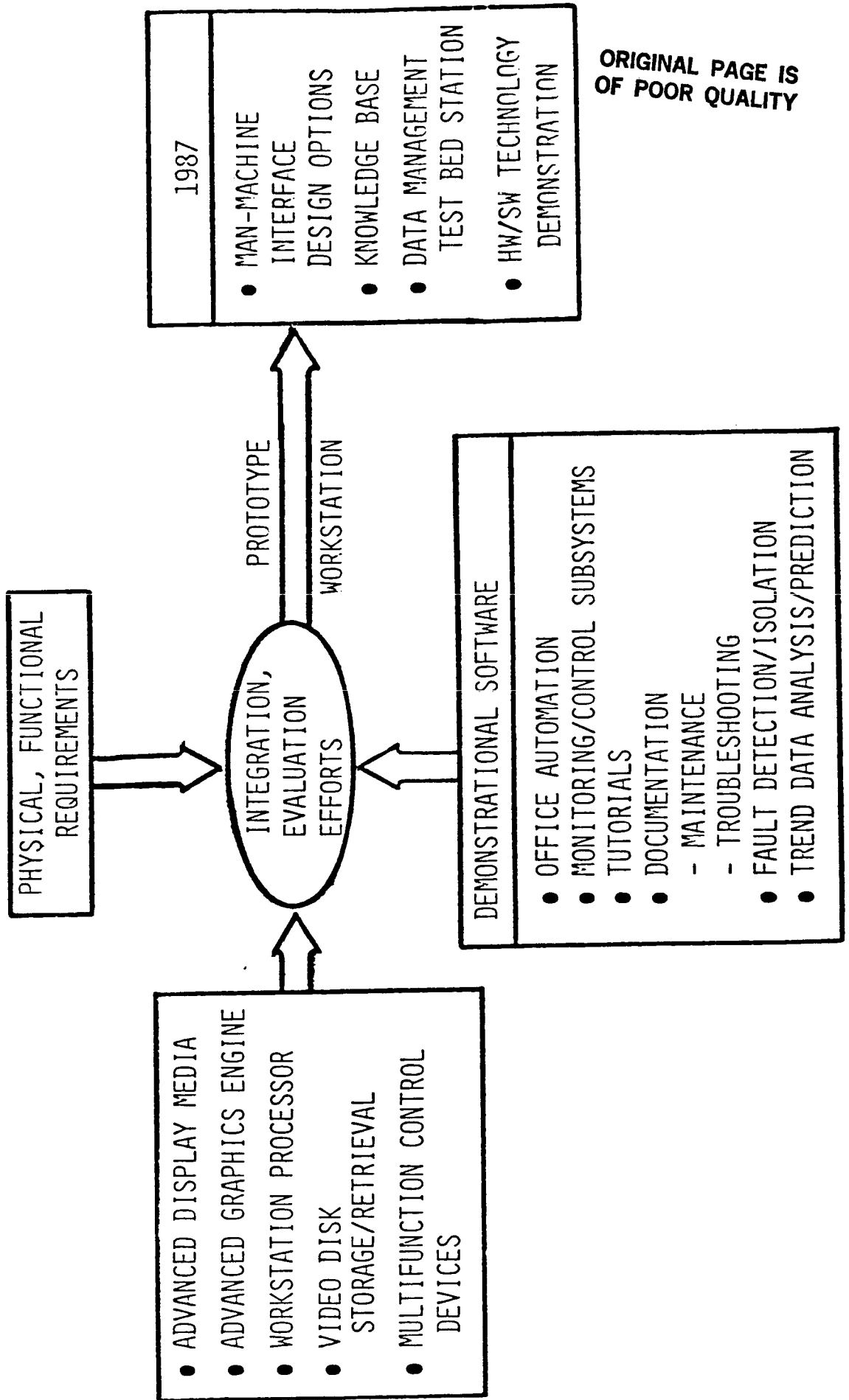
- o TO ACHIEVE THROUGH AN ORDERLY PROCESS OF ASSESSMENT ANALYSIS, DESIGN, DEVELOPMENT AND TEST, AN INTEGRATED REPRESENTATIVE WORKSTATION WHICH USES PRESENTLY AVAILABLE TECHNOLOGICAL ELEMENTS AND IS ADAPTIVE TO FUTURE EVOLUTIONARY TECHNOLOGIES, ADVANCED ARCHITECTURES, AND ENHANCED SOFTWARE.

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BENEFITS

- o INNOVATIVE C/D INTERFACE
- o INTEGRATED DESIGN APPROACH
- o REDUCED DESIGN/PRODUCTION COSTS
- o IMPROVED MISSION FLEXIBILITY
- o HIGHLY-RELIABLE WORKSTATIONS
- o MODULARLY-EXPANDABLE SYSTEMS
- o ENHANCED SAFETY/PERFORMANCE
- o TRAINING MINIMIZATION

FOCUSED TECHNOLOGY: SPACE STATION ELECTRONIC CONTROL/DISPLAY INTERFACE TECHNOLOGY

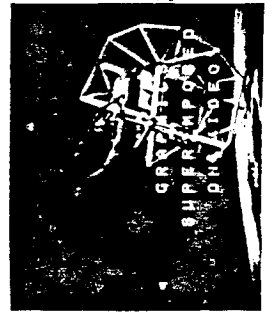
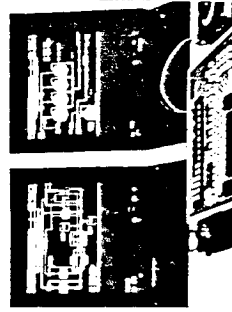
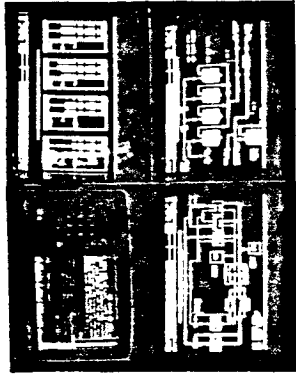
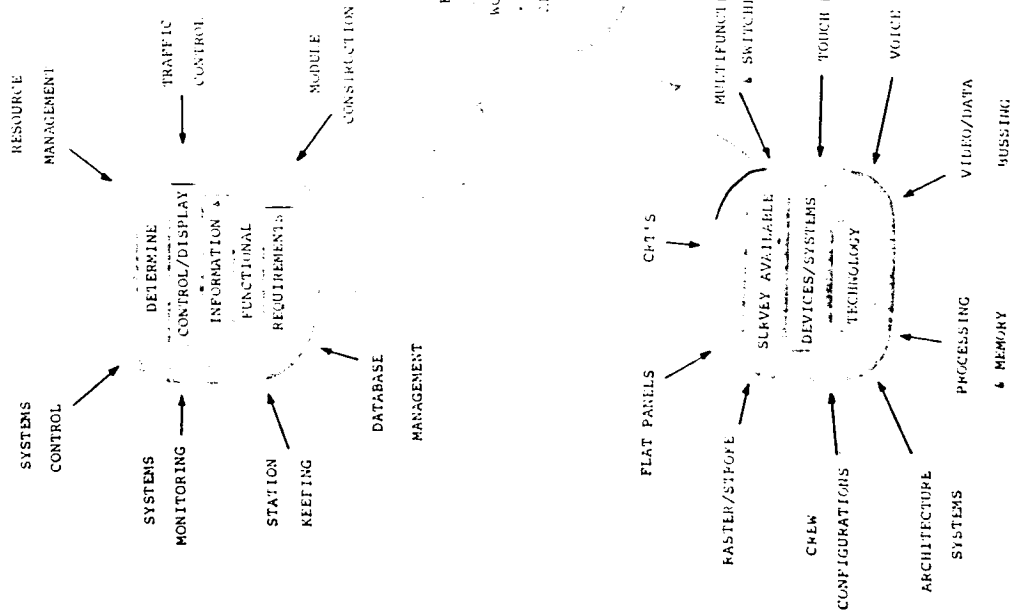


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ADVANCED INTERACTIVE CONTROL AND DISPLAY TECHNOLOGIES FOR SPACE STATION APPLICATIONS

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PROGRAM PLAN



LEFT-UP PROTOTYPE
 WORKSTATION FOR
 TECHNOLOGY DEMONSTRATION
 (UNIDENTIFIED TO LEFT)

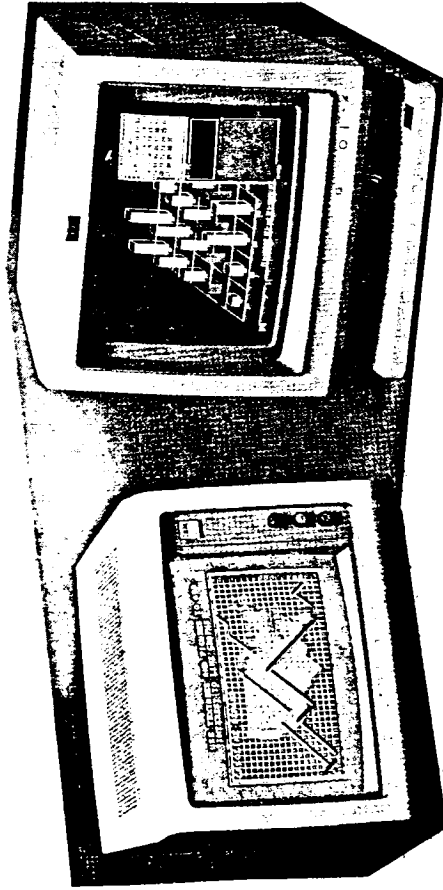
ELECTRONIC CONTROL/DISPLAY INTERFACE TECHNOLOGY

FY-85

- * ANALYZE FUNCTIONAL REQUIREMENTS
- * SURVEY/COMPILE CONTROL/DISPLAY TECHNOLOGY BASE INTO INTERACTIVE DATABASE (DELIVERABLE FY-87)
- * ASSEMBLE INTERIM WORKSTATION
 - PROCESSOR - VIDEO DISK
 - I/O DEVICES
- * SELECT APPLICATIONS FOR TECHNOLOGY DEMONSTRATIONS
 - OFFICE AUTOMATION
 - VIDEO DISK
 - VOICE I/O
 - SUB-SYSTEMS
 - MONITORING/CONTROL
 - TREND DATA ANALYSIS
 - FAULT DETECTION

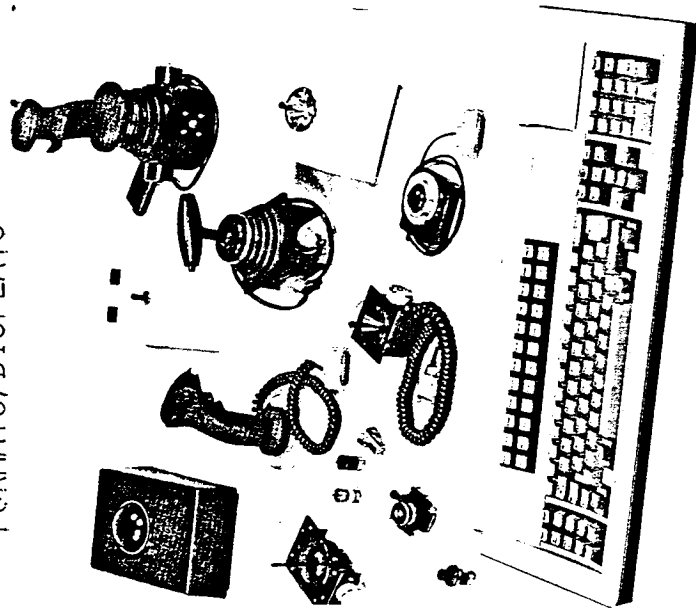
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ELECTRONIC CONTROL/DISPLAY INTERFACE TECHNOLOGY
INTERIM WORKSTATION FUNCTIONAL REQUIREMENTS



DISPLAYS

- * MINIMUM OF THREE FULL-COLOR, 13" OR 19", CRT'S
- * CONTROLLED DYNAMIC WINDOWING OF CONCURRENT DISPLAY FORMATS
- * CONTROLLED VIDEO SWITCHING OF FORMATS/DISPLAYS



INPUT/OUTPUT CAPABILITIES

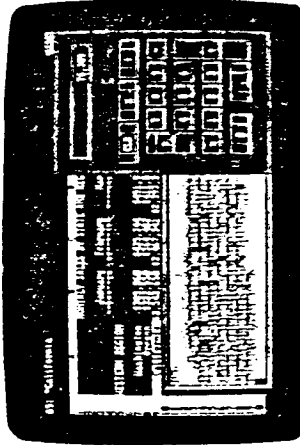
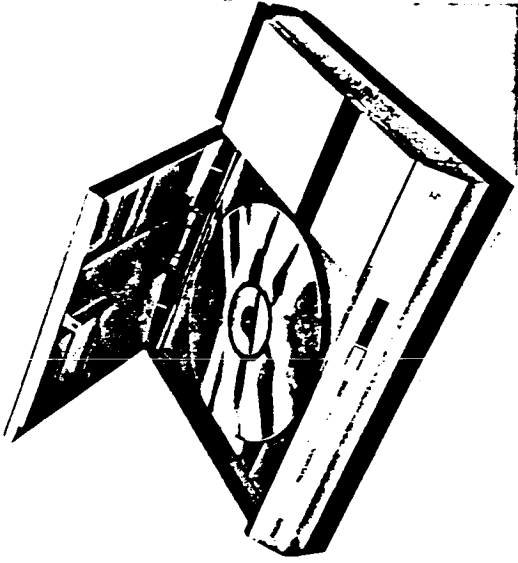
- * PDP'S
- * KEYBOARD
- * MINIATURE IMBEDDED TRACKBALL (WITHIN HAND-CONTROLLER)
- * CONVENTIONAL TRACKBALL
- * TOUCH OVERLAYS
- * VOICE RECOGNITION AND SYNTHESIS

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ELECTRONIC CONTROL/DISPLAY INTERFACE TECHNOLOGY
INTERIM WORKSTATION FUNCTIONAL REQUIREMENTS

VIDEO DISK UTILIZATIONS

- * PREVENTIVE MAINTENANCE,
UNPLANNED MAINTENANCE
- * TRAINING TUTORIALS



SUB-SYSTEM APPLICATIONS

- * MONITORING/CONTROL DEMONSTRATION
- * TREND DATA ANALYSIS/PREDICTION
- * FAULT DETECTION/ISOLATION DEMONSTRATION
- * TRAINING SIMULATIONS

OFFICE AUTOMATION FUNCTIONS

- * WORD PROCESSING
- * SPREAD SHEET
- * DATABASE MANAGEMENT
- * SCHEDULER
- * GRAPHICS PACKAGE



ELECTRONIC CONTROL/DISPLAY INTERFACE TECHNOLOGY

ARCHITECTURAL GOALS

- o DUAL DATA BUSES FOR FUNCTIONAL PARALLELISM AND SINGLE POINT DATA PATH FAILURE PROTECTION
- o DEDICATED MULTI-PROCESSORS FOR MAXIMUM EFFICIENCY, MAINTAINABILITY AND FLEXIBILITY
- o FAULT MONITORING AND AUTO-REPARTITIONING OF FAILED FUNCTIONS
- o MODULAR FOR EASE OF GROWTH AND ADAPTABILITY TO DESIGN CHANGES/ IMPROVEMENTS
- o NO PART REDUNDANCY
- o REASONABILITY LIMIT CHECK IN S/W ON CRITICAL PARAMETERS
- o INCORPORATES PRESENT TECHNOLOGIES AND IS ADAPTABLE TO EMERGING TECHNOLOGIES

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FOUR LEADING CANDIDATES FOR LARGE AREA DISPLAY

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PERFORMANCE CHARACTERISTIC	COLOR CRT	LCD	TFEL	LED
HIGH RESOLUTION	✓		✓	
LOW POWER CONSUMPTION		✓	✓	
COLOR CAPABILITY	✓			PARTIAL
LOW DEPTH BEHIND PANEL		✓	✓	✓
LOW VOLTAGE OPERATION		✓	✓	✓
VIDEO RATE ADDRESSING	✓	✓	✓	✓
ENVIRONMENTAL TOLERANCE	✓		✓	✓
MEAN-TIME BETWEEN FAILURE			✓	✓
INHERENTLY RUGGED		✓	✓	✓
GRACEFUL DEGRADATION		✓	✓	✓
COST				✓

INFORMATION MANAGEMENT TECHNOLOGIES: EMERGING I/O DEVICES

COMPONENT EVALUATION

CANDIDATE DEVICE EVALUATION

SUBSYSTEM INTEGRATION AND EVALUATION

DISCRETE LED TECHNOLOGY

LCD MATRIX TECHNOLOGY

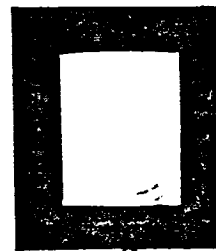
LED MATRIX TECHNOLOGY

TFEL/TOUCH TECHNOLOGY

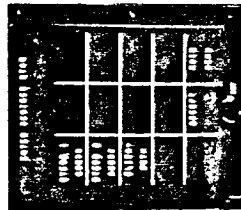
CRT/MTAS TECHNOLOGY



ICP



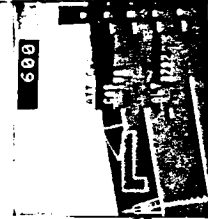
VGT



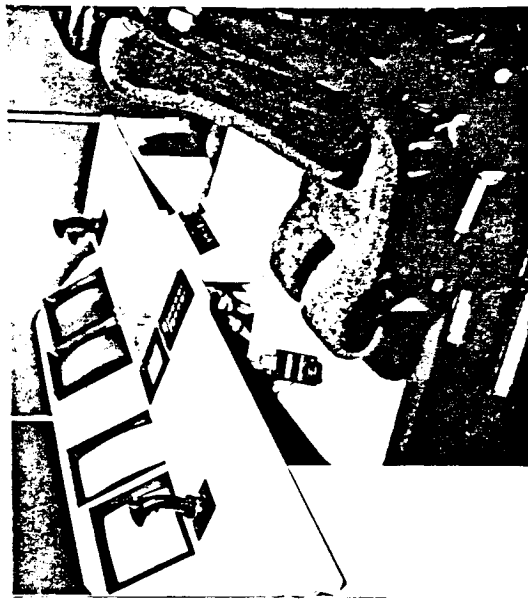
BOWMAR



PDPs (BOEING)



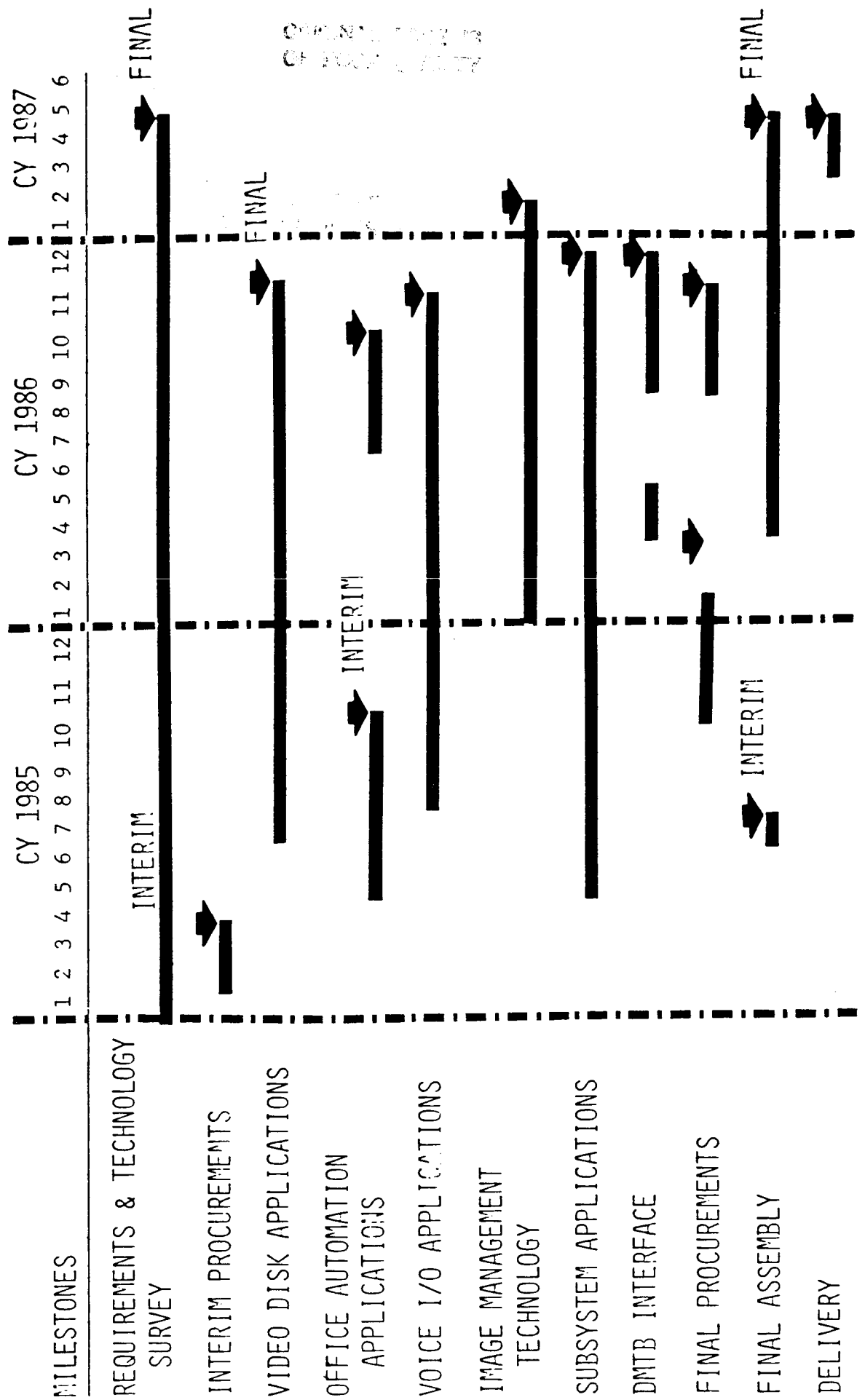
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INTEGRATED SUBSYSTEM EVALUATION IN AN OPERATIONAL CONTEXT

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ELECTRONIC CONTROL/DISPLAY INTERFACE TECHNOLOGY SCHEDULE



VIDEO DISC TECHNOLOGY

USES

- o INTERACTIVE TRAINING
- o INFORMATION STORAGE & RETRIEVAL
 - MAINTENANCE MANUALS
 - TROUBLESHOOTING PROCEDURES & DIAGNOSTICS
 - REPAIR PARTS MANUALS
 - VIDEO/DATA/AUDIO
- o VIDEO DATA HANDLING
 - GIGA BYTES OF ON-BOARD STORAGE
 - HIGH DATA RATES
 - LOW ERROR RATES

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VIDEO DISC TECHNOLOGY
(CONT.)

ADVANTAGES

o VIDEO DISC-BASED INTERACTIVE TRAINING VS. TRADITIONAL SELF-TAUGHT COURSES

- MORE POSITIVE STUDENT RESPONSES
- MORE PRODUCTIVE & EFFICIENT TRAINING

*- TRAINING ON ACTUAL EQUIPMENT IS SAME AS TRAINING ON VIDEO DISC (.001 CONFIDENCE LEVEL)

o INFORMATION STORAGE EXAMPLE: U.S. ARMY'S PATRIOT MISSILE SYSTEM

	CONVENTIONAL	VIDEO DISC
MANUALS	80,000 PAGES	3 DISCS 54,000 FRAMES PER DISC 1 FRAME PER 5 PAGES
WEIGHT	300 LBS.	30 LBS. (INCLUDING PLAYER & COMPUTER)

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VIDEO DISC TECHNOLOGY

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OVERALL BENEFITS

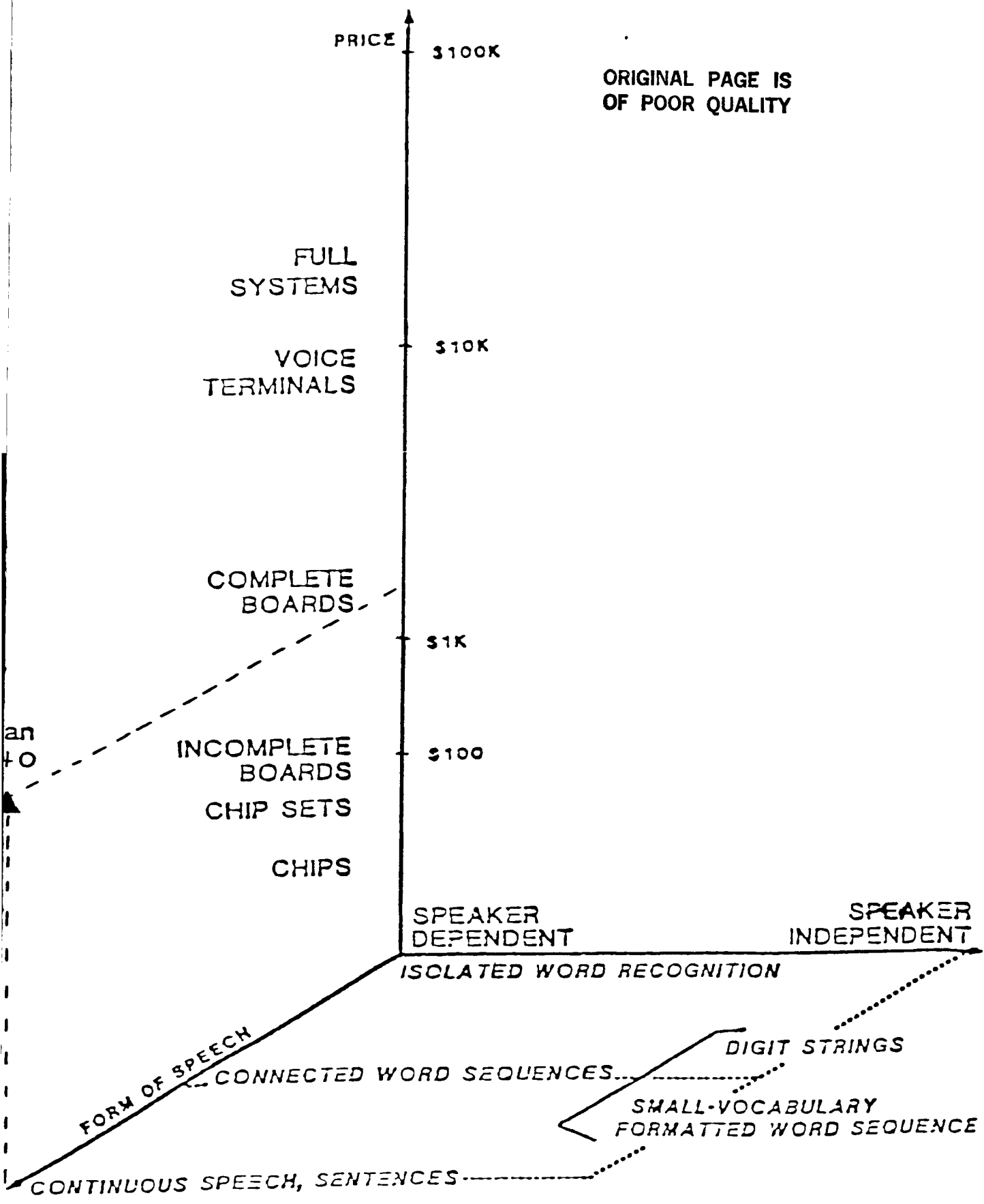
- o INCREASE IN STORAGE CAPACITY/DECREASE IN SPACE & WEIGHT & COST
- o COMBINED STORAGE (SINGLE MEDIA) OF VIDEO/AUDIO/DIGITAL-DATA ON ONE STORAGE MEDIUM
- o INTERACTIVE CAPABILITY

POTENTIAL BENEFITS

- o IMPROVED STORAGE RELIABILITY & LIFE-SPAN
- o REDUCTION IN MAINTENANCE OVERHEAD
- o SIMULATION OF OPERATIONAL SYSTEMS

COMMERCIAL SPEECH RECOGNIZERS

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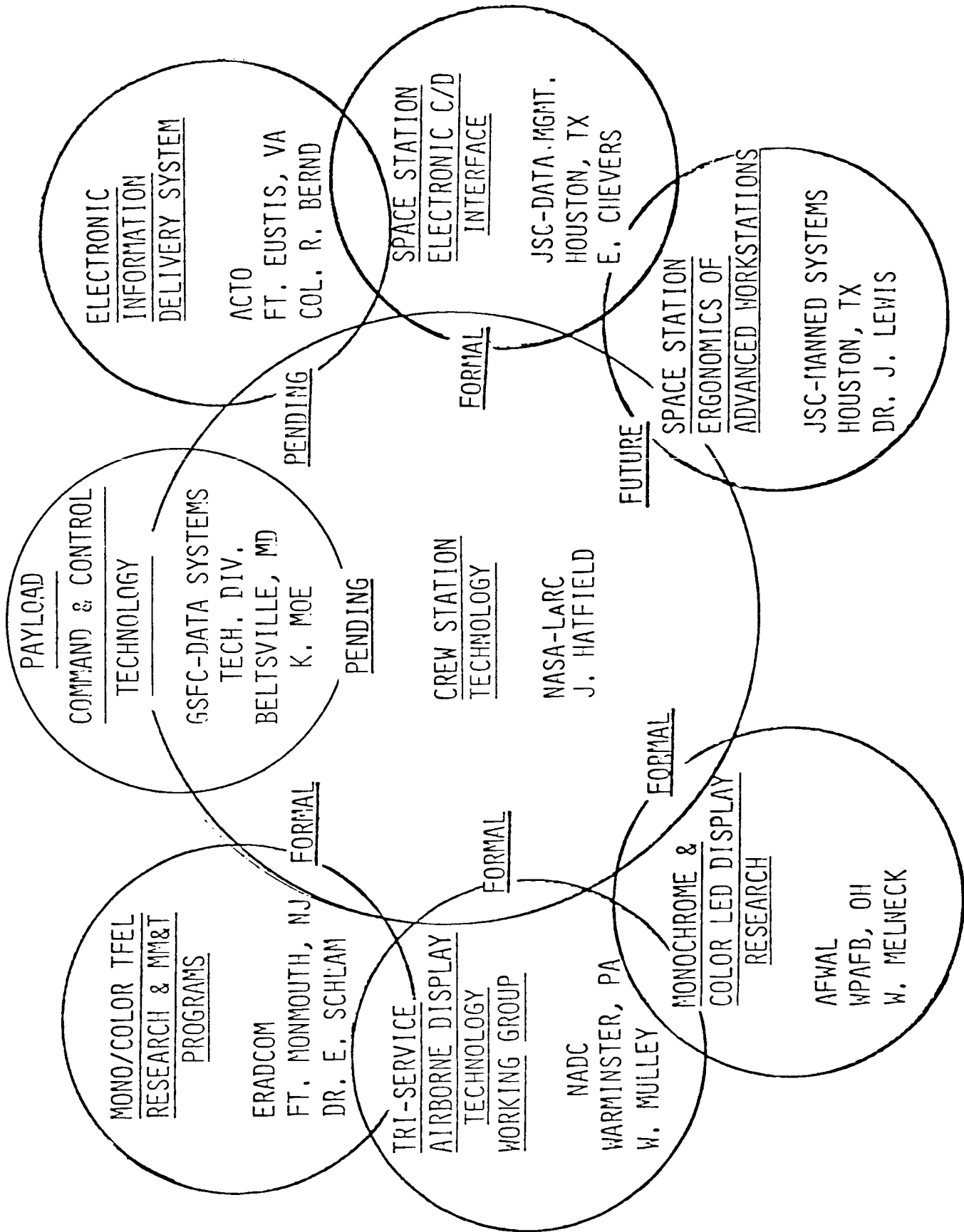
ELECTRONIC CONTROL/DISPLAY INTERFACE TECHNOLOGY

FY-86

- * SURVEY/COMPILE CONTROL/DISPLAY TECHNOLOGY BASE INTO INTERACTIVE DATABASE (DELIVERABLE)
- * DEVELOP APPLICATIONS
 - VIDEO DISK
 - MAINTENANCE
 - TROUBLESHOOTING
 - TUTORIAL
 - VOICE CONTROL/RMS VIEWS
- * DEVELOP IMAGE MANAGEMENT SYSTEM
 - VIDEO BUS/SWITCHING
 - CONTROL TECHNIQUES
- * DETERMINE JSC INTERFACE REQUIREMENTS
- * SELECT/PROCURE FINAL WORKSTATION COMPONENTS (DELIVERABLE FY-87)
- * INCORPORATE LARGE-SCREEN FLAT PANEL
 - MONOCHROME
 - BORROWED, FOR DEMONSTRATION ONLY

FY-87

- * FINAL ASSEMBLY
 - HARDWARE
 - SOFTWARE
- * DELIVERY TO JSC DATA MANAGEMENT TESTBED
- * DOCUMENT WORKSTATION AND RESEARCH FINDINGS



S P A C E S T A T I O N W O R K S T A T I O N T E C H N O L O G Y

RESOURCES SUMMARY

<u>FUNDING</u>	<u>FY '81</u>	<u>FY '82</u>	<u>FY '83</u>	<u>FY '84</u>	<u>FY '85</u>	<u>FY '86</u>	<u>FY '87</u>
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R & T BASE

CREW STATION TECHNOLOGY	\$1066K	\$775K	\$461K	\$392K	\$396K	\$359K	\$500K
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FOCUSED TECHNOLOGY

ELECTRONIC CONTROL/
DISPLAY INTERFACE TECH.

\$175K	\$120K	\$120K	\$120K
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ERGONOMICS OF ADVANCED
WORKSTATIONS

-0-	\$120K	\$80K
<u>\$175K</u>	<u>\$240K</u>	<u>\$200K</u>

LARC DIRECT MAN-YEARS

CREW STATION TECHNOLOGY	8.7 MY	13.4 MY	11.0 MY	11.4 MY	15.3 MY	15.0 MY	15.5 MY
FOCUSED TECHNOLOGY					3.0 MY	4.5 MY	4.0 MY

S U M M A R Y

- o EFFORT WILL PRODUCE A REPRESENTATIVE WORKSTATION FOR THE DATA MANAGEMENT TEST BED THAT PROVIDES:
 - MAN/MACHINE INTERFACE DESIGN OPTIONS FOR CONSOLIDATING, AUTOMATING, AND INTEGRATING
 - HARDWARE/SOFTWARE TECHNOLOGY DEMONSTRATIONS OF SPACE STATION APPLICATIONS
 - ADDITIONS TO THE OVERALL KNOWLEDGE BASE OF MAN/MACHINE INTERFACE DESIGN METHODOLOGIES.
- o WORKSTATION WILL EMPHASIZE:
 - ADVANCED GRAPHICS ENGINE
 - ADVANCED DISPLAY/CONTROL MEDIAS
 - IMAGE MANAGEMENT TECHNIQUES
 - MULTIFUNCTION CONTROLS
 - VIDEO DISC UTILIZATIONS

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