COCKPIT AVIONICS INTEGRATION AND AUTOMATION

Keith M. Pischke
Honeywell Inc.

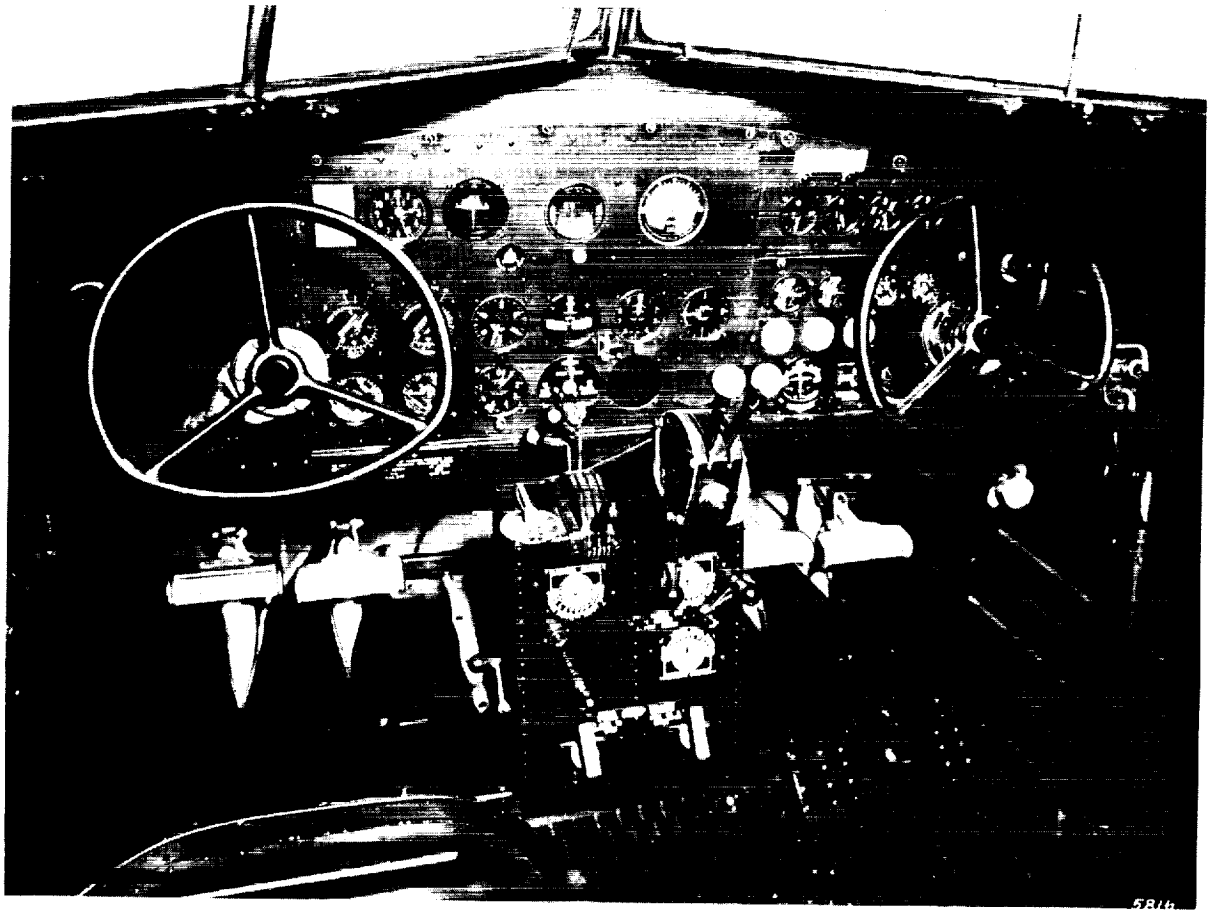
Integration

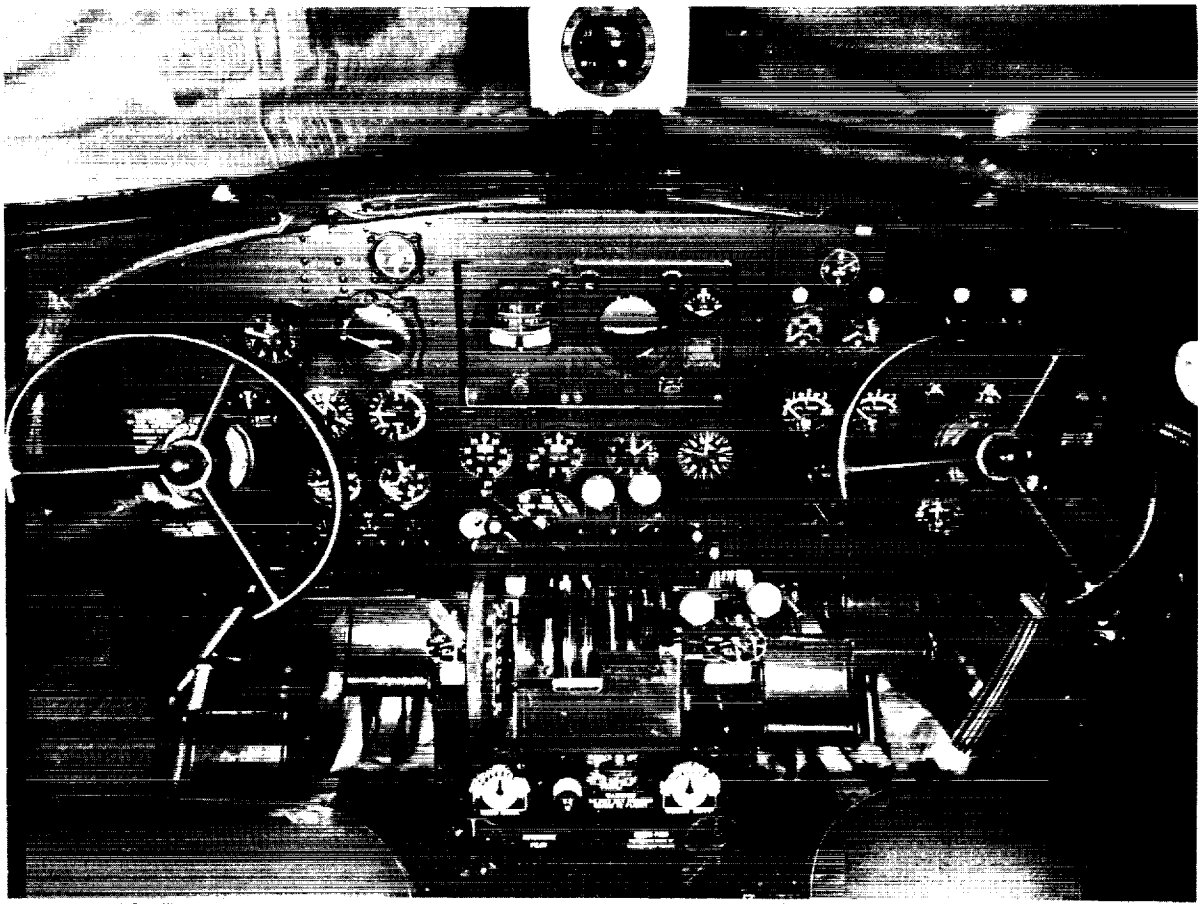
What is it Really?

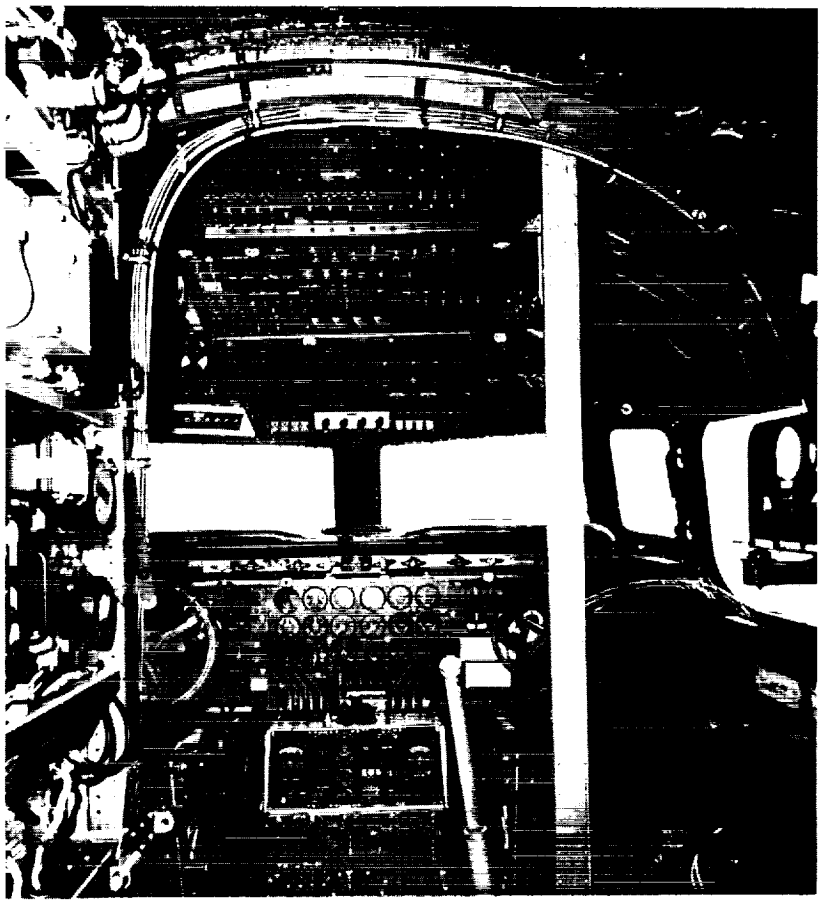
- The act of forming, coordinating, or blending into a functioning or unified whole.

Merriam-Webster

How does integration apply to Cockpit Avionics? . . . .

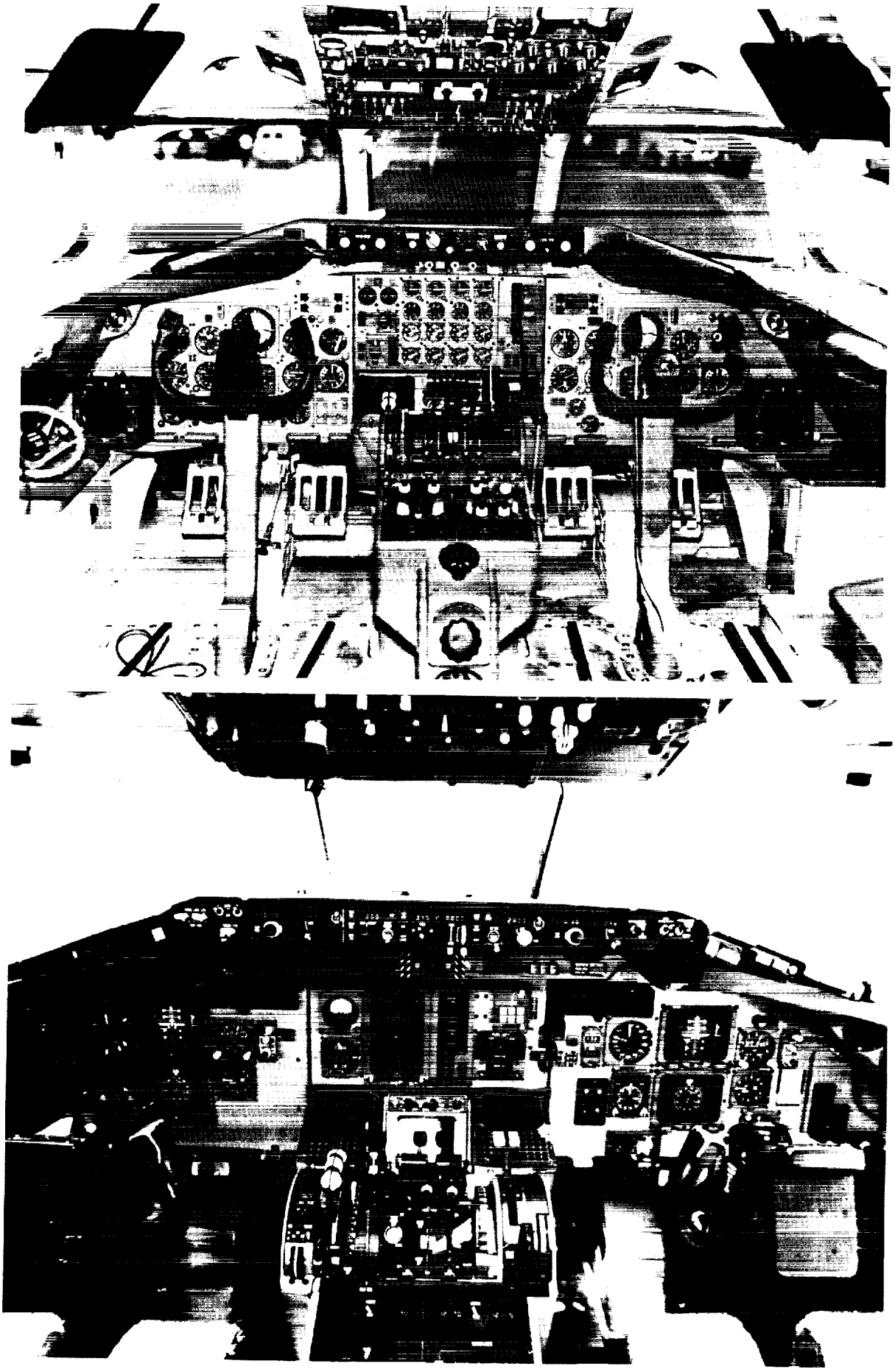






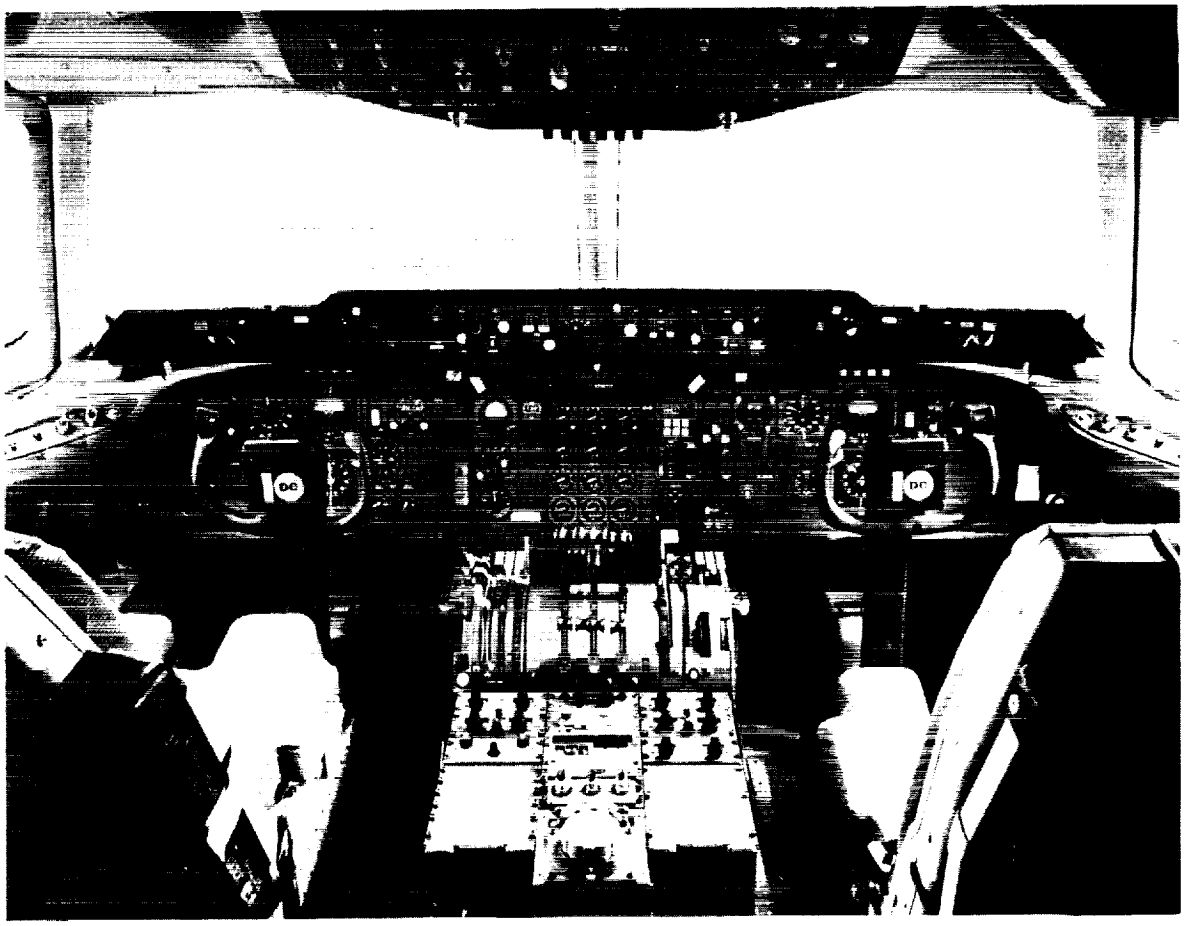
ORIGINAL PAGE
BLACK AND WHITE PHOTOGRAPH

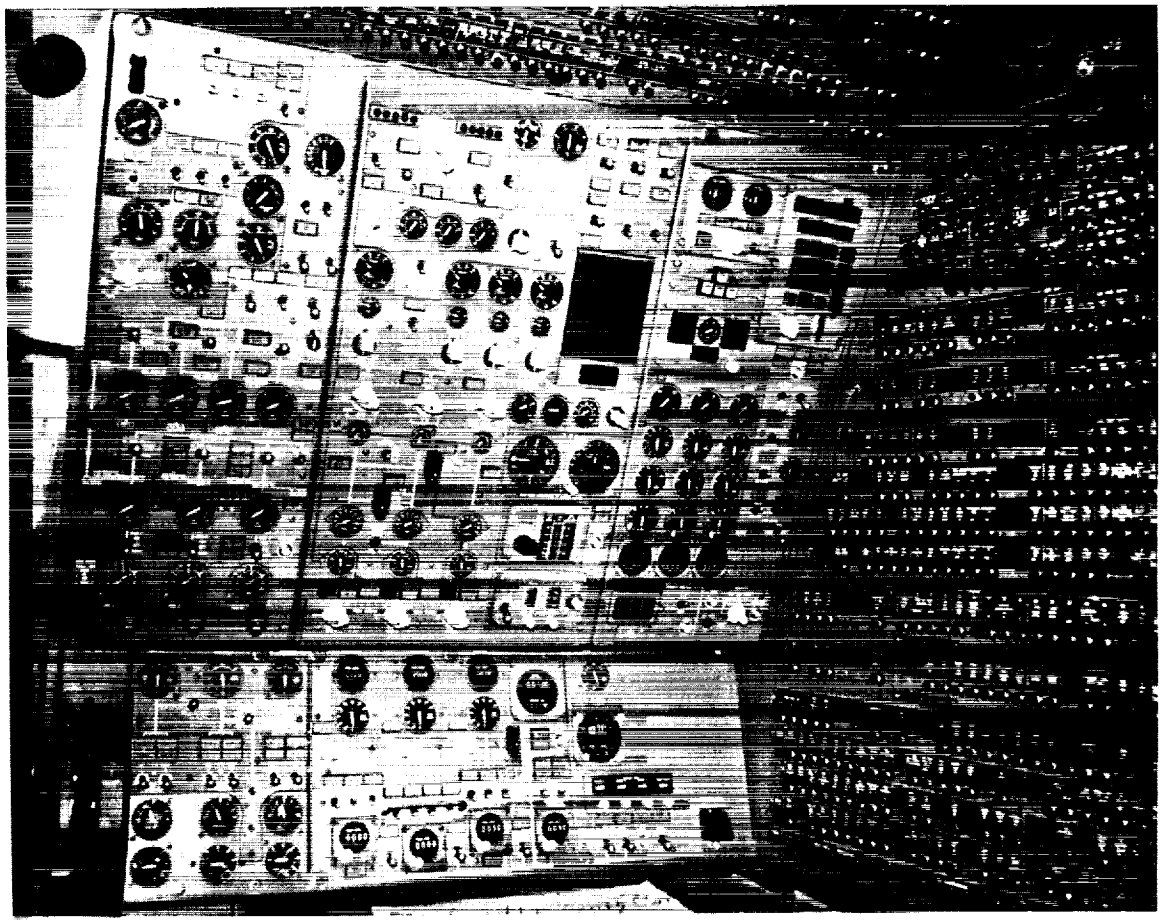
ORIGINAL PAGE IS
OF POOR QUALITY



ORIGINAL PAGE
BLACK AND WHITE PHOTOGRAPH

ORIGINAL PAGE IS
OF POOR QUALITY



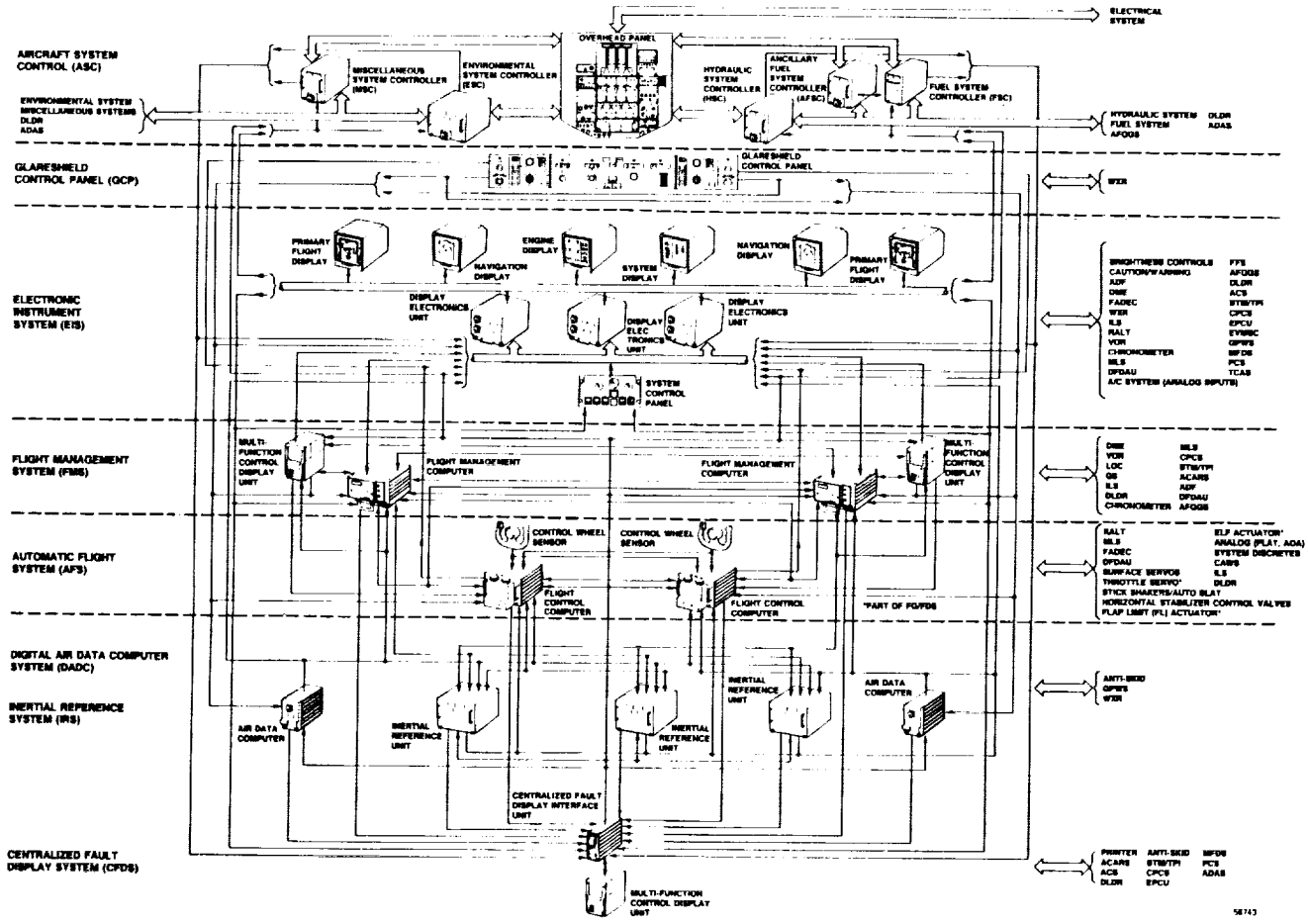


Benefits of Cockpit Integration

- Reduced pilot work load
- Increased system redundancy
- Increased maintainability
- Greater design flexibility for aircraft manufacturer
- Greater design flexibility for equipment manufacturer

MD-11 Flight Guidance/ Flight Deck System (FG/FDS) Overview

Flight Guidance/Flight Deck System



MD-11 Flight Guidance/Flight Deck System
Honeywell System Summary

- 44 Line replaceable units (LRUs) per shipset
- 28 Different LRU types
- 48 Microprocessors per shipset
- 8 Different types of processors
- 1.5 Million total words of software
- 175 ARINC 429 type buses
- 8 Different ARINC data protocols
- 14 Other signal types

Honeywell Approach to Avionics Systems Integration

- Goals
- Tools and techniques

Honeywell Approach

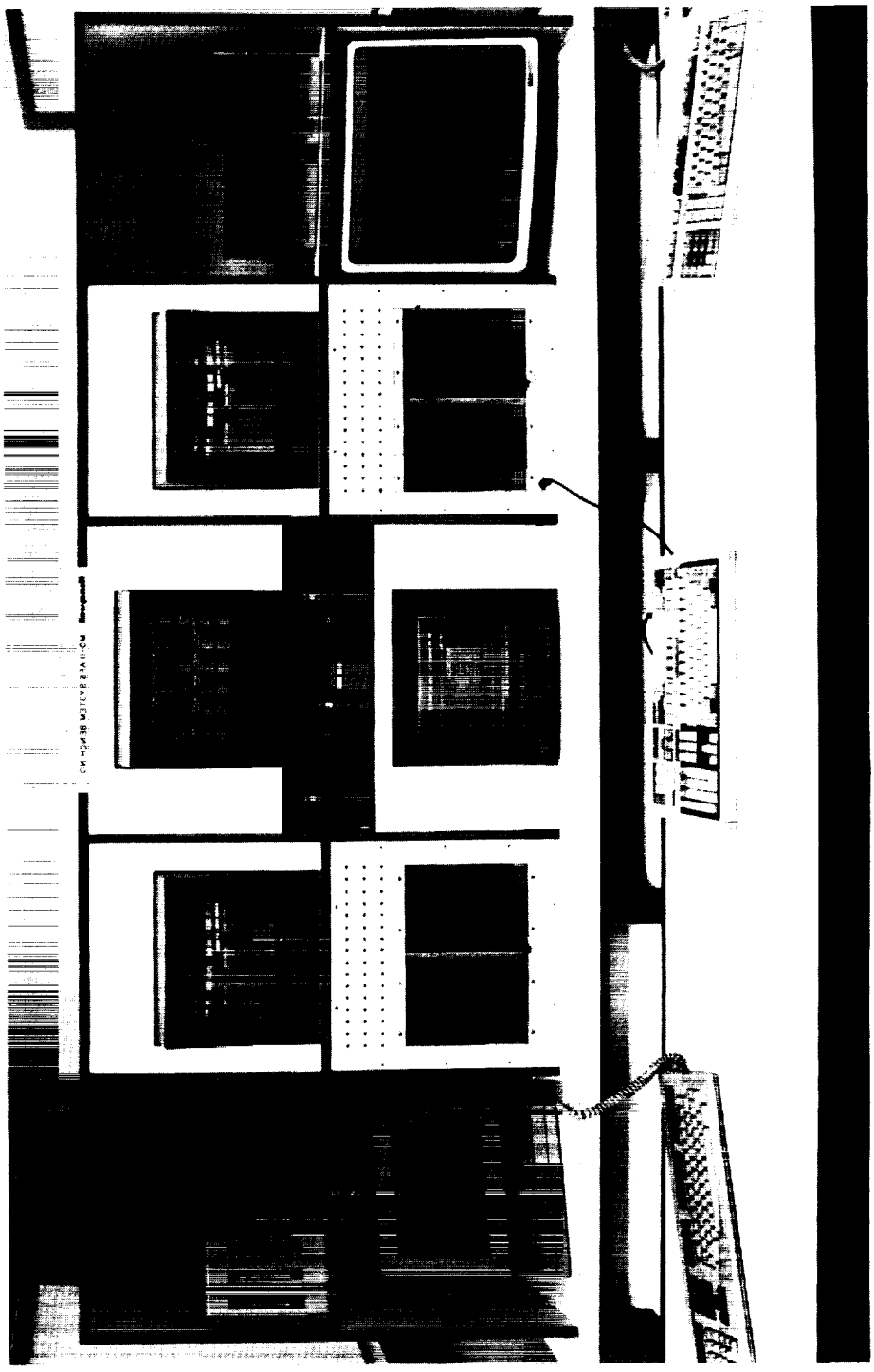
Goals

- Develop systems that are safe and meet regulatory agency requirements
- Develop systems that optimize the operation of the aircraft
  - For the pilots - Passengers - Operators - Mechanics
- Develop, test, and certify systems on schedule at a reasonable cost
  - Minimize interface problems
  - Reduce on-aircraft development, test, and demonstration time
  - Identify and correct system problems early

Tools and Techniques

- Team approach with airframe manufacturer
  - Joint development of system architecture and system analyses
  - Use of combined systems experience-airframe/avionics
- Systems integration organization
  - Coordinate top level system design
  - Enhance communication internal/external
  - Coordinate solutions to common design problems
  - Coordinate solutions to problems involving multiple systems
  - Perform top level system testing
  - Provide flight test and flight operations support
- System level test facilities
  - Subsystem test benches
  - Subsystem validation facilties (VALFAC)
  - Integration validation facility (VALFAC)

MD-11 AFS System Bench

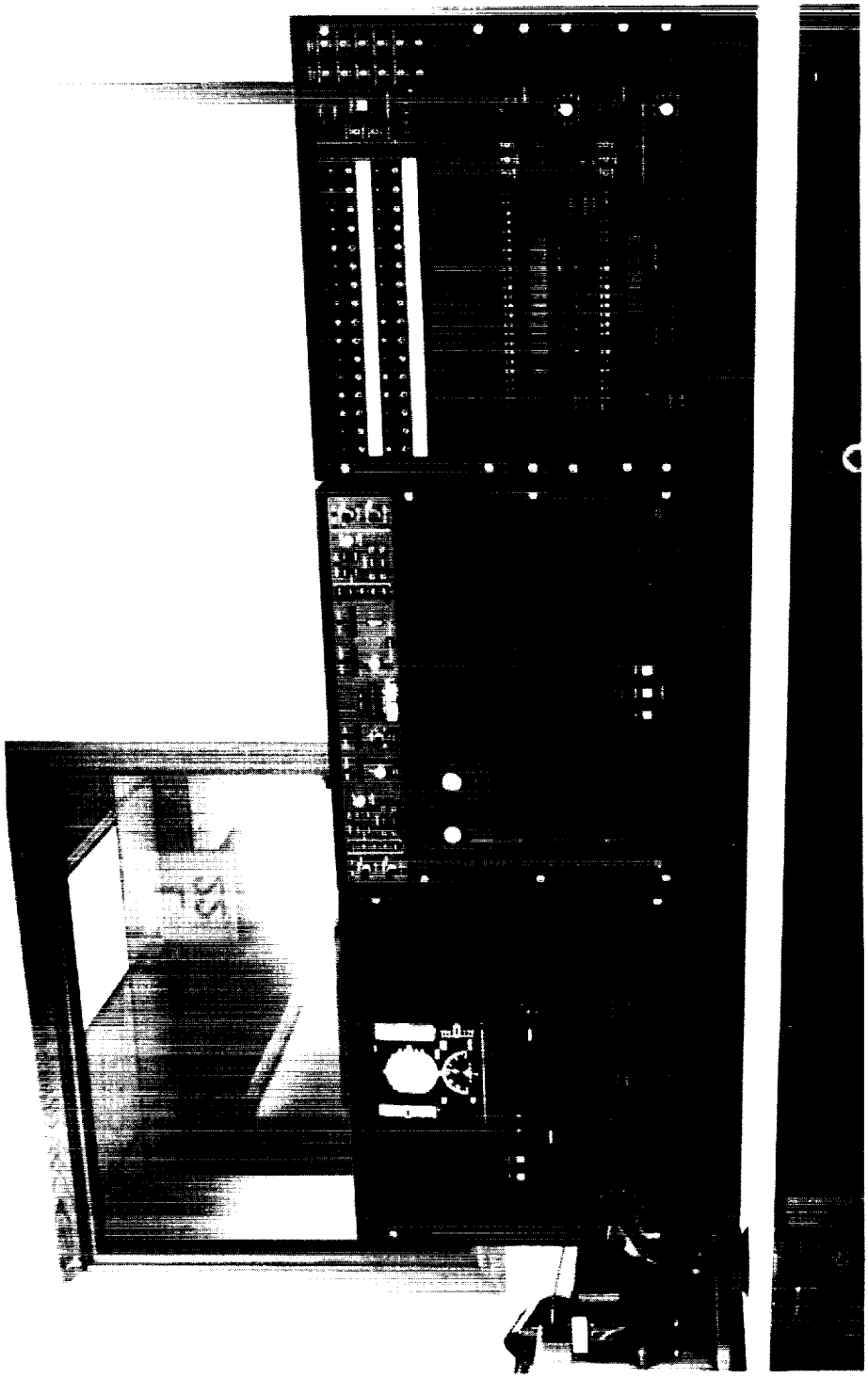


ORIGINAL PAGE
BLACK AND WHITE PHOTOGRAPH

ORIGINAL PAGE IS
OF POOR QUALITY

ORIGINAL PAGE
BLACK AND WHITE PHOTOGRAPH

MD-11 AFS Subsystem VALFAC



ORIGINAL PAGE IS
OF POOR QUALITY

MD-11 Integration VALFAC

Cockpit Avionics Integration
Conclusions

- Level of integration in cockpit avionics has increased significantly in recent years
- Benefits of integration are readily apparent in modern aircraft cockpits
- Approach to avionics system design must change in order to take full advantage of system integration
- Different types of test facilities/test procedures are required for integrated systems
- Changes in aircraft manufacturer/avionics system supplier relationship likely

Cockpit Avionics Integration

What are the effects on Cockpit Automation? . . . .

Automation

What is it Really?

- Automatically controlled operation of an apparatus, process, or system by mechanical or electronic devices that take the place of human operators.

Merriam-Webster

- How does this apply to Cockpit Avionics? . . . .

MD-11 Cockpit Automation

Typical Aircraft System	MD-11 System
Autopilot Flight Director Auto Throttle	Auto Flight System
Compass System (slaved) Auto Nav - Lateral Auto Nav - Vertical Performance (Auto Speed)	Flight Management System
Attitude Director Indicator Horizontal Situation Indicator Engine Instruments Aircraft Alerts	Electronic Flight Instrument System
Fuel System Hydraulic System Environmental System Electrical System	Aircraft System Controllers

MD-11 ASC Hydraulic System Functions

- Pre-flight
  - -Pressure test (manually initiated)
  - -Engine-driven pumps test
- Normal
  - -System operation monitor
- Abnormal
  - -Fault isolation and system reconfiguration

MD-11 ASC Fuel System Functions

- Pre-flight
  - -Test
- Normal
  - -Fuel schedule
  - -Tail fuel management/CG control
  - -Fuel circulation to prevent freezing
  - -Wing fuel balance
  - -Forward pump control
  - -Ballast fuel management
- Abnormal
  - -Fuel dump monitor
  - -Manifold drain
  - -Outboard tank monitoring (trapped/premature transfer)
  - -Tank overfill
  - -Component failure accommodation

MD-11 ASC Environmental System Functions

- Pre-flight
  - -Test
- Normal
  - -Engine start configuration
  - -Bleed air limit
  - -Manifold pressurization
  - -Take-off mode control
  - -Economy mode
- Abnormal
  - -Failure reconfiguration
  - -Manifold failure

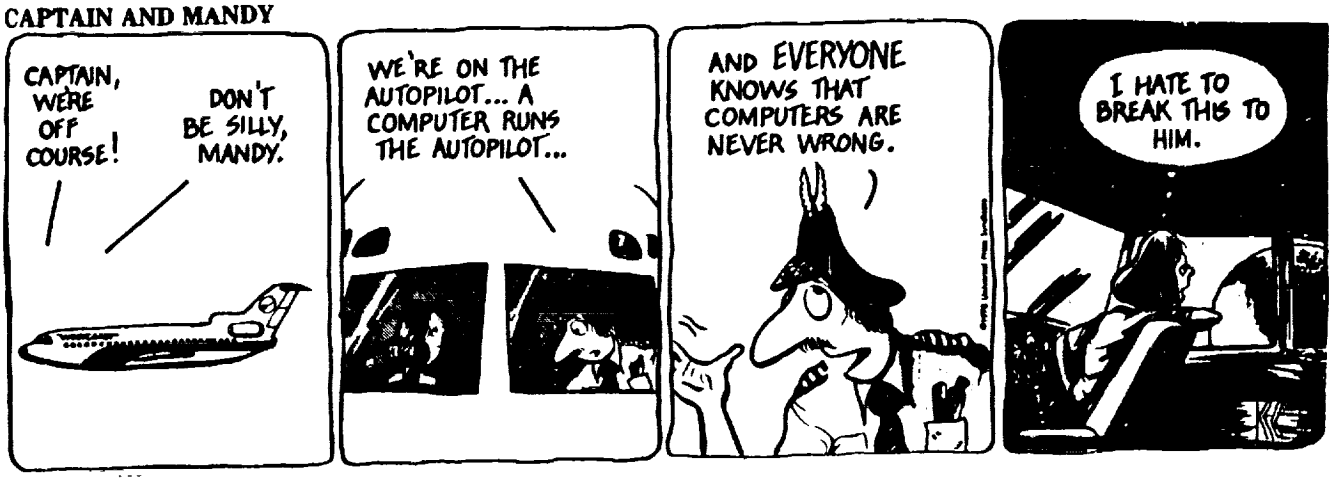
MD-11 ASC
Miscellaneous System Functions

- Pre-flight
  - -Cargo fire test
  - -Cargo doors test
  - -Air data heaters test
  - -Emergency lights battery test
- Normal
  - -Engine start control
  - -Auto ignition
  - -Cargo fire agent timing
  - -APU/CFDS interface
  - -APU shut down, on/off control
- Abnormal
  - -Pilot heat fault recovery

Cockpit Automation Concerns

- Crew awareness – does pilot need to know
- Crew work load
- Fail safe design
- Compatibility with existing operational environment
- Certificability

CAPTAIN AND MANDY



Cockpit Automation Conclusions

- Automation is unavoidable
- Automation is beneficial
- Cockpit designs must address operational/ human factors concerns
- Pilot is ultimately responsible for aircraft/ passenger safety. He must be able to do his job.