SEXTANT AVIONIQUE

VDO Luftfahrtgerätewerk GmbH

Modern Display Systems

Principles, Solutions and New Approaches

The cockpit of an airplane/helicopter is designed to fulfill different tasks:

- control of motion and position of the airplane in the space
- control and changing of flight situation
- control of the status of the plane
- communication with internal and external systems

Due to the evolution of technology there are new systems available, which lead to new requirements and possibilities for the cockpit design. The time period between the introduction of new systems decreases dramatically, so the cockpit concept must be as flexible as possible, to avoid a redesign for the introduction of new functions.

Today the cockpit may be called an "information center". The basic function of flying has been pushed to the background. Now the scanning and control of the subsystems is the main task. This gives new requirements for the design of a cockpit.
The increase of information, which has to be presented to the crew, leads to new definitions of the necessary instruments in the cockpit. Today it is impossible to present all available information of a plane at the same time and at the same level. This would lead to an overload of the crew and even the available display area would not be sufficient. The solution for this problem is a reduction in the displays to necessary and relevant informations. Intelligent computer systems have the task to preselect informations and to react according the actual situation. This means a very complex man-machine-interface (MMI), which must be designed to meet the requirements of the crew.

This system has to support the crew and to give the right information in the adequate form at the right time. Interactivity is needed to enable the crew to get additional information on request. The needs of mission control will lead to former requirements for interactive input possibilites.

Evolution of Cockpit Instrumentation

1. Dedicated Instruments
- direct link from signal source to indicator
- classic dial instrumentation
- loss of signal or indicator leads to loss of one information
- today still used for redundand "back up" instrumentation

2. Glass Cockpit
- general purpose displays
- signals connected to data concentrators
- bus systems (ARINC, MIL 1553)
- introduction of ECAM (Electronic Centralized Aircraft Monitor)
- introduction of navigation display (ND) with weather radar (WXR)

3. Interactive System (improvement of 2.)
- keypanel around the displays (touch panel)
- future requirements > joystick ?
- weapon delivery
- mission planning

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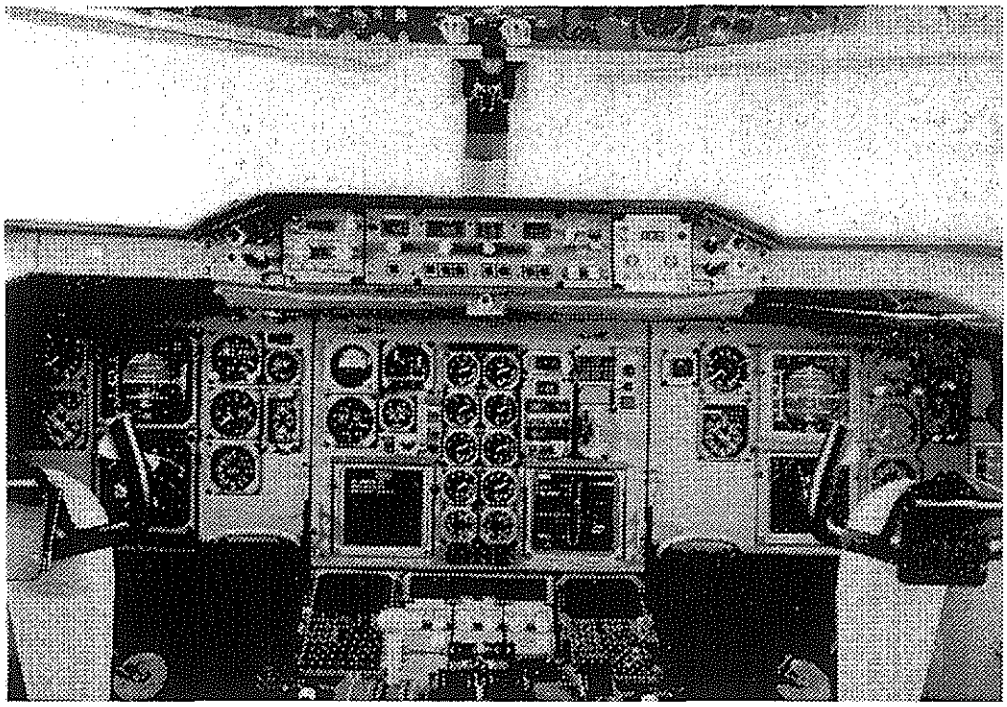
Evolution of Cockpit Instrumentation

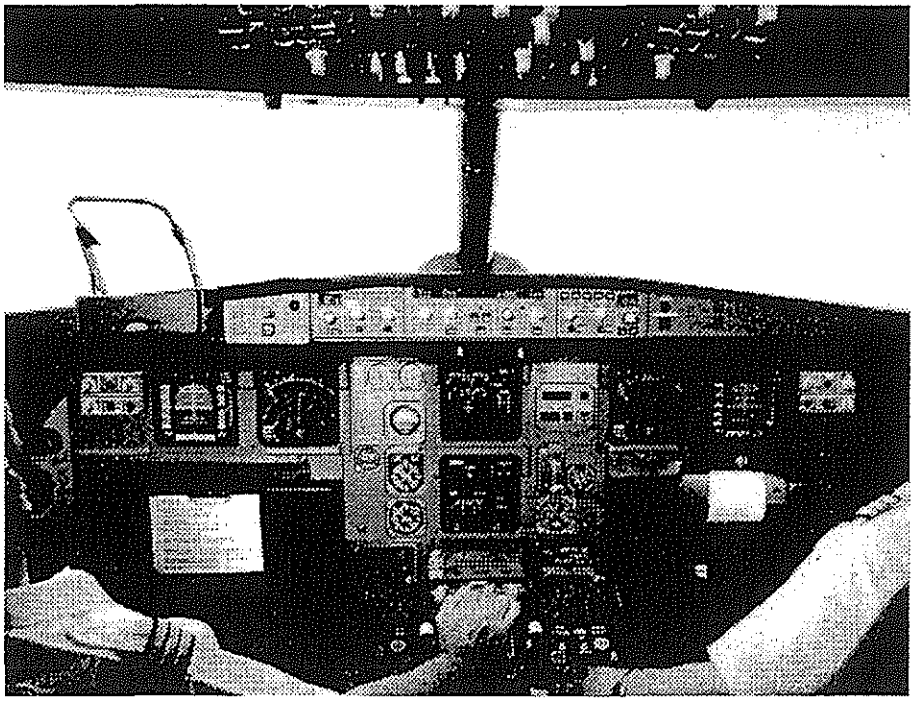
1. Airbus A310
- first airplane with glass cockpit
- six color CRT displays (first color display in a plane)
- complete set of classic instruments in addition
- ARINC bus system
- due to introduction of ECAM obsolence of flight engineer

2. Airbus A340
- six color CRT displays
- ARINC bus system
- only backup instruments left

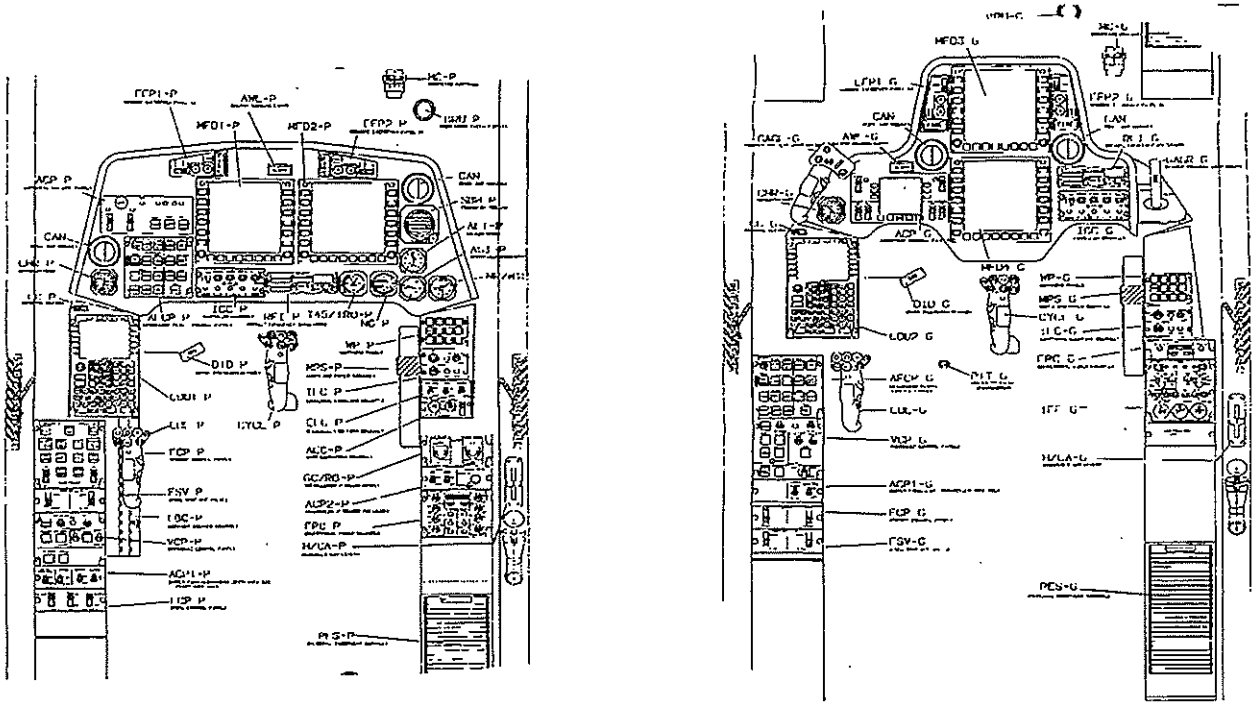
3. PAH2 - TIGER
- two separate cockpit
- each with two color LCD
- MIL bus system
- video picture (FLIR)
- keypanel around the displays
- few backup instruments (only in front cockpit)



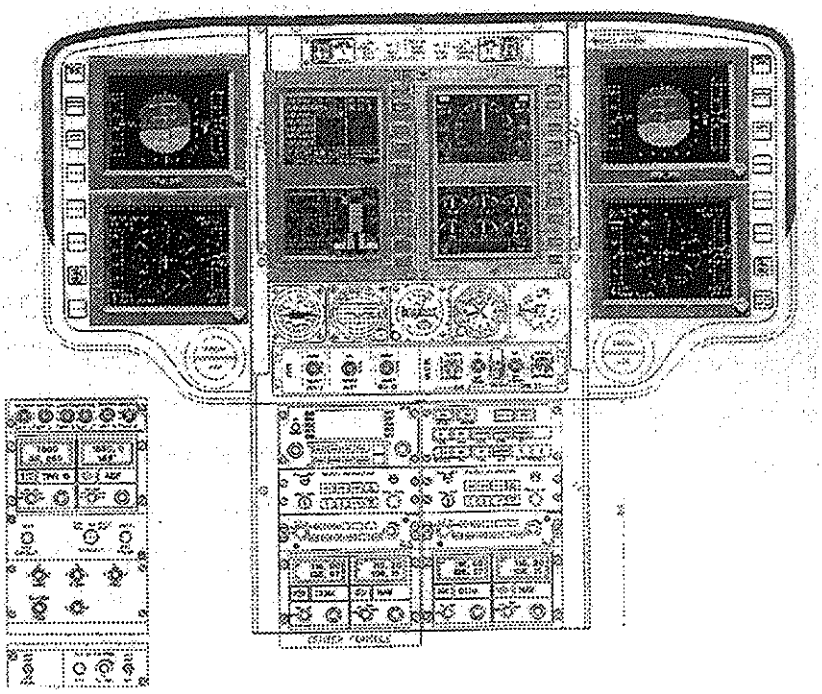
Cockpit of AIRBUS A310



Cockpit of AIRBUS A320/340



Cockpit of PAH2 - TIGER (Pilot - Gunner)



Cockpit Design of Avionique Nouvelle (AN)

Avionique Nouvelle (AN)

- program for new avionic structure in helicopters (sponsored by the french governement
- first applications in EC120 and EC135
- modular concept
- EFIS - ECAM concept
- general purpose smart color LCD (including symbol generator)
- ARINC bus interconnection
- video capability
- reconfiguration by permanent BIT
- redundancy available
- integration of control panels and keypanels
- data concentrator for additional systems

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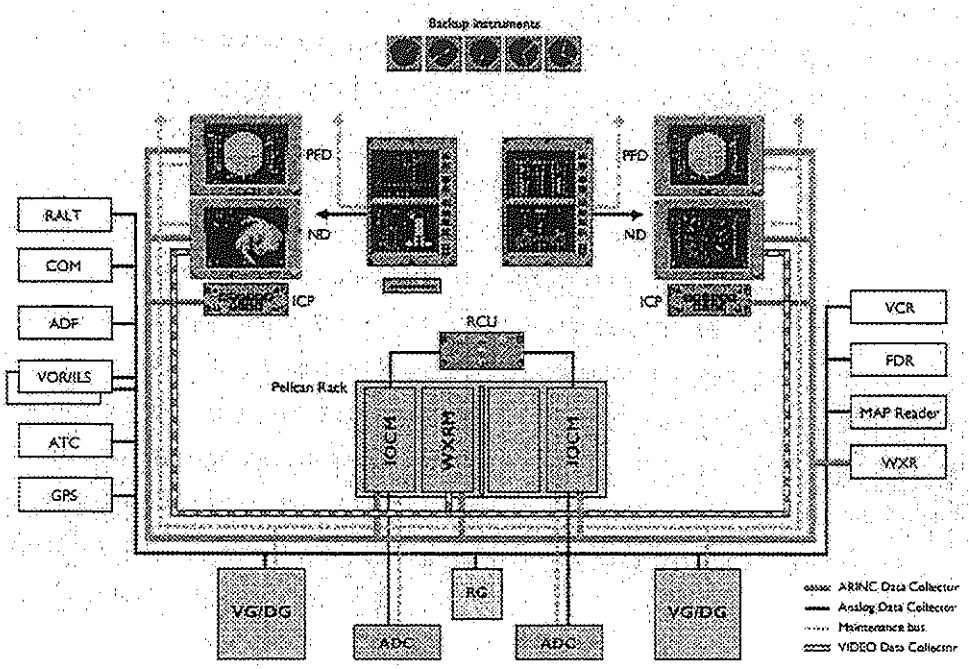
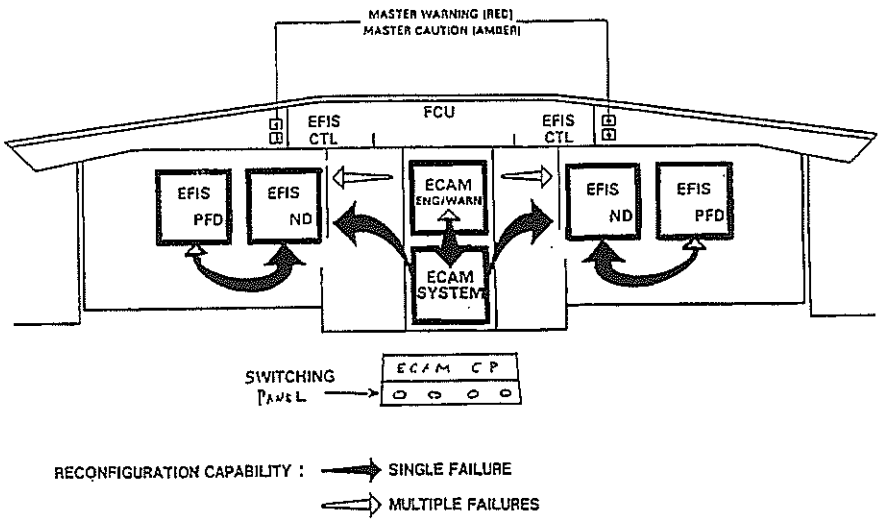


Example of system structure for Anionique Nouvelle (AN)

A320 E.I.S. N° 465.170/84 APRIL 84

DU'S RECONFIGURATION



Principle of display reconfiguration of AIRBUS A320

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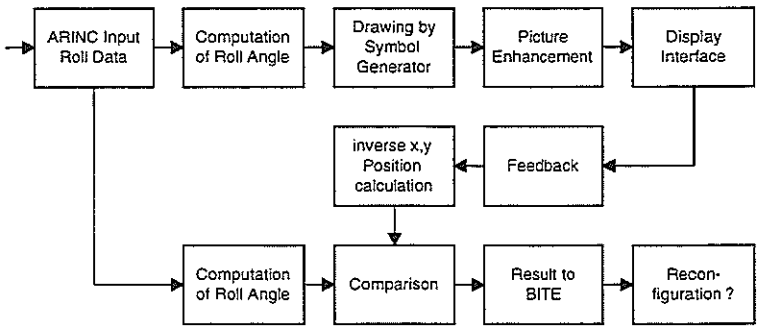
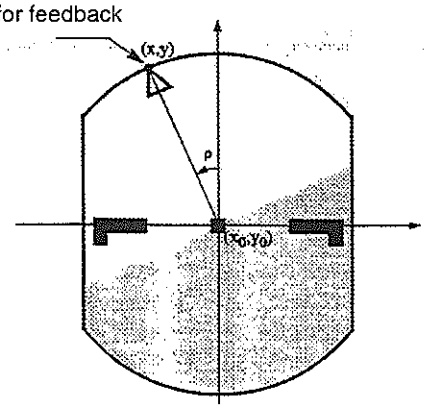


x,y position for feedback



Principle of parameter feedback

Stroke - Raster

Stroke (Symbology)
- low writing speed (high brightness on CRT)
- no aliasing effect on display
- drawing of area not effective (time consuming)

Raster (video sources)
- high writing speed (low brightness on CRT)
- flickering on CRT (frequency of video norm and phosphor physics)
- aliasing effects with symbology

Consequence
- bright raster display needed
- storage effect in display necessary
- stroke-raster conversion necessary
- antialiasing necessary
- LCD with "new" electronics

Types of Display

Head Down Display (HDD)
- flight control and system information
- Electronic Flight Instrument System (EFIS)
- Electronic Centralized Aircraft Monitoring (ECAM)
- bright and colored picture (CRT or LCD)
- problems with NV systems

Head Up Display (HUD)
- for take off and landing
- weapon control
- projection of informations as overlay on outside view
- monochrome (green) picture on CRT (or LCD)
- FLIR information

Helmet Mounted Display (HMD)
- flight control, system information and weapon delivery
- FLIR picture as overlay to outside view
- visor projection (CRT)
- detection of head movement
- control of FLIR camera by head movement

Helmet Mounted Display with Visor Projection and NV capability for TIGER

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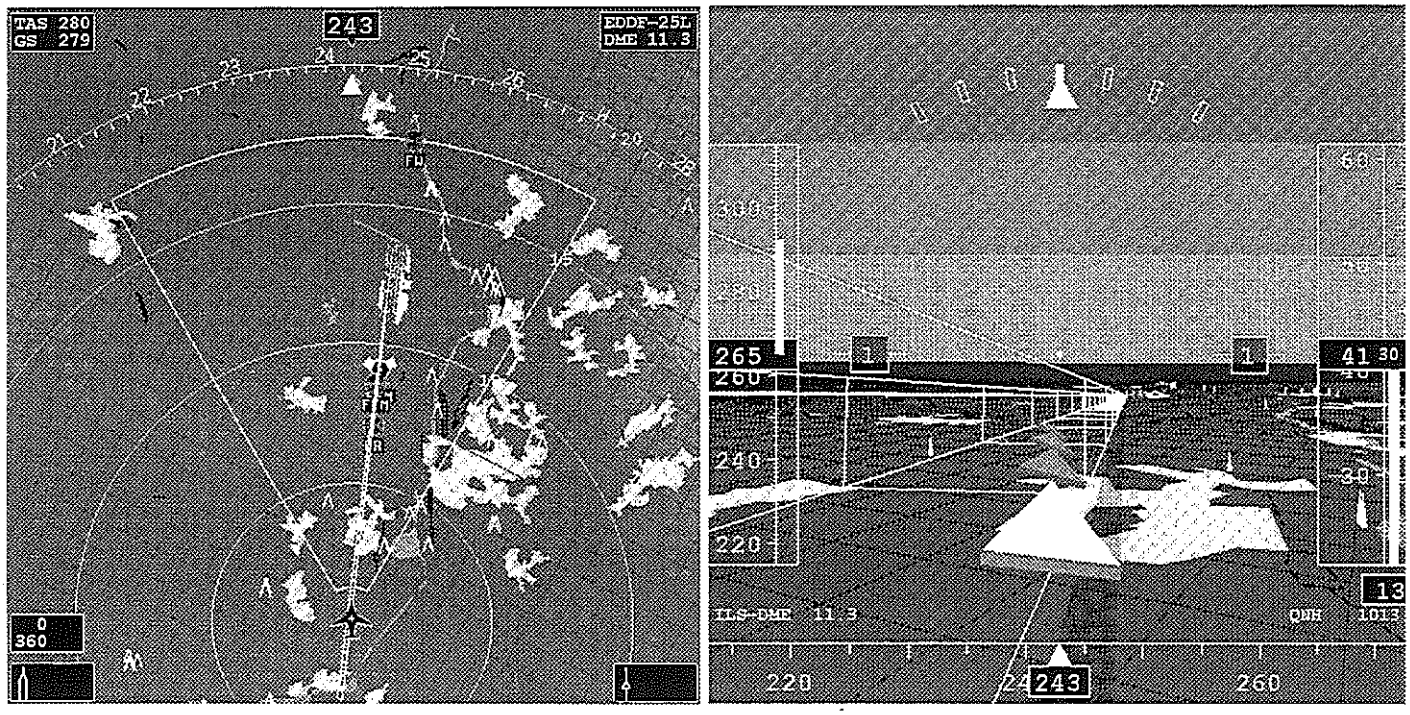
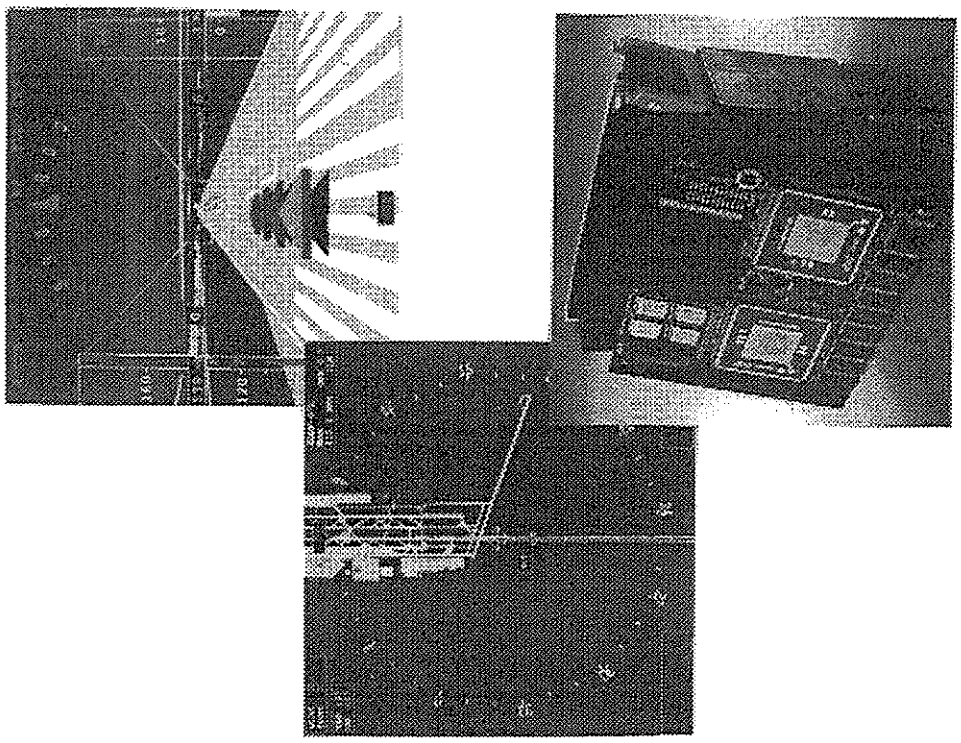
Future 3D System

- display of terrain in 3D
- overlay of attitude information
- overlay of system information
- flight guidance under bad weather conditions and low level
- digital data base necessary for terrain data and flight informations
- computer and graphic systems with real time performance required
- bright raster color display necessary (LCD)
- investigations for MMI very important



Examples for Display Formats on Future 3D Systems



Available 3D System Modul with C40 DSP and VDO ASICs