

Cockpit Displays:

"steamgauges" and "glass"

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#### **Evolution of the Flight Deck**



- Early instrumentation located on panel whereever the designer found space
- England 1940ies: definition of **Basic-T**
- Today: **still lack of standardisation** in many areas



B-737 NG



B-727

3



- Glass Cockpits first appeared in Civil Aviation in the mid-eighties (A-310, B-757 / B-767)
- Research (e.g. Nagel&Wiener) focus man-machineinterface, mostly in context with automation and human error
- Early Discussions about *"Phantom Errors"* – unexplained indications or airplane behaviour
- <u>Gradual</u> replacement of electromechanical instruments: engine indication, ADI, HSI



Boeing 737-400: PFD and MFD, electromechanical ASI and Altimeter





#### Glass Instrument and Electromechanical Instruments

Basic-T Boeing 767





Thus when the second

- "Glass Cockpit" long tradition in military aviation – (Head Up Display- HUD)
- HUD only recently in civil aviation (HGS of CRJ, B737NG customer option)
- Glass or Not no discussion any more: even older generation airliners are retrofitted (B737 – B737NG)
- First CRT-technology, now LED technology
- Flight Management Unit, EICAS etc. is all part of the "glass cockpit"



Flight Control Unit B-767









- Today glass cockpit is state of the art in all sectors of aviation
  - Military
  - Homebuilts
  - General Aviation
  - Air Transport
- Discussion whether or not glass cockpit is useful virtually stopped
- Lots of advantages:
  - Common cockpit
  - Failed screens can be swapped



DA 40 Diamond Star- Garmin 1000



• Gliders:



Mixed "Steamgauges" and "Glass"







GARMIN



### Airbus Common Cockpit Philosophy



#### **Common Cockpit Philosophy**

Airbus Family





#### Early Discussions

Needles are easier to "speed-read" compared to digits Digits have to be read – needles can be glanced at !





ALL NEEDLES DIRECT THE SAME DIRECTION IN NORMAL CONDITION



### Early Discussions

Electromechanical equipment :

- less reliable (maintenance intensive)
- can be mis-read, too (3-pointer altimeter, small gauges etc.)





#### Today ´s Basic-T



Primary Flight Display B-737NG: FL400



- Lots of information in a very condensed space
- Small digits difficult to read
- Small knobs difficult to grab/adjust (turbulence!)
- Information overload - distraction (display is cluttered)









# Glass cockpits give lots of options

- Cockpit displays can be set-up in a variety of modes ("check your mode")
- Requires a
   standardisation of
   panel setup when
   operating with mixed
   crews (e.g. Range
   display, WX, terrain,
   etc.)







#### Interface design:

## Some equipment still with **less than ideal man-machine interface**:

e.g.: accurate pitch attitude easier to read with classic aircraft symbol (left) rather than V-bar (right)







#### System Developement:

- Systems often designed by software geeks – not engineering pilots
- Manufacturers of such equipment do not always employ professional test pilots
- Still lack of standardization (colors, flight mode designation)







# Danger of getting used to the gadgets:

- what about system failures ?
- Pilot does not feel comfortable, unless system (flight path) is fully programmed
- His desire to re-programme system will cause increased head down time, especially when flight plan changes are required at lower altitudes



#### Recommendations

- Use available Classroom/Home Training Material, preferably interactive training (CD-ROMs, Computer Based Training) for sophisticated flight management system
- Whenever possible, split cockpit workload
  - Pilot Flying
  - Pilot Monitoring
- Practice Flying in Basic Modes / with system malfunctions





#### Scanpath video ILS Approach

Pilot eye movement during Approach

Courtesy Univ.-Prof. Ernst Pfleger, www.viewpointsystem.com

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