



Information Displays in Aerospace: Past, Present, and Future

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Opening Thoughts

Why is display technology so important to the aerospace industry?

- **Touches just about every aspect of aviation from design and build to operations and maintenance**
- **Electronic displays have enabled significant progress in safety, efficiency, and human interface within aerospace industry**

A Brief History of Flight Instruments

Early Single Seat Aviation



Model 40A Cockpit

Early Commercial Transport



314 Clipper Control Deck

Transport Aircraft – Last of an Era



377 Stratocruiser

Moving into the Turbo Jet Era



DC-8 Flight Deck

Continuing the Turbo Jet Era



747-200 Flight Deck
A thousand lights, gauges & switches

The Beginning of Electronic Displays



757 887 Flight Deck

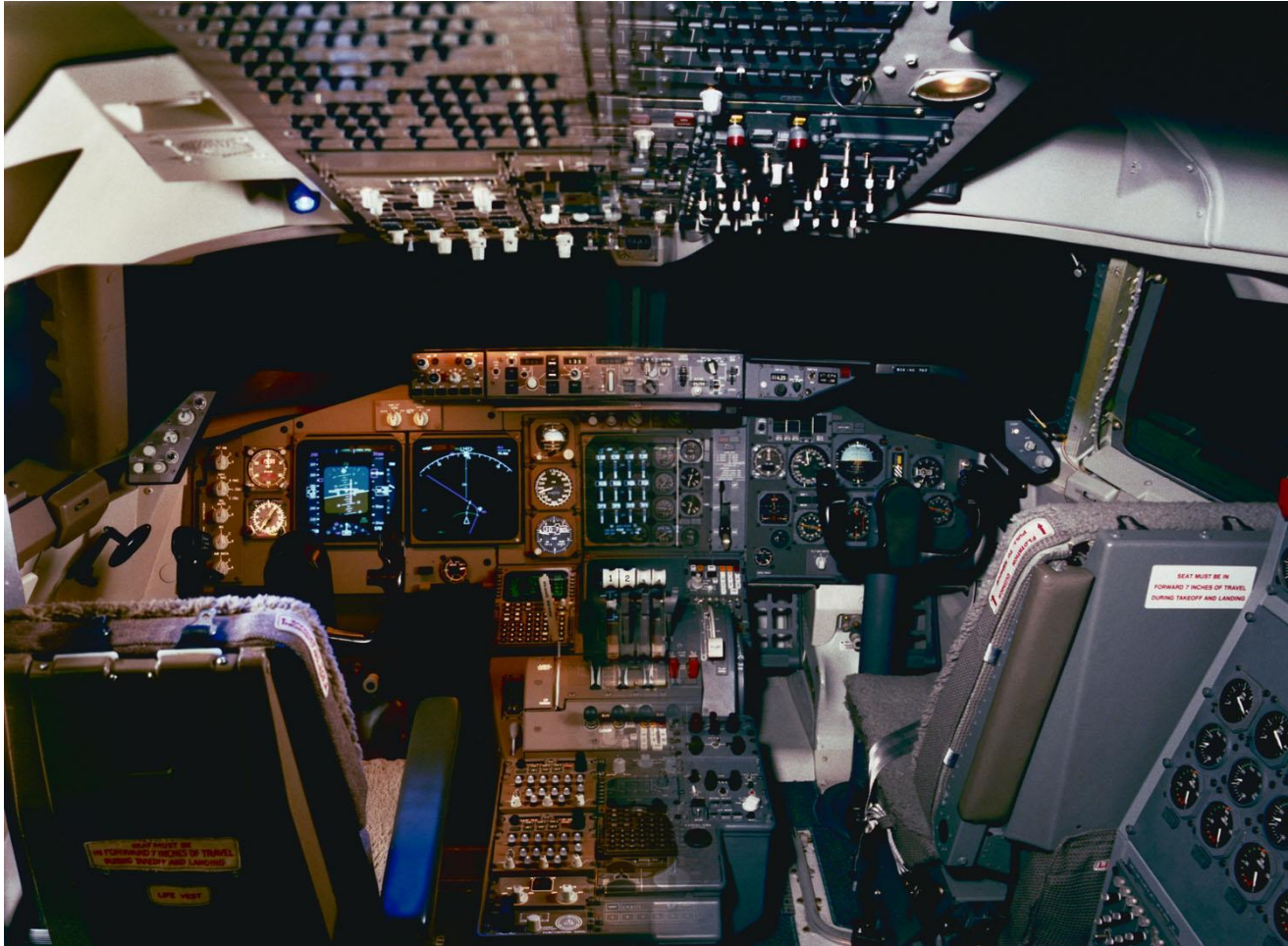
Evolving Electronic Displays



757/767/787/788 Flight Deck

Electronic Displays:

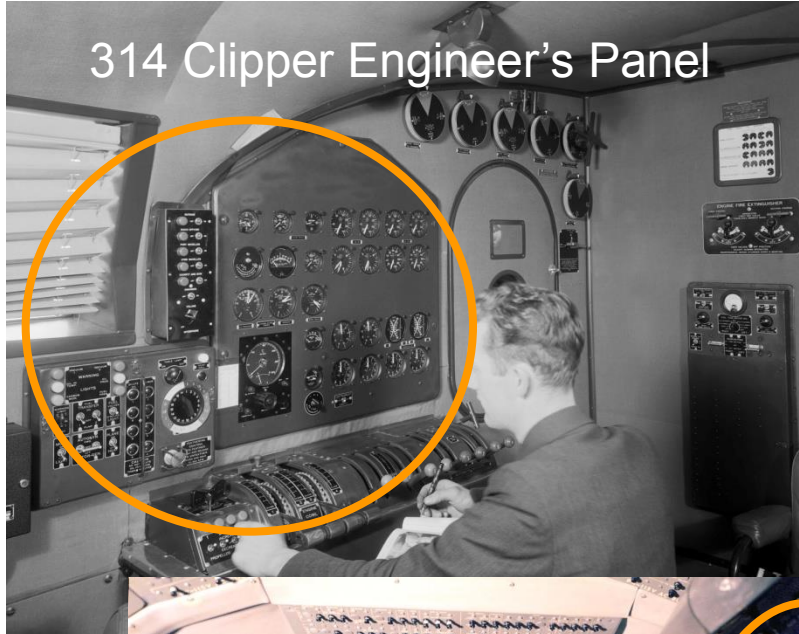
Enabling information from data



747-400 and 747-200

Engine Instruments / Crew Alerting

314 Clipper Engineer's Panel



EICAS enabled by CRTs supported move from 3 to 2 crew



707



Engine Instruments and Alerting Challenges

Engine Instruments / Crew Alerting



Electronic Checklist & Synoptics

The image displays two panels from an aircraft's electronic display system.

Left Panel: Electronic Checklist

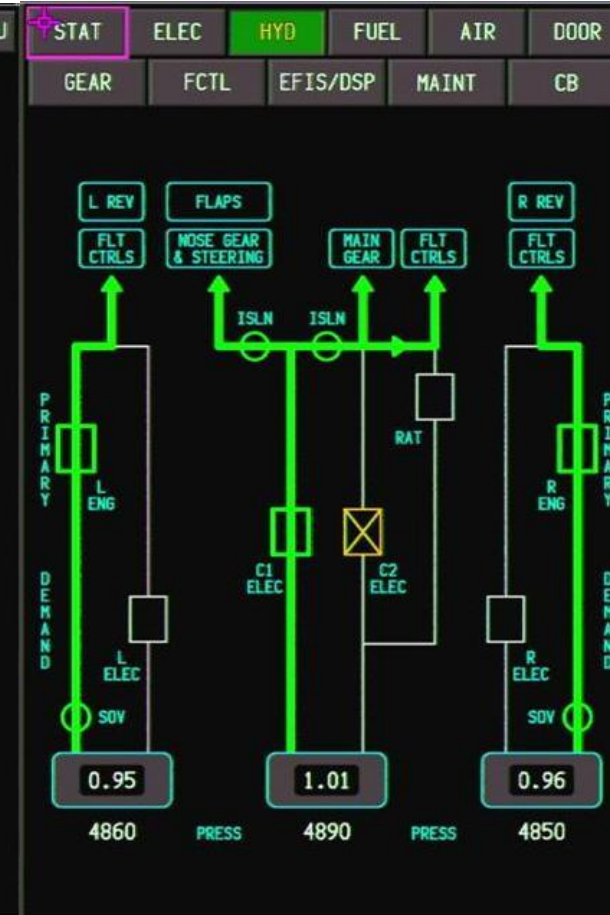
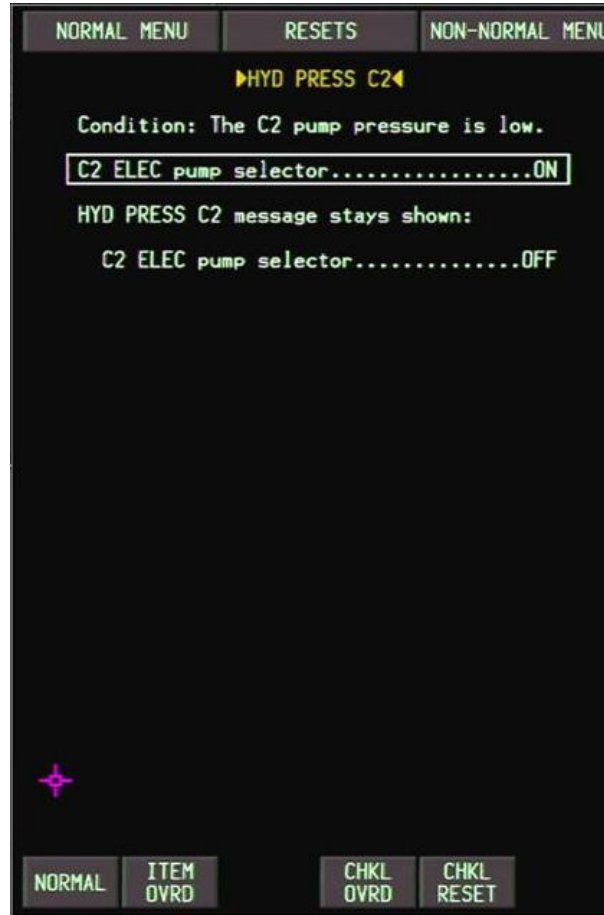
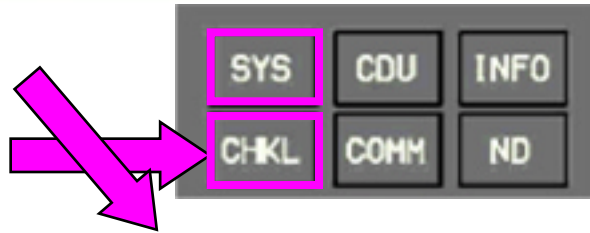
- Menu: NORMAL MENU | RESETS | NON-NORMAL MENU
- Section: ▶PREFLIGHT◀
- Item 1: Oxygen.....Tested, 100%
- Item 2: Flight instruments....Heading __, Altimeter __
- Item 3: Parking brake.....Set
- Item 4: FUEL CONTROL switches.....CUTOFF

Right Panel: Synoptic Diagram

- Menu: STAT | ELEC | HYD | FUEL | AIR | DOOR
- Sub-menu: GEAR | **FCTL** | EFIS/DSP | MAINT | CB
- Diagram Labels: SPOILERS, L AIL, L FLPRN, R FLPRN, R AIL, L ELEV, R ELEV, RUDDER, RUDDER TRIM (0.0), STAB (5.25)
- Mode: FLT CTRL MODE **NORMAL**

Challenges?

Integration & Linkage of Information

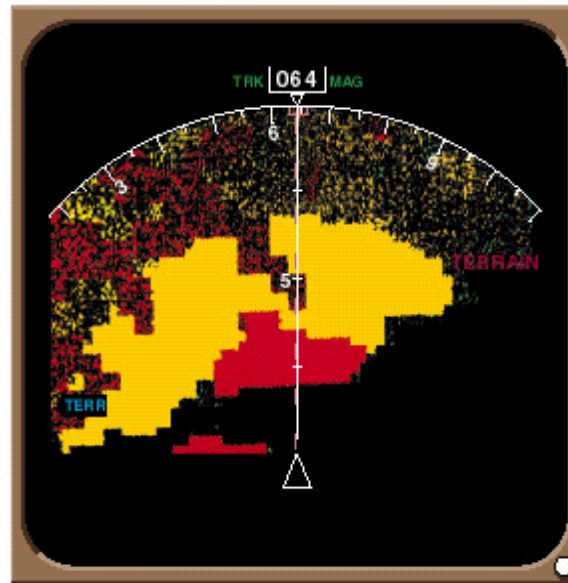


Navigation Display

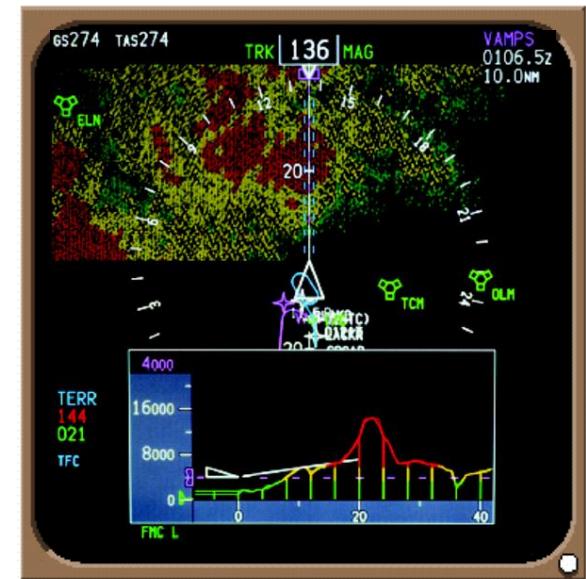
Basic Navigation Display with Flight Plan Path



Navigation Display with Terrain

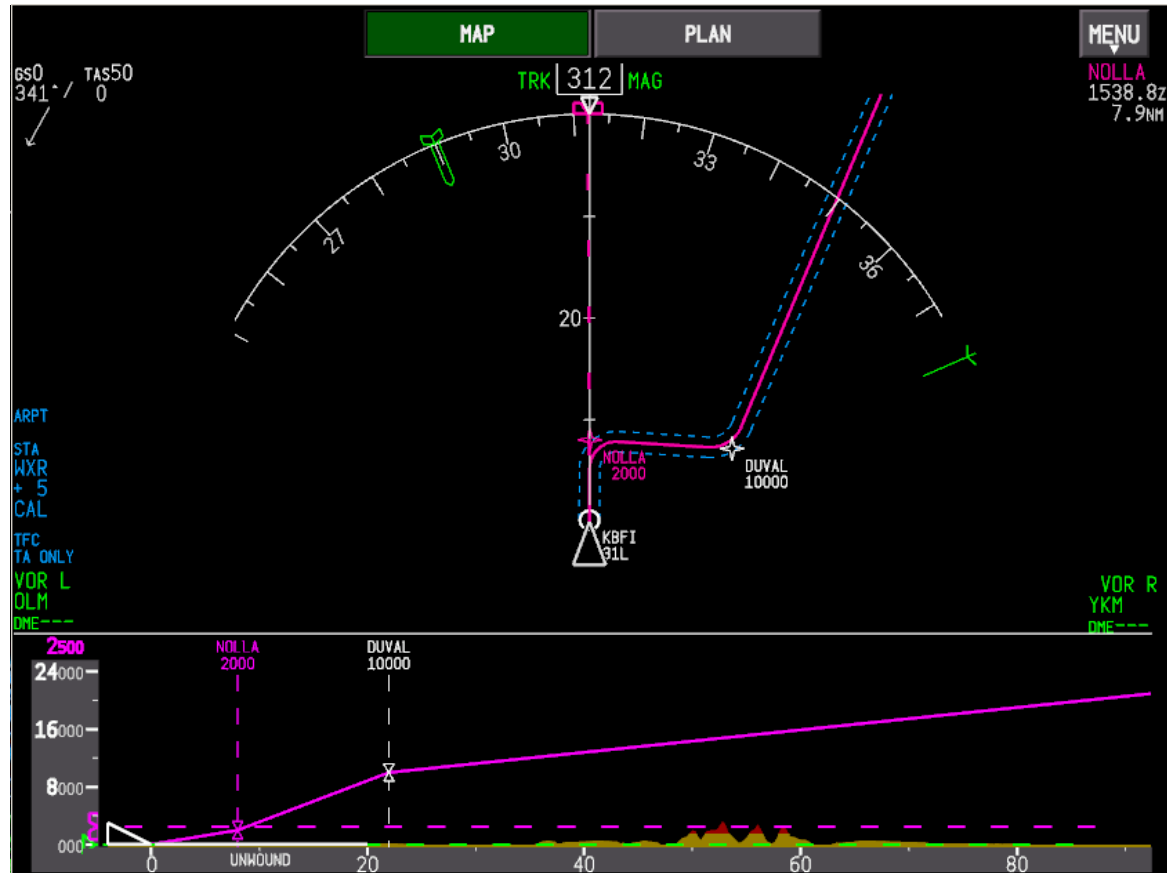


Navigation Display with VSD



Future Challenges?

Enhanced Navigation Display - 787



Enhanced Navigation Display - 787



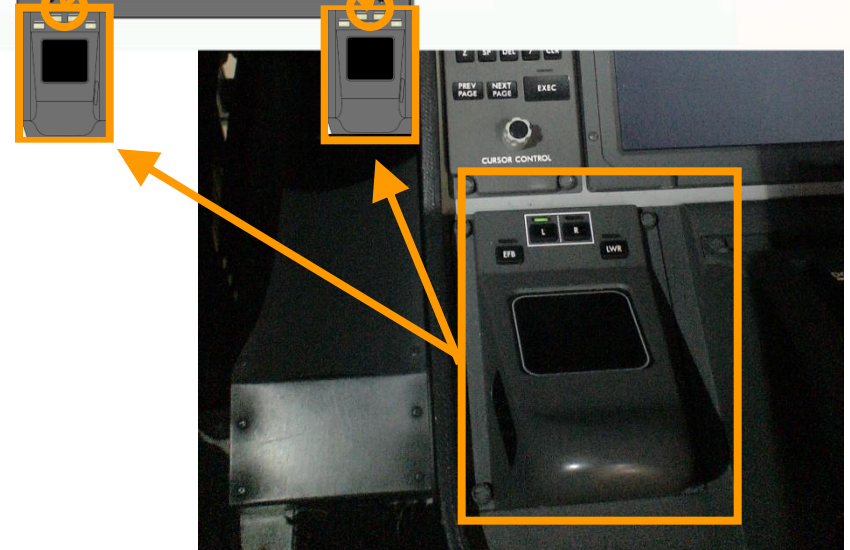
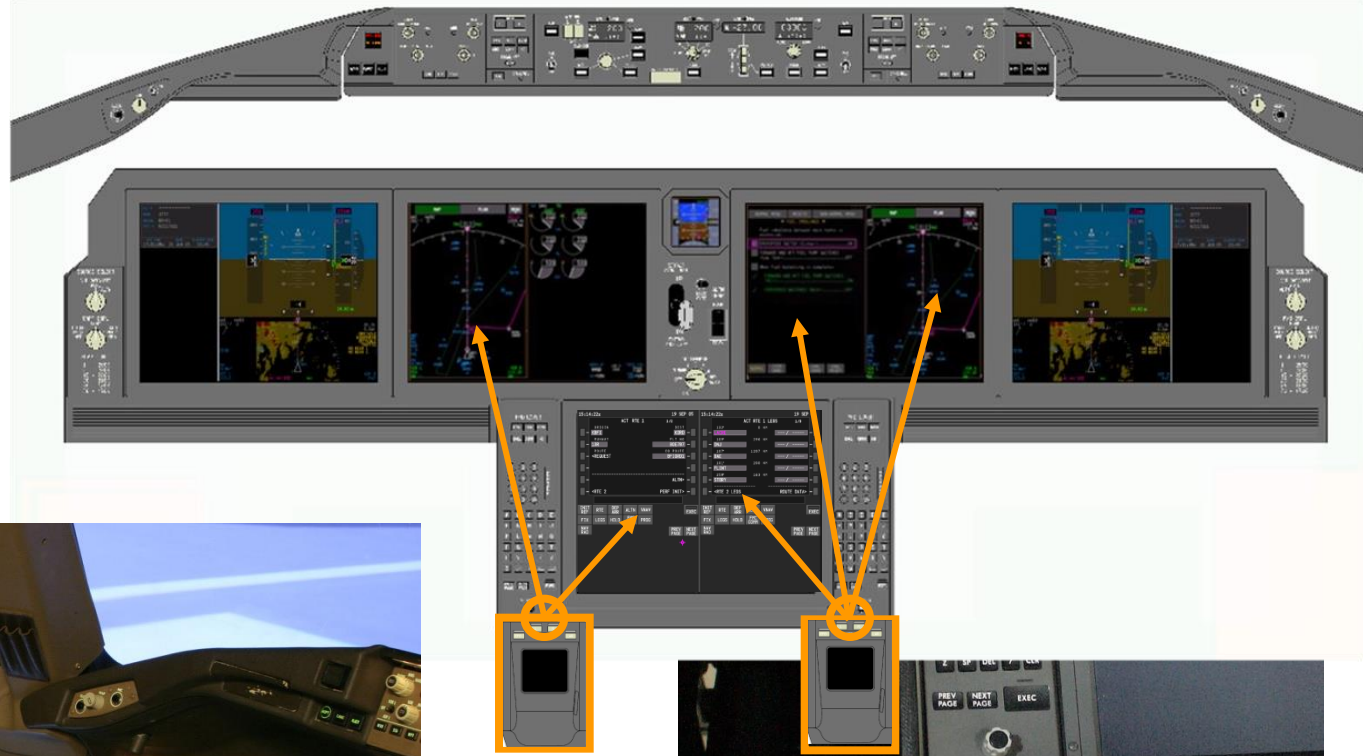
Surface Navigation

Future Possibilities



Airport Moving Map on the 787

Interactive Flight Deck Displays

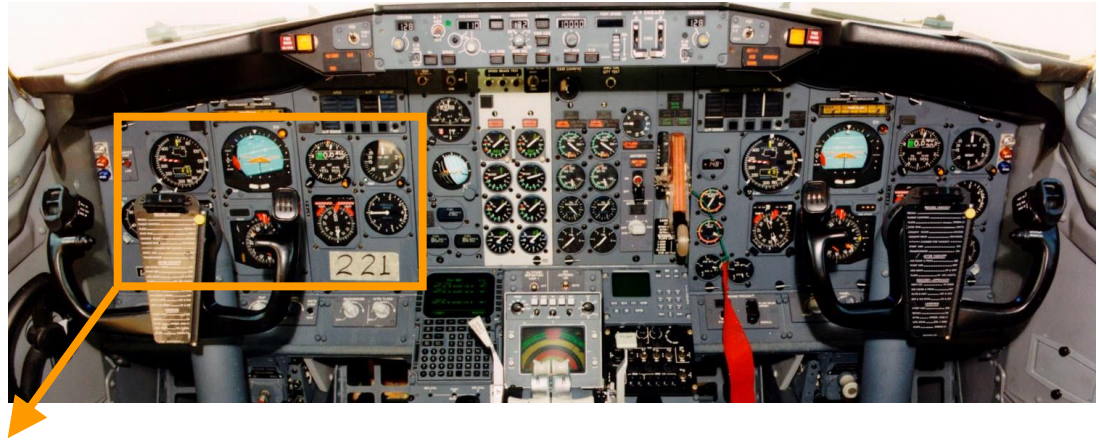


Going to Paperless



Primary Flight Information

Growth of Situation Awareness



Synthetic Vision Displays



Head-Up Displays

Superimposing on the outside view



Enhanced Vision Displays

Enhancing the outside view



Normal
HUD

HUD w/
EVS



Photo Courtesy
Rockwell-Collins International

Displays in Airplane Design



Drafters circa 1920s

Historical View



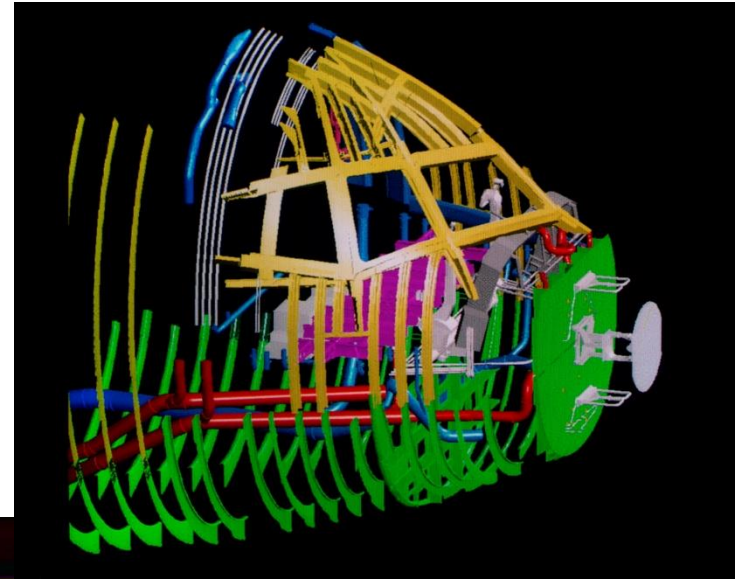
Drafters circa 1960s

Displays in Airplane Design

Airplane design today!



Designing the 777
On CATIA



Designing the 777
and the 787

Displays as Enablers (Disablers)

- **CRTs enabled Moving Maps, Electronic Checklists, System Synoptics**
- **LCDs enabled common displays with multiple display configs, i.e., 737 Classic EFIS and 737 NG (with 777 formats)**
- **HUDs enabled safer and low visibility approaches**

- **What will future display technology enable?**

Future Needs for Aviation

- **Continued enhancements to safety**
- **Increased capacity and efficiency in flight operations**
- **Move to paperless (facilitates integration and database updates)**
- **Continued emphasis on reduced non-recurring time and cost**
- **Continued pressure on recurring cost, power and weight**

What might the future hold?

- **Virtual windows - flight crew and passengers**
- **Touch-enabled display and control**
- **Head Worn Displays for maintainers and pilots**
- **Fully immersive 3-D computer design**
- **High reliability, low cost, light weight**
- **Easily upgradeable – economically support the 30-40 year airframe life cycle**

Summary

- **We have seen where we have been**
- **We know where we are today**
- **We have discussed some of the possibilities for the future**
- **It is up to us together to determine where we will go next**
- **An exciting future is before us**