THALES Avionics system development in recent History
- AIRBUS, BOMBARDIER, GULFSTREAM, ATR, EMBRAER, SUKHOI
  - Interactive Cockpit Display Systems,
  - Flight Management Systems,
  - Integrated Modular Avionics,
  - Electronic Flight Controls Computers,
  - Head-Up Displays,
  - Enhanced Vision Systems,
  - IFE.

THALES Innovation
NEW TECHNOLOGIES
- Flight Deck Innovation Strategy,
- Global Environment – Thales actions & major Industry initiatives,
- R&D and emerging technologies – some considerations,
- Avionics evolving Business Model,
- New generation of flight crew & new approach to develop flight deck,
- Competency and training methods,
- Bridging the gap between pilots and systems,
- New interaction languages,
- Helping pilots to handle complexity.

THALES Training Technologies
Thales Recent Avionics developments
Thales - intelligence onboard

Integrated Modular Avionics
Cockpit Display + HUD + EVS
Flight Guidance
Flight Management
Communication, Navigation, Surveillance

Connectivity - SATCOM
Electrical Power Generation / Conversion
Flight Controls

Utilities: Braking
Steering
Fuel
Engine Controls
Doors & Slides

Integrated Maintenance
In-Flight Entertainment Systems
Cabin lighting
Cabin interiors floor to floor
Intelligence onboard the Latest Worldwide Cockpits

Aeronautical equipment and functions

THALES - provides entire cockpit to Industry leaders
Intelligence onboard Gulfstream G650 and Boeing 787

Aeronautical equipment and functions

- Cabin systems
- (IFE, Cabin lighting)
- Electrical Systems
- Navigation (Stand-by Instrument)
- Flight controls

Three-axis fly-by-wire flight control computer system

- Primary and secondary flight control management
- Digital flight control computers
- Backup flight control unit

THALES - provides critical systems to the innovators
TopSeries in-flight entertainment systems

- Integrated entertainment and communication solutions and connectivity with personal electronic devices
- TopSeries now represents 50% of the global market (> 1000 A/C in service)

Connectivity Systems

- TopFlight Satcom: onboard satellite link allowing passengers and crew to communicate with the outside world
- First on an international flight with SMS and voice communications via mobile phone
- Internet connectivity, GSM, GPRS, WiFi.

Thales - brings innovation right to the passenger's seat
Thales Innovation and future operational challenges
Flight Deck Innovation Strategy – A REAL CHALLENGE

Global Environments

Concrete value added solutions for all parties involved in the future of civil aerospace

Economic cycle and evolving Business Model

R&D and Emerging Technologies

New generation of Pilots; Bridging the gap between the user and the system

March 2010
Global Environment – Thales actions via major Industry initiatives

Onboard Avionics versus ATM cooperation

- 4D trajectory exchange
  - Manage Gate To Gate Predictions
  - Improve datalink - clearance automation
  - Manage multiple RTA, ETA Slots display for negotiation
- ASAS procedures versus FMS, coupling with Traffic situation
- Departure / Arrival procedures (“green procedures”)
- “What if” Concept and associated Option Routes
  - ETOPS & RIF routes with associated decision points
  - Multiple departure/arrival preparation for quick selection in case of runway change
- Accurate weather modelling for more precise predictions,
  - To use more accurate weather situation data
    - Grid winds/temperature, jet streams, turbulence
    - FIS-B Weather uplink

A seamless collaboration

THALES AVIONICS

THALES AIR SYSTEM
Avionics FUNCTIONS:
- AP, FMS, ANF, TAWS,
- Weather, TCAS/ADS-B,
- Comm Data link, EFB apps

On board Segment

Avionics FUNCTIONS:
- AP, FMS, ANF, TAWS,
- Weather, TCAS/ADS-B,
- Comm Data link, EFB apps

Engine, aircraft Model

Environment

Traffic generator, Weather conditions...

Architecture
Flexible

Ground Segment

Airline Operation Center
Tower Airport Control
Control Center

Cockpit Control & Displays

Other Thales simulators

Other external simulators

EISE
SEATTLE

Airlab
TOULOUSE RUNGIS

Data Link
HAL
RMI
R&D and emerging technologies – some considerations

R & D investment from COTS electronics domains are transforming the civil aerospace market in most of the Avionics sub-systems as defined today…

- Display (CRT to LCD to… multi-touch)
- Man Machine Interface (Interactivity, Cursor Device… Haptic display)
- Augmented Vision (HUD, EVS, SVS … CVS)
- Integrated & opened architecture based on Full duplex network backbone using BUS coming from IT domain
- NAV and Inertia using GPS/GALILEO for all flight phases
- COM Ops and COM passengers (Low speed to Gigabits)

R&D investment in-line with know how and expertise through multi-domain activities
Federated electro-mechanical avionics
Quantity of products/sub-assembly /moving parts
Products reliability
Achievable MTBF
Spares/repairs

Product driven Revenue

Safety
(system safety, performance, environmental constraints, certification, …)

Human Factors
(teamwork, stress, confidence, workload, training, multi-culturality, …)

Life cycle cost
(reliability, availability, maintainability, testability…)

Integrated opened network
Quantity of LRUs
Quantity of software/functionalities
Systems reliability
Required life cycle cost
Spares/repairs

System driven revenue

New different business model required in order to address safety, human factors and life cycle cost and generate profit
New generation of Pilots; Filling the gap between the pilots and the systems

3 years and more of civil and/or military training

2000 -3000 flight hours

15 years, 80000 F/H +, Multiple (4+) aircraft annotations

Average age of flight crew in 2010 ; 40-50 years old + (10 000 F/H +)

18 months ab-initio / MCPL

500 -1000 flight hours

5 years, 1500 F/H, 1 or 2 type annotations

Average age of flight crew in 2030 ; 25-35 years old + (3 000 F/H +)
No more 3 crew cockpit

**CRM Evolution**
- In the 90ties: CRM = Cockpit Resource Management
- In 2000: CRM = Crew Resource Management (including PNC)
- In 2010: CRM = Company Resource Management (Including, AOC, Ground Ops...)
- In 2020?: CRM = Complete Resources Management? including ATC?

**Technology competency**
- On board computers and electronics systems
- Automation
- Communication
- Decision aiding systems

**Piloting competency**
- Situation Awareness
- Keep the flying basics (fly, navigate, communicate, manage the A/C)
- Flying techniques: Flying quality, ....

March 2010
iDeck – Early validation, prototyping and concept development Tools

Cockpit rapid design & validation tool
iDeck uses & objectives

During bids & programs

To rapidly test new configurations and cockpit solutions
To help to make choices and to validate specifications early

- Improve innovation by rapidly testing new configurations and solutions
- Focus and centric solutions by including the pilots in an immersive prototyping environment and thus enabling early validation of Cockpit Display System and function Man Machine Interface concepts
- Reduce development cycles and costs by increasing significantly the cockpit specification maturity at the first steps of the program

iDeck : improve innovation, competitiveness and maturity
Improve requirement capture through short loop iterations with customers & users at the very beginning of the program
Optimize continuity between specification and development using an appropriate continuous toolset

Start development earlier, with validated cockpit MMI and behaviour. Pilots, Engineers in-sync during early development phases
iDeck history

Advanced Studies simulators
A380 Bourget Airshow
A400M Bourget Airshow
S76 Farnborough Airshow

iDeck / A350 version
Platform & tools
iDeck / Advanced studies version

iDeck : from “cockpit demo centre” to “cockpit design centre”
iDeck instances

Advanced Studies
Thales Bordeaux

Topdeck vision
Customer facilities

A350 Program
Thales Toulouse

A350
Farnborough Airshow

Business Jet
NBAA Orlando

iDeck: allowing rapid prototyping of specific cockpit solutions
Bridging the gap between pilots and systems

Empathic systems
Helping to anticipate

Adapting the cockpit to crew tasks, intentions and abilities

Personalization
Cockpit that takes crew and companies into account...

Research areas:
- Pilot task analysis, intention detection, workload scheduling, cognitive resource management, anticipation of user errors, adaptive interfaces, incapacitation monitoring, biosensors...
- Multi-cultural (social & organizational), skill & training evolution, pilot sociological evolution, company procedures & culture, personalization vs. cross-crew qualification,...
Supporting new interaction languages

Dematerialization
Reducing device footprint and increasing display area

Direct interactions
Using natural human interaction skills (touch, feel, …)

Research areas:
- Flat projection, OLED display, pico-projectors, ePaper, flexible screens, high-performance/high integrity, wide eye-box HUD, compact optics
- Touch interaction patterns, haptic feedback, 3D view & interactions, personal viewers (in glasses), 3D sound, active noise reduction, gesture recognition, integrated biosensors
Helping pilots to handle complexity

Data merging
A safe synthetic view to pilot, navigate and manage the mission

Research areas:
Safety critical display, sensor fusion, image processing, certified database, confidence, immersion, distributed situation awareness, 3D augmented reality, graphic data merging, sensors,...
THALES Civil Aircraft Training Solutions
Thales has 45 years of Full Flight Simulator design and production.

Thales has the largest installed Customer base and has been consistently in the top two manufacturers of pilot training equipment.

Thales has a proud record of firsts in the industry.

<table>
<thead>
<tr>
<th>Aircraft Type</th>
<th>Customer</th>
<th>CA Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>A300</td>
<td>First FFS for Airbus</td>
<td>1975</td>
</tr>
<tr>
<td>B757</td>
<td>First FFS for Boeing</td>
<td>1979</td>
</tr>
<tr>
<td>B767</td>
<td>First FFS for Boeing and TWA</td>
<td>1979</td>
</tr>
<tr>
<td>BAe 146</td>
<td>First FFS for BAe</td>
<td>1984</td>
</tr>
<tr>
<td>A320</td>
<td>First FFS for Airbus and American West</td>
<td>1985</td>
</tr>
<tr>
<td>B747-400</td>
<td>First FFS for Boeing</td>
<td>1986</td>
</tr>
<tr>
<td>A330/340</td>
<td>First FFS for Airbus</td>
<td>1989</td>
</tr>
<tr>
<td>B777</td>
<td>First FFS for United</td>
<td>1992</td>
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<tr>
<td>B737NG</td>
<td>First FFS for Lufthansa</td>
<td>1995</td>
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<tr>
<td>A380</td>
<td>First FFS for SIA</td>
<td>2007</td>
</tr>
<tr>
<td>B787</td>
<td>First FFS for Boeing</td>
<td>2007</td>
</tr>
</tbody>
</table>
Airbus A380 Training Simulators

Aircraft launch airline SINGAPORE AIRLINES are the world’s first airline to have their A380 FFS and TFST certified for training 23 August 2008

THALES training solutions benefit from close synergy with THALES avionics

LUFTHANSA and MALAYSIAN AIRLINES have also chosen THALES to supply their A380 training simulators
THALES Selected as Training Systems Supplier by SUKHOI/ALENIA

Contract signed for 3 Full Flight Simulators

SuperJet 100 Cooperation ⇒ The best evidence
Long term single source supply of training suites for the B787

- Full Flight Simulators
- Flat panel trainers
- Classroom simulation systems

Extensive support agreement covering availability of training equipment

- Software and hardware fault correction
- Spares, repairs, obsolescence management
- Update and engineering services

Availability based contracting model including lifecycle cost guarantees
Fully Accredited Civil Product Range

Over 600 Simulators in Service World-wide

CMM Level 3 moving to CMMI Level 2
Internationally ISO 9001, 14001, 18001
Key Advisory Positions to major international Simulation Working groups

Integrated Product Range Delivers Cost Effective Training
Conclusion

THALES

AVIONICS   AIR SYSTEM   TRAINING & SIMULATION
ENSURING THE SUCCESS OF OUR KEY CUSTOMER