Alenia Aeronautica

Technologies applied in R&D

Napoli 25 Maggio 2011

N. Cauceglia - CTO
• Mission, Centers of Excellence & Network
• Main Programs
• Market Drivers & Challenges
• Research & Innovation Network and main Research Project
• Laboratories & Test Facilities
• Relationships with Academic Institutions
• B787 overview and Composite experience
CENTRES OF EXCELLENCE IN ITALY

Torino Caselle
- Final assembly
- Ground and flight test
- Logistic support
- Design
- System integration and flight simulators

Venegono / Alenia Aermacchi
- Trainer aircraft

Venezia
- Overhaul and maintenance

Venezia/SuperJet International
- Marketing, Logistic Support and special versions regional aircraft

Foggia
- Carbon fiber and composite material technologies assembly

Nola
- Machining
- Large sheet metal fabrication
- Large panel assembly

Pomigliano
- Design
- Metal bonding
- Large structure sub-assemblies
- Structural laboratories

Casoria
- Sheet metal

Capodichino
- Logistics
- Components production

Total Headcount in Italy: ~12,000

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WORLD PRESENCE

Alenia main subsidiaries, main consortia, JVs and program suppliers

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MAIN INDUSTRIAL LINKS

Military Programs

BAE Systems
Eurofighter
Tornado

Boeing
767 Tanker

Dassault
Neuron

EADS
Eurofighter
Tornado

L-3 Communications
C-27J (JCA Program)

Lockheed Martin
F35-JSF
C-130J

Embraer
AMX

Commercial Programs

Airbus
A380
A340
A330
A321

Boeing
787
767
777

Bombardier
CSeries

Dassault
Falcon 2000 EX
Falcon 900 EX

EADS
ATR42/72

Sukhoi

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Aerospace & Defence Market: innovation drivers

- Low Cost Communication
- Low Cost Countries
- Technology as offset

Globalization

- Russia & Asia Growth
- Brazil Growth

New Comers

- Less Military Expenses
- Airline crisis
- Growing Operative Costs

Economic Crisis & Oil Price growth

- Fast Technology Evolution
- Huge R&D Investment
- Strategic alliances required

R&D Cost

Public/Private Funding

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THE CHALLENGE OF DESIGN DEPARTMENT

- MULTICULTURAL ENVIRONMENT
- NEW PARTNERSHIPS IN NEW COUNTRIES
- STRONGLY COMPETITIVE CIVIL A/C MARKET
- INTELLECTUAL PROPERTY AS A STRATEGIC ASSET

ONLY ONE ANSWER:
- MORE RESEARCH
- MORE INNOVATION
- MORE DEVELOPMENT

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GROWING BY SHARING: RESEARCH & INNOVATION
TRIPLE HELIX

Main National & European Universities & Research Centers
- CIRA
- ONERA
- DLR
- many others

Main International & National Industrial Stakeholders
- SELEX Communications
- Boeing
- EADS
- Dassault Aviation
- Thales
- Cytec
- Avio

Regional, National & European Institutions

Technology Districts

Government Partners

R&D 474M€*
R&D/Revenue~18%*

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*© 2009 Economic Data
National role: Technology Districts Network

PIEMONTE
- Torino Wireless
- Distretto aeronautico piemontese - Integrazione di sistemi complessi

PUGLIA
- DHITECH
- DAP - Distretto aerospaziale pugliese - Advanced process engineering, production and repair

LAZIO
- Distretto dell’Aerospazio e Difesa - Systems development, infrastructure, laboratories

CAMPANIA
- IMAST
- DAC - Distretto aerospaziale campano - Airframe integration (structure, systems)

LOMBARDIA
- Distretto aeronautico lombardo - Embedded tactical training system

District recognized by MIUR
District being established

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Alenia and European Research

Industrial Management Groups

EDA Working Groups

ETAP Industrial Steering Committee

Civil & Military Funders

MIDCAS

ETAP GSS ETAP TDP 4.5

European Projects

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JTI Clean Sky - General Technical Organization

Vehicle ITD

1600 M€
800 EU + 800 Stakeholder

Eco-design
For Airframe and Systems

Leaders: Dassault Aviation & Fraunhofer Institute

Smart Fixed-Wing Aircraft

Leaders: Airbus & SAAB

Green Regional Aircraft

Leaders: Alenia & EADS CASA

Green Rotorcraft

Leaders: Eurocopter & AgustaWestland

174 M€
87 EU M€+ 87 Stakeholder

Clean Sky Technology Evaluator

Systems for Green Operations

Leaders: Liebherr & Thales

Sustainable and Green Engines

Leaders: Rolls-Royce & Safran

Transverse ITD for all vehicles

ITD: Integrated Technology Demonstrator

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Green Regional Aircraft – Participants

- **AIR GREEN Cluster**
  - with following members:
    - Piaggio, Italy, single-voice Cluster's representative
    - Polo delle S&T, Univ. Naples, Italy
    - Centro Sviluppo Materiali (CSM), Italy
    - IMAST, Italy (technological district)
    - FoxBit, Italy
    - Sicamb, Italy
    - Politech Turin, Italy
    - Univ. Bologna/Forlì, Italy
    - Univ. Pisa, Italy

- **ATR**

- **CIRA PLUS Cluster**
  - with following members:
    - CIRA, Italy, single voice Cluster's representative
    - Dema, Italy
    - Aerosoft, Italy
    - INCAS, Romania
    - Elsis, Lithuania

- **HELLENIC AEROSPACE INDUSTRY**

- **ONERA**

A sizeable amount of activities are reserved to Call for Proposals open to European Institutions and Industry: we expect to reach about 53 additional partners.

For end of this year, we foresee about 85 participants involved in GRA!!
Green Regional Aircraft – 5 Technological Domains

Innovative structures (Low Weight Configuration)
- multifunctional composites
- advanced metallic materials
- Structure health monitoring

Advanced aerodynamics (Low Noise Configuration)
- Lower Fuel Consumption
- Better climb performance
- Lower Airframe noise from high lift devices and landing gear

Innovative systems (All Electrical Aircraft)
- Bleed less architectures
- Limited hydraulics
- Energy management

Evaluation of new avionics architecture in MTM domain for
- Fuel & noise reduction
- Upgraded capabilities for MTM
- Lower Maintenance costs

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SESAR (Single European Sky ATM Research)

• Present ATM system is characterized by:
  – Fragmentation of airspace,
  – Obsolescence of present ground and on-board systems
  – Low usage of airspace resources

• SESAR objectives:
  – To triple the **airspace capacity**
  – To reduce **ATM costs** by 50%
  – To increase **safety** by a factor 10
  – To reduce **environmental impact of single flight** by 10%

• In three Phases:
  – **Definition** (2004-2008): to define new operative concepts and new R&D requirements (**activity completed**)
  – **Development** (2008-2013): research & development of new systems & standards by a common organization, the **SESAR Joint Undertaking (in progress)**

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Extended Enterprise - Collaboration

Multidisciplinary optimisation

Concurrence

Life Cycle Virtual prototyping

Knowledge Management

Product Lifecycle Management

Digital data
Alenia Aeronautica and the new Frontier of Simulation & Testing
Alenia Aeronautica Labs & Test Centers

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**Innovation through Hardware**

- Ideas are not enough
- State of the art labs in relevant areas
- Skylight simulator
- Anechoic Screened chamber
- HIRF
- Structural Test lab
- The Flight Test Center

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Alenia Aeronautica from 767 to 787
Leadership in Composite Technology

Innovation through Specialization

- **Eurofighter Prototype (15%)**
  - Wing panel cobonded spars

- **AMX (3%)**
  - Tailplane cocured multi spar box

- **ATR 42/72 (19%)**
  - Tailplane extended cobonding

- **TYPHOON (40%)**
  - Extended composite application

- **787 (51%)**
  - Fuselage “one piece barrel fuselage”
  - Cocured horizontal stabilizer

- **SSJ 100**
  - Future Narrow Bodies
  - New composite-metal hybrid solutions

- **Neuron - Advanced UAV**
  - Advanced design technologies and tools

- **JSF F-35**
  - Wingbox composite-titanium integral design

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Aerostructures: Examples of Composite Structures Research

**EU - ALCAS**
Innovative assembly tools for wing CFRP structures

**National projects**
- RFI Window Frame
- Integral Fuselage frames
  “one-piece frame-shear tie”

**EU - AWIATOR – A340 Platform WINGLET**
Cocured multispar box
(Closed mold cure)

**EU - FACE**
cabin comfort design

**JTI - Green Regional Platform**
Low weight:
- Multifunctional materials
- Adaptive materials
- Nanomaterials

**National projects**
- Titanium Welding
- Enhanced acoustic performance structures
Since 2005 Alenia Aeronautica has launched educational programs in close collaboration with local Scientific Faculties and Polytechnics

Examples of these educational programs are the following:

- **Advanced Training ENgineers Aeronautics** (ATENA – 2005-2007 – dedicated to Greek students – advanced aeronautic education by Turin Polytechnic’ Profess mixed with training on the job at Alenia premises)

- **Master Of Science in Aeronautics for the International Community** (MOSAIC 2008-2010 – dedicated to Turkish, Lithuanian, Bulgarian, Greek, Romanian students – continuation of ATENA scheme)

- **AEROTECH** (1st edition 2006-2007 – dedicated to post-graduated engineers – in partnership with ATR Toulouse (France), Cira, SAM Consortium, Magnaghi, Officine Aeronavali, OMASUD, Piaggio Aereo Industries, Sintart, Tecnam, Vulcanair and with Dipartimento di Progettazione Aeronautica (DPA), Università degli Studi di Napoli Federico II, Consorzio Eubeo (Consorzio Universitario per l’Innovazione), Regione Campania, Unione Industriali di Napoli

- **INDUSTRIAL PhD Program** (2010-on – dedicated to Italian post-graduated students)
MOSAIC:
Post Graduated Master Of Science in Aeronautics for the International Community

Specific Areas

- Aircraft System Engineering
- Advanced Materials & Manufacturing
- Virtual Reality, Simulation and Training
- Logistic support and maintenance

Aircraft System Development

Mixed Courses/Training on the Job

Product oriented

Applied Thesis
Advanced Technologies

Research oriented

Research Thesis
Advanced Technol. Develop.

Training on the job

3 months

6 months

9 months

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Benefits for Universities

• For Professors:
  • initial possibility to provide lectures and seminars and in future be part of the consortium for the International Master hosting courses etc.

• For students and Professors:
  • opportunity to visit Italian Universities/Research centres/Industries, gain knowledge, establish new links, be part in network (concerted action) participate in common research projects (for instance within European Framework Programs) ….

• For students:
  • high level education also suitable for those willing to continue academic career (ex. PhD)

• Student education tailored also on industrial needs
  • (Master different orientations)
B787-8 Design Features

- Advanced wing design
- Breakthrough passenger cabin
- Overhead crew rests
- Enhanced flight deck
- Advanced engines and nacelles
- Large cargo capacity
- Composite primary structure
- Innovative systems technologies
Advanced Systems Technologies Provide Value

- Common Core
  - Open Systems Architecture

- More Electric Systems Architecture

- Advanced Flight Controls

- Integrated Health Management

- e-Enabled Systems
Composites Serve as Primary Structural Material

<table>
<thead>
<tr>
<th>Material</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon laminate</td>
<td>50%</td>
</tr>
<tr>
<td>Carbon sandwich</td>
<td>15%</td>
</tr>
<tr>
<td>Other composites</td>
<td>10%</td>
</tr>
<tr>
<td>Aluminum</td>
<td>20%</td>
</tr>
<tr>
<td>Titanium</td>
<td>5%</td>
</tr>
<tr>
<td>Titanium/steel/aluminum</td>
<td>5%</td>
</tr>
</tbody>
</table>

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Boeing 787 - The First “Plastic” Airplane

For the first time in aviation history, composites will be applied to every primary structure of an airliner

**Composites:** lighter, no fatigue or corrosion

Complete, large sections cocured together (One Piece Barrel) gives fewer joints, fewer parts, simple assembly, lower weight

Benchmark for future airliner development:
- 20% lower Direct Operating Costs
- Savings from aerodynamics, materials and systems, engines and their synergies

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Boeing 787 One Piece Barrel

Skin Lay Up

Trim & Drill

Extraction

Cleaning & Preparation

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Alenia 787 Program Experience

BOEING 787-8 HORIZONTAL STABILIZER (Alenia Patented Technology based)

TECHNOLOGY SCALE-UP:
FROM FEASIBILITY SPECIMEN (1983)
TO AMX STABILIZER & VERTICAL FIN (1986)
TO ATR 42/72 STABILIZER (1995),
TO 787 STABILIZER DEMONSTRATOR (2006)
Thank you for your attention