Diversity delivers Innovation

Ian BURNS, Director of performance ORACLE TEAM USA
Charles CHAMPION, Head of Engineering AIRBUS
Airbus brings its innovation and high-tech know-how to ORACLE TEAM USA

• The AMERICAS’ CUP: the biggest sporting event in 2017

• ORACLE TEAM USA - Winner of the 33rd and 34th America’s Cup. Led by CEO Sir Russell Coutts and skipper James Spithill with some of the best international sailing, design, engineering and boat-building talents

• AIRBUS and ORACLE TEAM USA announced the Official Innovation Partnership in October 2014

• Airbus is also a technology partner to the Japanese Challenger Softbank Team Japan
• Louis Vuitton America’s Cup World Series regattas started in 2015 - Upcoming 2016 events:
  • Chicago (USA) June 10-12
  • Portsmouth (UK) July 23-24
  • Toulon (FRA) September 10-11
  • Fukuoka (JP) November 18-20 (tbc)

• America’s Cup Qualifiers and Challenger Playoffs in 2017 (May to June)

• 35th America’s Cup Match in 2017 (June 17-27)
Synergies between sailing and flying are greater than ever

- **Boat powered by a wing and flying above water surface on foils**
- **20m tall / 83.5m² sail wing** (similar to the A320 wing) consist of 3 individually controlled flaps and a skeleton made of carbon composite
- **Use of aeronautical technology** increases boat performance
- **Similar challenges**: flight qualities, aerodynamics, light weight materials, systems, test in the air/at sea
- **Diversity delivers Innovation**
Who better to make a boat fly?

- Airbus delivers a step change to the sailing world with technology, competences, methods and tools
- Quest for lighter & stronger materials e.g. 3D printed parts
- High level of composite used to build the AC45 / 53% for the A350 XWB
Airbus technology provides a competitive edge

- **Foil Design & Testing**
- **Hydraulics**
- **Yacht Aerodynamics**
- **3D Printing**
- **MEMS Pressure Sensors**

- **Over 30 Airbus engineers**: aerodynamics, instrumentation and simulation, composites, structures, control systems and data analysis
Foil Design & Testing

A flying yacht

- At high speeds the **foils are like wings** that lift the boat out of the water, eliminating hull drag
- **The shape** of the foil **defines the speed** of the boat in foiling mode
- Foils support **high loads**:
  - Weight of the boat
  - Wave impact
  - Manoeuvring
Pushing the foil to the limit

- The shape and composition of the foil is comparable to the A320 Sharklets

- 2 component tests were done in the Airbus’ Hamburg facility to validate the rigidity criteria against structural strength required

- Alternative design and manufacturing process proposed by Airbus
**Hydraulics**

- Aircraft and foiling catamaran hydraulic systems architecture share common fields:
  - Hydraulic power supply: 5000psi pumps powered by 4 crew members - grinders (same pounds per square inch as A350 XWB)
  - 3 hydraulic circuits (as on the A320)
  - 17 actuators: elevator pitch, wing camber, jib control, foils (daggerboard) control
  - Control system: controller, CAN network, loggers, sensors, human interface, optic fiber, Wi-Fi antenna
The Iron Shark, created in conjunction by Airbus & ORACLE TEAM USA engineers in Bermuda:

- Dedicated test bench acting as a pre-integration test, just like an Airbus Iron Bird
- Includes pumps, control software, valves and actuators performance and works with a human interface.

- Improved weight when compared to previous Cups
- Improved reliability
- Time saving
- Improved energy consumption
Yacht Aerodynamics

- Airbus’ expertise in Computational Fluid Dynamics - CFD - is providing support to evaluate the yacht aerodynamics design options

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\begin{align*}
\text{A350: Reduced Drag} & \quad = \quad \text{Lower Fuel Burn \& Increased Range} \\
\text{AC45: Reduced Drag} & \quad = \quad \text{Increased Performance}
\end{align*}
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- The very accurate digital representations enable building a more representative global sailing simulator - equivalent to a flight simulator in the aeronautical industry
Platform Aerodynamics

- Airbus & ORACLE TEAM USA’s virtual testing capabilities improve modelling of the aerodynamic resistance of each component of the yacht:
  - Hulls, cross beams, cockpits and even the crew
  - Simulations in various sailing configurations to evaluate the crew positioning and define design options
Foil Hydrodynamics

- Requirement for a **fast exploration tool** to validate dagger board design taking into account **yacht speed, cavitation and hydro elasticity**

- Airbus’ **MARES** tool is used to evaluate the tail section of an aircraft in the development phase

- The tool allows **quick down selection of the most promising design concepts**
3D printing

• Forward Organiser part created using Additive Layer Manufacturing - ALM
• Further parts are being printed
• Integration of design optimisation

• Objectives:
  ✓ Weight reduction: up to 57%
  ✓ Reduction of production lead time
  ✓ Reinforced strength
  ✓ Increased complexity
Airbus MEMS Technology

• Aerodynamic Pressure Sensors to optimize performance, manoeuvres and wing settings

• Introduction of non-intrusive, micro devices which are providing accurate wind profile determination all along the wing shape:
  • 8 strips of 100cm of MEMS (400 sensors) on the wing acting as digital barometric pressure sensors
  • Multiple potential applications: Anemometer, Wind data post processing and anti-stall device

• Providing the sailing team with high value information on the behaviour of the flow around the rigid sail in various sailing conditions
A winning partnership: Diversity delivers Innovation

• Sharing best practices, ways of working and collaborative mindset
  • Adaptability & agility of Airbus engineers to improving overall boat performance
  • Exchange of know-how and ways of working

• Technical benefits for engineering
  • Technological benefits for ORACLE TEAM USA
  • Return on experience for Airbus:
    • Improved working knowledge of tools
    • Explored new areas of R&T