Innovation Days 2016
Hamburg

OFFICIAL INNOVATION PARTNER OF
ORACLE
TEAM USA

Diversity delivers Innovation

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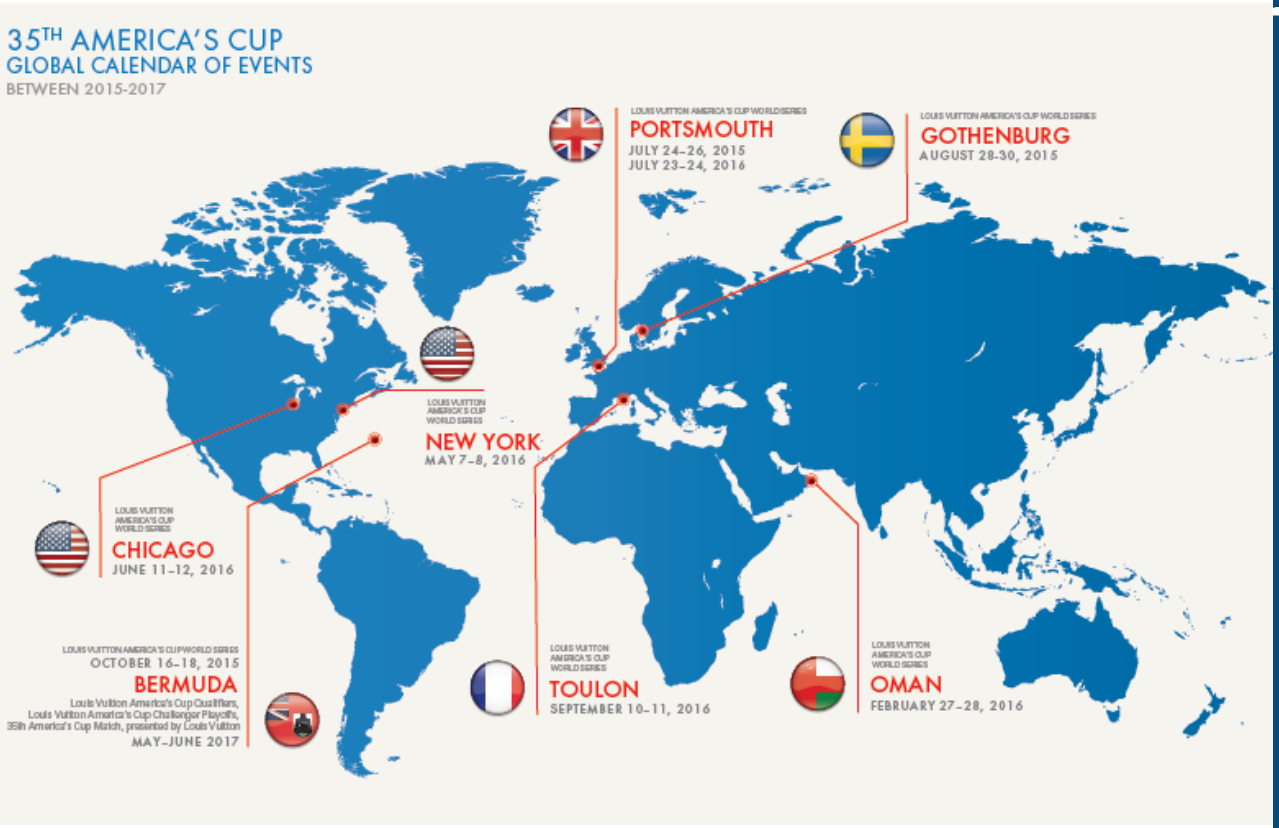
AIRBUS

Airbus brings its innovation and high-tech know-how to ORACLE TEAM USA

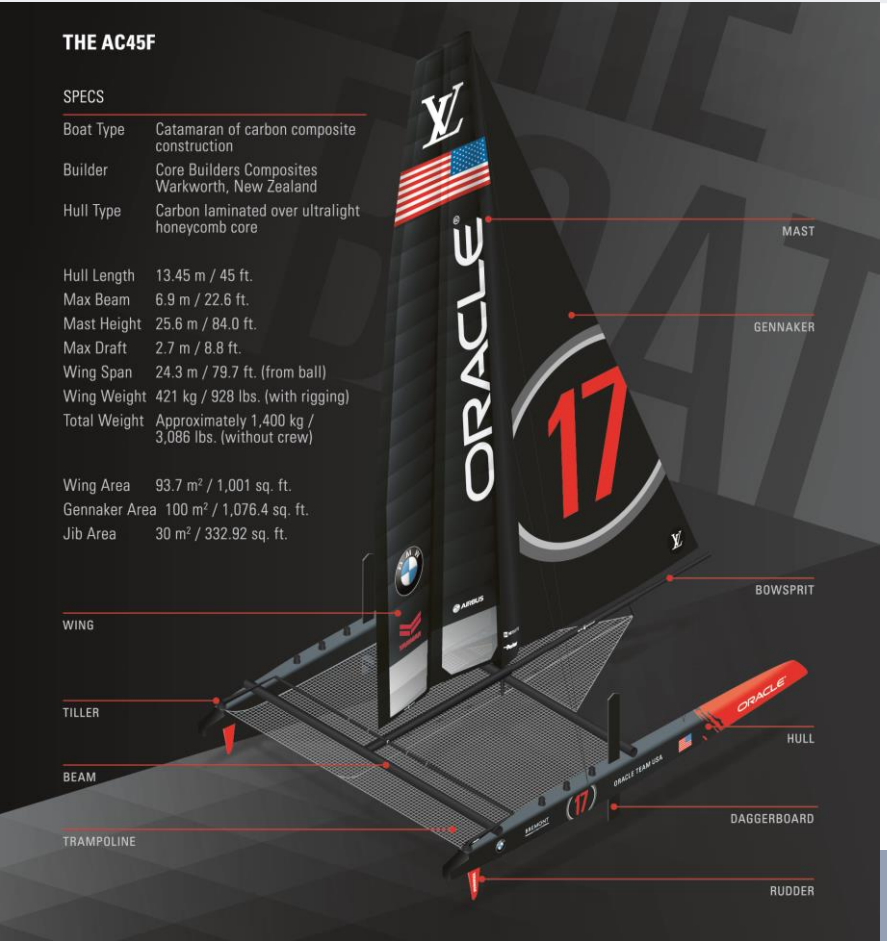
- The **AMERICAS' CUP** : **the biggest sporting event in 2017**
- ORACLE TEAM USA - **Winner of the 33rd and 34th America's Cup** Led by CEO Sir Russell Coutts and skipper James Spithill with some of the best international sailing, design, engineering and boat-building talents
- AIRBUS and ORACLE TEAM USA announced the **Official Innovation Partnership** in October 2014
- Airbus is also a technology partner to the Japanese Challenger Softbank Team Japan

THE 35TH AMERICA'S CUP



- 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

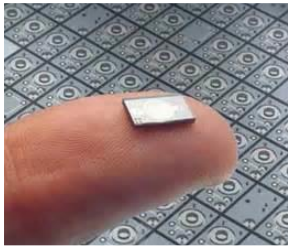
Foil Design & Testing

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

ORACLE TEAM USA / Photo Rick Tomlinson

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

Iron Shark versus Iron Bird

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

A350:	**REDUCED DRAG**	=	**LOWER FUEL BURN & INCREASED RANGE**
AC45:	**REDUCED DRAG**	=	**INCREASED PERFORMANCE**

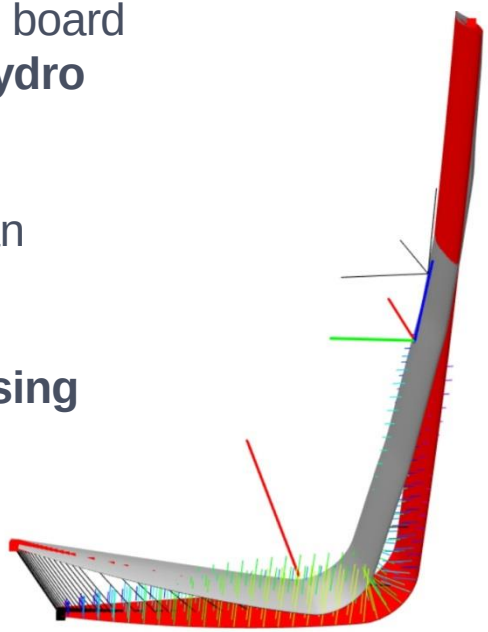
- The very accurate digital representations enable building **a more representative global sailing simulator** - equivalent to a flight simulator in the aeronautical industry

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

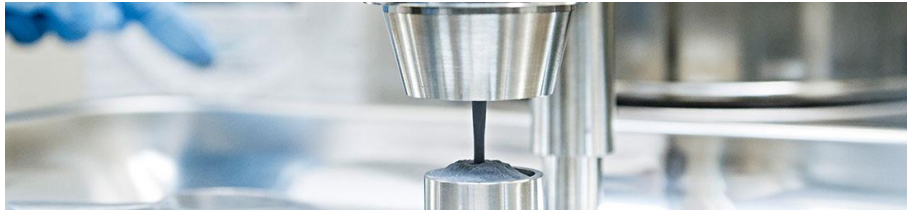
Foil Hydrodynamics

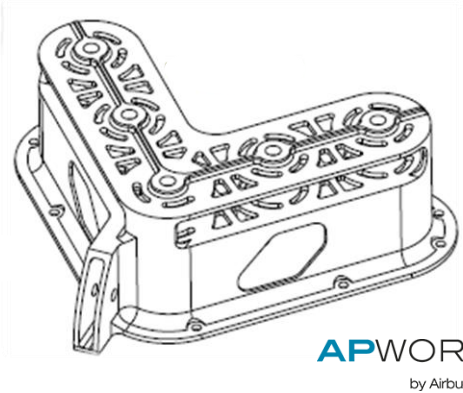
- Requirement for a **fast exploration tool** to validate dagger board design taking into account **yacht speed, cavitation and hydro elasticity**
- Airbus' **MARES** tool is used to evaluate the tail section of an aircraft in the development phase
- The tool allows **quick down selection of the most promising design concepts**



3D printing

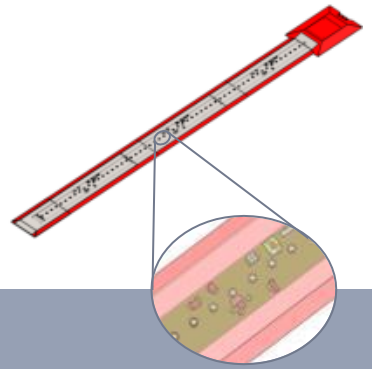
- Forward Organiser part created using **Additive Layer Manufacturing** - ALM
- Further parts are being printed
- Integration of **design optimisation**
- Objectives:
  - ✓ **Weight reduction: up to 57%**
  - ✓ **Reduction of production lead time**
  - ✓ **Reinforced strength**
  - ✓ **Increased complexity**





Airbus MEMS Technology

- Aerodynamic Pressure Sensors to **optimize performance, manoeuvers 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