DASSAULT SYSTEMES

MARINE & OFFSHORE

ORACLE TEAM USA

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Challenge:
ORACLE TEAM USA needed to design, test and build a foiling catamaran based on entirely new, design specifications in less than three years to defend its title in the 35th America's Cup.

Solution:
The team used Dassault Systèmes' **3D**EXPERIENCE platform including CATIA for virtual product design, ENOVIA for collaborative innovation, and SIMULIA for realistic simulation and testing.

Benefits:
ORACLE TEAM USA was able to rapidly develop, test and perfect its cutting-edge boat designs in a collaborative virtual environment, leveraging the expertise of its global teams to foster innovation.

SEEKING A THIRD CONSECUTIVE WIN

Since the *America* sailed to victory in 1851 in yachting's oldest international sporting event, only four nations have brought this trophy home in more than 150 years. A member of this select club is ORACLE TEAM USA, winner of the 33rd and 34th America's Cup in 2010 and 2013 and the Defender in the 2017 contest, disputed off the coast of Bermuda in June.

As the Defender, ORACLE TEAM USA was in a unique position to negotiate the rules for the 35th America's Cup. The chosen boat, the AC50, is a foiling catamaran with a 50-foot rigid wing sail manned by six sailors that can hit top speeds of 40 knots (50 miles per hour). Some of the design elements are fixed based on the rules and others are free to be customized. For instance, the daggerboards that lift the boat out of water and allow it to foil, or "fly on water," are a critical design differentiator between the teams.

"The appendages, the boards, rudders, the controls and the control of those appendages are free," Grant Simmer, Chief Operating Officer of ORACLE TEAM USA, said. "That's where the big developments are being made and that's where we're spending our technical effort."

TECHNOLOGY HAS A DECISIVE ROLE IN THE RACE

"The America's Cup is a technological and a sporting race," Simmer said. Designing the fastest and best boat is essential to winning, and technology plays a big role.

"We not only need the best solution in terms of our daggerboard and rudder geometry, we also have to have the best control system so that we can regulate the position of those foils as efficiently as possible," Simmer said.

"These boats are very, very technical boats," Ian Burns, performance manager for ORACLE TEAM USA, added. "All of the systems – hydraulics, electronics and cabin fiber work – have to be done perfectly because if you're better than your opponent, it'll translate into performance during the race. This also is why we needed the best modeling and simulation applications."

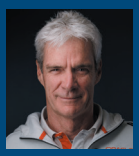
To meet its complex design challenges, ORACLE TEAM USA once again relied on Dassault Systèmes' **3D**EXPERIENCE® platform. "We know and love the **3D**EXPERIENCE platform having used it in the previous Cup," Aaron Perry, design engineer for ORACLE TEAM USA, said. "The design and simulation applications produce really efficient, fast results and they're very reliable."

"Dassault Systèmes was one of the first partners we signed up with for this Cup. Their market-leading solutions haven't disappointed us for one moment," Simmer added.

"The **3D**EXPERIENCE platform is fantastically realistic. I've been designing boats for the America's Cup for over 32 years," Burns said. "Back then, we were designing a boat and communicating our designs to the builders with 2D drawings. It was very limiting. Now, with these 3D technologies, we can visualize, analyze and build things that were technically impossible to make in the past. When we model a boat with CATIA, we can see every detail with incredible realism. It's a huge breakthrough."

FASTER ITERATIONS HELP CONVERGE TOWARD THE BEST DESIGN

3D printing also has proven to be invaluable technology that enables the team to think out of the box and quickly try out new and daring ideas that can give them a competitive advantage during the race.



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– Grant Simmer, Chief Operating Officer, ORACLE TEAM USA

"We're able to prototype parts or even entire molds for composite parts, and quickly 3D print them out of various materials such as plastic or titanium," Perry said. "The advantage is that we can create parts that cannot be machined. CATIA's composites modeling features are essential because we deal with stack ups of very thin layers of laminate sheets. CATIA gives us very accurate rebate, drop offs or the way plies will stack up. We then can quickly translate into for the shipbuilders. The **3D**EXPERIENCE platform has been invaluable in allowing us to rapidly turn around designs and get them on the water the next day after conceiving something new."

"Once tested on the water, if we need to make design changes, we can rapidly implement them and reorder a 3D-printed

part," Burns added. "Design iterations are very fast and a clear example where technology from the **3D**EXPERIENCE platform is accelerating our cycle time and our ability to build a better boat."

The design team also uses SIMULIA for virtual simulation to optimize boat weight. "One area where we use the **3D**EXPERIENCE simulation applications is for structural design of the boat and its components," Perry said. "We can apply loads and restraints to see where we can remove material to reduce the boat's weight or where we need to add material for additional strength. We don't waste time producing physical prototypes of parts that may break or that we have to refine down the line. We can hit our target on the first go."

A RACE AGAINST TIME

"When we received the America's Cup rules describing the characteristics every boat must abide by, that's when the fun began," Burns said. "People are quite passionate about predicting what the winning and most creative solutions would be. The hardest part, in my opinion, was meeting our deadlines. These boats consume an incredibly large number of man-hours. Some components have over 10,000 pieces of carbon fiber that are laid one on top of the other, individually templated and cut so that they're perfectly oriented. It's a painstaking and time-consuming process because there are numerous iterations – churning out new designs, testing them, and redesigning them to make them better. It's always a balance between meeting schedules and making the best product we can."

"Luckily, changes can be implemented very quickly using the **3D**EXPERIENCE platform," Perry said. "In a typical day, we set our daggerboards at specific angles, in all degrees of freedom, and with CATIA we look at the exact range and motion we can expect when executing a certain maneuver. We then run through it on the water, make note of the wind conditions, and other results. After practice, we debrief, look at the video, run through the data we collected off the water, and use CATIA to show how a change might affect the boat the next day out. We repeat this process until we make measurable gains.

"Having a solution that allows us to model the hull, the foils, the composites components and the associated molds, and to simulate how they will interact with the water or the air in a fast and efficient manner is critical to meeting our deadlines," Perry added. "In fact, what would normally require four designers to do, can now be done by only one person with the **3D**EXPERIENCE platform."

The design team also tests the boat's control systems to determine if they function properly. "With the **3D**EXPERIENCE platform, we can visualize an entire system and simulate the time needed for this system to engage when a button is pressed," Burns said. "Because in a race, response time is critical."

After practicing on the water, ORACLE TEAM USA inputs the gathered data into the **3D**EXPERIENCE platform in order to analyze and simulate how a change may affect the boat making measurable and time-saving gains.

Focus on ORACLE TEAM USA
American yacht racing team and Defender of the 34th America's Cup

Number of people on the team: 80

Headquarters: San Francisco, California

For more information
oracle-team-usa.americascup.com/en/home.html

WORKING TOGETHER

Designing these boats is a collaborative effort between the design team and the sailing crew, the latter providing input from the earliest stages so that the right design choices are made.

"The collaborative capabilities of the **3D**EXPERIENCE platform are invaluable assets during design review meetings with the crew," Burns said. "Our sailors are really technology-savvy and appreciate the fact that the **3D**EXPERIENCE platform allows us to tie everything together – the boat's design and the data collected on the water – to perform simulations that enable the crew to share new design ideas, in real time, with the rest of the team. The sailing team can be virtually immersed in the 3D model of the boat and make design calls on how it should be arranged, way before we get to the point of trying it out or physically mocking it up. Making design decisions at these early stages, rather than after the boat is built, saves us a lot of time. Historically, the sailors get on the boat, they find things they don't like and we're required to make changes in the workshop. This is no longer the norm. The **3D**EXPERIENCE platform helps us get to the starting line in great shape."

"Moreover, members of the ORACLE TEAM USA team are scattered around the world in Bermuda, US, Germany and New Zealand," Perry said. "Everyone is connected to the platform enabling me, for example, to work on a particular connection where the rudder elevators meet the foil, and to save the latest version so that the person working at another site can create all the molds that the builders in New Zealand can then access – all in one afternoon. With the **3D**EXPERIENCE platform, I'm confident that everyone has the most up-to-date and accurate designs and know that when I make modifications, all downstream stakeholders have immediate access."

Daring design choices, efficient and highly-trained crews, and tactical decision-making, the America's Cup teams' every accomplishment will be followed by millions of people around the world. What fuels a team like ORACLE TEAM USA? "Passion," Simmer said. "Team spirit is strong and one of the reasons, if you ask me, why we won the 34th Cup. Everyone wants to do a good job and not let their teammates down. Whether you're a sailor on the boat, or one of the designers working on a new component, or a manager making sure that the team's got everything they need to succeed, everyone carries out their role in the team with passion doing what they do to the best of their ability every day. This is what drives us."

Our **3D**EXPERIENCE® platform powers our brand applications, serving 12 industries, and provides a rich portfolio of industry solution experiences.

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