

SIEMENS

Ingenuity for life

Marine

Land Rover BAR (Ben Ainslie Racing)

America's Cup team uses Siemens PLM Software technology in quest to "bring the cup home"

Products

NX, Teamcenter, Femap, Fibersim, STAR CCM+

Business challenges

Design and configure a fast boat

Ensure stability and safety

Provide continuous improvement

Keys to success

Use integrated design and analysis tools

Achieve speedy design-to-manufacture process

Use NX Open scripting to enable automated workflows

Leverage Teamcenter to manage all technical data and documentation

Results

Saved time by using simultaneous multiple analyses

Enhanced performance by simulating complex fluid flows

Ensured accurate manufacturing by using precise geometry

Gained efficiency with scripted processes

Siemens PLM Software solutions enable critical performance improvements to continue right up to race day

The final countdown

For three years, Siemens PLM Software's product lifecycle management (PLM) software has been underpinning Land Rover BAR's ambitious project to design, evaluate, verify and produce a winning America's Cup Class (ACC) catamaran on time and on budget.

The motto for Land Rover BAR (Ben Ainslie Racing), based in Portsmouth, England, is, "Bring the cup home." The goal is to return the America's Cup to Portsmouth where the yachting race first took place in 1851. "As a new team, it has been a fantastic journey so far," says Martin Whitmarsh, chief executive officer (CEO), Land Rover BAR. "We won the America's Cup World Series and we go into the final qualifying with a two-point advantage."

After more than 85,000 hours of design and build across multiple disciplines, Land Rover



Results *(continued)*

Avoided inconsistency and error by using automated workflows

Maximized design freedom within compliance limits

Enabled agile response to competitive developments

BAR has a 15-meter racing boat that includes 1,200 meters of electronic and electrical cabling connecting 190 sensors and four video cameras. R1, also known as Rita, was launched in Bermuda in February, 2017, three months before the start of the 35th America's Cup. After the inaugural sail, Olympic medalist and 34th America's Cup winner, Sir Ben Ainslie, who is team principal and skipper, commented, "It's a massive day for the team to get our race boat out on the water sailing for the first time, and it was a really, really promising sail."

Simon Schofield, design manager, Land Rover BAR, adds, "The boat is in the water but we are still developing parts every day, iterating very quickly, coming up with new shapes within NX and manufacturing very quickly." During the countdown to the first race, intensity increases as the engineering team focuses on optimizing performance. Whitmarsh states, "Our aim is still to make the boat faster and Siemens PLM Software is enabling us to do that."

An integrated virtual environment

Land Rover BAR can make last-minute changes because it has an integrated virtual environment for digital modeling and simulation, using solutions from product lifecycle management (PLM) specialist Siemens PLM Software. These include NX™ software for product design, Teamcenter® software for data management, the Fibersim™ portfolio of software for composites engineering and the Simcenter™ software portfolio, which



incorporates Femap™ software and STAR CCM+® software for engineering analysis and computational fluid dynamics (CFD) analysis.

Land Rover BAR has gained clear benefits by building up its Siemens PLM Software toolset over the past three years. "Our Siemens PLM Software toolset is now mature and we have done the background work of developing models and proving engineering processes," says Schofield. "As a result, we might spend a few days on a task instead of a month. For example, we have a scripted process between Fibersim and NX to produce templates and patterns for plybooks. This is automated at one click so it is not only quicker, it is less prone to mistakes."

“Our aim is still to make the boat faster and Siemens PLM Software is enabling us to do that.”

Martin Whitmarsh
Chief Executive Officer
Land Rover BAR



Team develops a digital twin

By using Teamcenter as the digital thread for managing engineering processes, team members know they are all working with a single source of data. Whitmarsh comments, "For a team of 30 to 35 design engineers, it is very important to have a high-level tool that allows us to share information in a relatively fast-moving environment. We race over a period of a month and each day the boat will be different. We can change hydrofoils up to the morning of the race."

The PLM solutions from Siemens PLM Software have enabled Land Rover BAR to create a virtual racing boat, known as the digital twin, which the design team can rapidly evaluate and modify. Land Rover BAR has an as-built configuration, a digital twin of each possible configuration of the boat. In the weeks preceding the race, as designers are still finalizing the dagger boards, they can ensure that each configuration maximizes the degrees of freedom (DOF) yet remains firmly within the window of compliance.

Managing complexity and maximizing innovation

The software that enables Land Rover BAR to conduct CFD analysis is STAR CCM+, and Rodrigo Azcueta of the concept team is a long-time user. "We make design decisions about the shape of components based on CFD analysis," he explains. "Hydrodynamic shapes deform if they are too light and thin, so we need to understand how



heavily components are loaded and how far can they be pushed to give the best performance."

One of the most challenging areas is the coupling of flow with structural integrity, known as the fluid-structure interaction. "We have to understand consequences; for example, what else changes when a structure deforms? It is not a state of steady flow," comments Azcueta. The team also has to contend with cavitation, a physical phenomenon that occurs in water when flow accelerates around a profile, such as a rudder, and pressure drops. Cavitation bubbles appear, creating drag and as a result, the boat hits a speed limit. "Cavitation is a problem that we aim to predict and avoid through modeling, and STAR CCM+ makes this possible," says Azcueta.

"The America's Cup is the most exciting race on water, the pinnacle of sailing by the best teams in the world. It is also an engineering race and the Siemens PLM Software toolset is helping us to move closer to winning."

Martin Whitmarsh
Chief Executive Officer
Land Rover BAR

"Considering that we had no legacy knowledge, the Siemens PLM Software toolset has done exactly what we hoped it would do."

Andy Cloughton
Chief Technology Officer
Land Rover BAR

“When we see other boats we can model something very quickly to assess whether we need to worry or not. Other teams are obviously doing the same, but we are much more integrated with streamlined workflows. We are the most integrated team and this gives us agility.”

Simon Schofield
Design Manager
Land Rover BAR

Multiple simulations, some lasting a few hours and others taking up to a day, are running 24/7 using a cluster of high-performance computers. America’s Cup rules do not allow a team to have an endless selection of real components, but the team can build as many virtual components as they want. Although the design of large components such as dagger boards must be frozen three months before the first race to allow time for manufacturing, the team is still able to work on smaller components in the final few weeks.

Digitalization speeds manufacturing

Andy Cloughton, chief technology officer (CTO), Land Rover BAR, says, “From my point of view, we are reaping the benefit of groundwork that we’ve done because all our modeling is parametric. Because these racing boats are so complex, we need to be precise, especially as we are

manufacturing at different sites away from our own base. Despite the complexity, we have compressed the time spent on producing drawings and can quickly go from a design shape to a manufactured drawing, and this means that we can delay decision making as much as possible. That is a key advantage with regard to the dagger boards, which are the main performance differentiators.”

The dagger boards are made from numerous layers of carbon fiber built up from a mold in a time-consuming process that involves the machining and scanning of surfaces. The design team must also allow for the thermal distortion that occurs during manufacture, and update machining files accordingly. “The accurate handling of geometries is the main reason that we originally chose NX, which allows us to easily continue defining and refining geometry,” explains Cloughton.



Control and consistency support collaboration and compliance

With Teamcenter supporting all Land Rover BAR's development work, designers and engineers in Bermuda and Portsmouth are seamlessly accessing the same design details and progress reports.

Teamcenter plays a particularly significant role in helping manage compliance. Instead of a time-consuming process involving manual input, scanning and checking, each submission is made with the click of a button. Teamcenter is used to store the certificates issued for each individual part. Because it holds a set of preapproved compliance documents for each potential racing configuration, Teamcenter is used to demonstrate compliance whenever the boat is physically checked and measured by referees.

Maximizing productivity, optimizing performance

"Considering that we had no legacy knowledge, the Siemens PLM Software toolset has done exactly what we hoped it would do," confirms Cloughton. "We are all working together in a consistent and integrated



manner and that is a standout success for Land Rover BAR. Our workflow is entirely in the Siemens PLM Software environment; nobody is running separate applications here and there."

Schofield comments, "When we see other boats we can model something very quickly to assess whether we need to worry or not. Other teams are obviously doing the same, but we are much more integrated with streamlined workflows. We are the most integrated team and this gives us agility."

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Solutions/Services

NX

www.siemens.com/nx

Teamcenter

www.siemens.com/teamcenter

Femap

www.siemens.com/plm/femap

Fibersim

www.siemens.com/plm/fibersim

STAR CCM+

mdx.plm.automation.siemens.com/star-ccm-plus

Customer's primary business

Land Rover BAR is a commercial sporting team led by Olympic gold medalist and 34th America's Cup winner, Sir Ben Ainslie. Launched in June 2014, the team's long-term aim is to bring the prestigious America's Cup back to Britain, where the first challenge was held in 1851 off the Isle of Wight.

land-rover-bar.americascup.com

Customer location

Portsmouth

England



Ainslie is completely focused on performance: "We can see a lot of the upgrades coming together and increasing our performance markedly, which is where we need to be." Whitmarsh concludes, "The America's Cup is the most exciting race on

water, the pinnacle of sailing by the best teams in the world. It is also an engineering race and the Siemens PLM Software toolset is helping us to move closer to winning."

"Cavitation is a problem that we aim to predict and avoid through modeling, and STAR CCM+ makes this possible."

Rodrigo Azcueta
Concept Team
Land Rover BAR

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