SIEMENS

Solid Edge

Edison2

The car of the future is very light, and entirely designed using Solid Edge

Industry

Automotive and transportation

Business challenges

Concept car needs to be redesigned to be more consumer-friendly

Original design work used a history-based modeling approach

Keys to success

Fast changes to original CAD geometry using synchronous technology

Automatic updates to interlinked components

Results

Car designed using Solid Edge won $5 million X Prize (mainstream category)

Changes to existing CAD models are made in minutes; without synchronous technology the same changes could take days

Innovations and lessons learned with concept car will lead to greater fuel efficiency in production cars

Synchronous technology speeds the transition from prize-winning concept vehicle to preproduction prototype

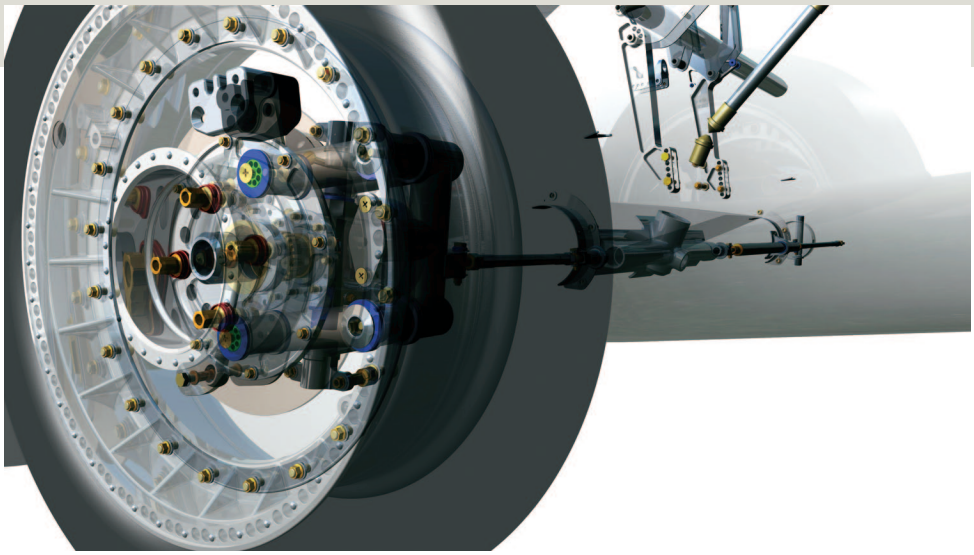
$5 million prize winner

Edison2 was founded by Virginia real estate developer and automotive entrepreneur Oliver Kuttner, in response to a challenge – the Progressive Insurance Automotive X Prize competition. This competition offered a top prize of $10 million to the team that could create a safe, clean, production-capable, well-performing vehicle that gets over 100 miles per gallon equivalent (MPGe, or the amount of energy contained in one gallon of pump gasoline; this measure was used as a way of including electric vehicles in the competition). Kuttner assembled a "dream team" from the top ranks of sports car racing.

"We entered the competition expecting to build an electric or electric-hybrid vehicle," says Brad Jaeger, director of R&D (research and development) at Edison2. "But our early analyses showed that instead of lugging around hundreds of pounds of batteries, a car would get better mileage if it were lightweight and had low aerodynamic drag." That led Edison2 to choose a more conventional power source for its competition vehicle: a heavily modified

"Anyone who has an interest in design should consider Solid Edge with synchronous technology. It's brilliant."

Ron Mathis
Chief of Design
Edison2



Yamaha WR250 250cc single-cylinder, internal combustion engine.

The resulting car, which ended up winning the $5 million mainstream class of the X Prize (vehicles with space for 4 passengers and cargo), weighed only 830 pounds. Unlike some of the cars in the contest, which were modified versions of small production vehicles such as a Prius and a Smart Car, the Edison2 was designed from scratch. Every component was evaluated and redesigned when necessary with an eye toward simplicity, strength and low weight. For example, its brake calipers, which usually weigh several pounds, are less than one pound; lug nuts are 0.2 ounces instead of 1 ounce.

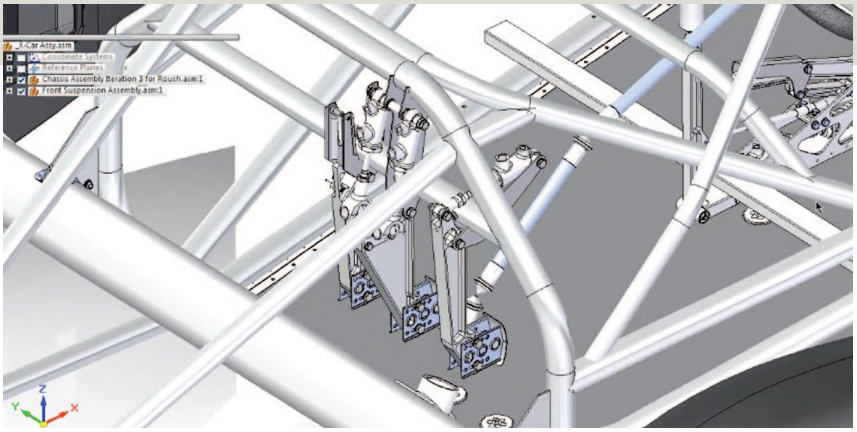
In terms of performance, the Edison2 was a huge success. It achieved the lowest coefficient of drag of any multi-passenger vehicle ever tested at the GM wind tunnel. At the Chelsea Proving Grounds, it had the best results ever recorded for a coast-down test, which is a way of looking at drag and includes rolling resistance. The car's fuel mileage ratings, as determined by the X Prize Foundation and confirmed by Argonne National Labs using standard Environmental Protection Agency (EPA) testing protocols, were 129.6 MPGe on the highway test, and 110.8 MPGe in combined city and highway driving. Equally impressive is the fact that the Edison2 car had the lowest amount of greenhouse gas emissions (82.6 grams/mile CO2) of all contest entries, including the electrics and hybrids.

Evolving the winning concept toward production

The Edison2 concept car that won the $5 million prize was designed entirely using Solid Edge® software from Siemens PLM Software. The team's chief of design, Ron Mathis, had been using Solid Edge for about 10 years at the time Edison2 was founded and, given the tight, two-year timeframe for the X Prize, he wanted to stick with the solution he had already used to design a number of successful race cars. "One of the cars Ron designed using Solid Edge came in third in its class at Le Mans this year, so he knew Solid Edge had the functionality he needed, in addition to being easy to use," says Jaeger.

In their efforts to make their car as light as possible, the Edison2 designers relied on the functionality of Solid Edge for determining the weight of digital components and assemblies. "This was invaluable," Jaeger notes. "It gave us the direction we needed as we were designing the car."

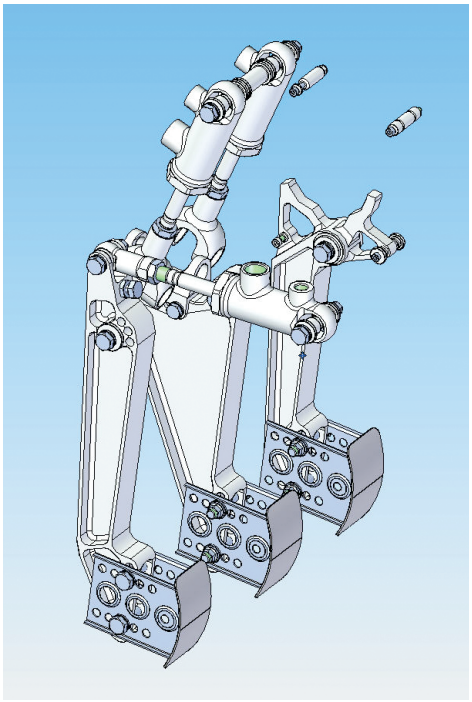
Now, with the X Prize competition over, Edison2 is using the lessons learned there to create a highly fuel efficient, next-generation car that the company hopes will eventually go into production. Called the Very Light Car, this differs from the



concept car in ways that make it more consumer-friendly, such as larger doors, and larger wheels with more powerful brakes, to name a few of the changes. Making these modifications has gone faster than expected because, since designing the concept car, Edison2 upgraded to Solid Edge with synchronous technology. "Synchronous technology is helping us develop the Very Light Car in a very short timeframe," says Jaeger. "We plan on using synchronous technology a lot in developing the next-generation car, and it's really going to cut down on the time to production with our preproduction prototype."

An easy way to work with history-based models

The original Solid Edge designs that are now being modified were created using an order-based modeling approach. There is no problem importing these into Solid Edge with synchronous technology, according to Jaeger. "Solid Edge is designed to work with both ordered or synchronous features and allows the designer to use either as needed. As an added bonus synchronous technology can also edit imported models not matter what CAD system was used to create them," he explains.



As an example of how Edison2 benefits from synchronous technology, Jaeger points to changes they made to the brake system. "We opened the original Solid Edge assembly and using synchronous technology we were able to instantly modify the rotor by adding two inches to the diameter as well as increasing the thickness," Jaeger says. "Then we created a few live sections, placed some critical dimensions and then modified the part. All this took about two minutes. Without synchronous technology, this change could have taken days." The rotor is part of an assembly, and because the parts in the assembly were interlinked, associated components updated automatically. "Without synchronous technology, we might have had to redesign the entire brake system," he adds.

The ability to make even fairly extensive design changes so quickly is allowing Edison2 to incorporate its concepts into a safe, comfortable car for the driving public in an amazingly short period of time. Another example is the work being done to strengthen the frame, which illustrates why fast design changes are crucial to getting the next-generation design even better. "As we move forward toward a car that will meet, pass and exceed FMVSS crash test standards, we're developing the frame to absorb more energy as it hits things," explains the chief of design,

Solutions/Services

Solid Edge with synchronous technology
www.siemens.com/solidedge

Customer's primary business

Edison2 combines physics with innovative design to produce workable and sustainable transportation solutions.
www.edison2.com

Customer location

Lynchburg, Virginia
United States

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Mathis. "It's an iterative process and synchronous technology is golden for allowing us to make changes quickly and easily. We can then simulate the new design using nonlinear finite element analysis, and make more design changes based on those results," Mathis adds.

Edison2's innovations in automotive efficiency apply regardless of power source. In addition to improving gas mileage in a car with an internal combustion engine, the Very Light Car's chassis and body will make hybrid and electric cars more efficient as well, helping solve their problems with range and performance. The Very Light Car is a more sustainable vehicle – not just efficient to drive, but cradle-to-grave environmentally more responsible. Less mass means fewer material inputs. Energy-intensive materials and hazardous or scarce materials are largely being avoided in favor of conventional materials, such as aluminum and steel, that are readily available, easily made in volume, and completely recyclable. "The Very Light Car has the potential to be the car platform of the future, and Solid Edge is helping make it happen," Jaeger concludes.

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