

# A Winning Formula

The Renault F1 Team is under tremendous pressure to develop and deliver complex composite parts in the traditional 16-week run up to the Formula One (F1) season, when it must completely redesign, manufacture, analyze, and test its vehicles. But that task paled in comparison when the team was asked to design and produce a composite diffuser for the R29 race car once the 2009 season was already underway. That could have put a real dent in our season.

*Software and services help Renault F1 Team speed to the starting line.*




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**Vitaly Petrov in the Renault R30, successor to the R29, leads two competitors on May 9th in the 2010 Spanish Grand Prix at Circuit de Catalunya in Barcelona.**

However, with the help of FiberSIM composites engineering software and the experience gained from working with the Vistagy professional services organization, the Renault team was able to reduce the time it took to design and manufacture a composite diffuser from 12 weeks to six weeks. As a result, we were able to get the new diffuser on the track two races sooner than would have been possible without FiberSIM, dramatically enhancing our competitiveness.

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In fact, we found that the 50% savings experienced on the first try at a double diffuser design, which reduced the composite laminate design time from 12 days to six days, was bettered again on the next iteration. The subsequent version of the double diffuser took just three days compared to about nine days for previous developments.

There's a constant battle in F1 to find ways to design and manufacture parts better and faster. Our experience with FiberSIM on the development of the composite diffuser once again demonstrated just how critical the software is to our efforts to meet our deadlines and put the best possible car on the starting grid.

Like many other teams, we had been working on our own version of the large double-diffuser floor, which smoothly channels air under and out of the back of the car, increasing downforce, lateral grip, and overall performance. The double diffuser was used to great effect by the Brawn GP, Toyota, and Williams teams in the first two rounds of the 2009 Formula One season.

However, ambiguity in the regulations led many teams to feel that the double diffuser was not permissible under the 2009 regulations. The Renault F1 Team was one of four teams to protest its use. The protest was denied by the governing Fédération Internationale de l'Automobile (FIA). Once the FIA issued the ruling allowing the use of the new diffuser, we turned to Vistagy for software and services that would enable us to get the diffuser on the track as quickly as possible.

### **Changing the Protocol**

To ensure efficient resource usage and productivity during the preseason, our team relies on established procedures. That's especially the case with the software we use to design and manufacture our cars. The team had never introduced new software into the production environment the first time we used it.

But that changed for the 2009 season even before we knew about the diffuser issue. Based on the team's success with previous versions of the FiberSIM, we were so confident that

Both decisions proved fortunate. We found that taking a comprehensive view of Vistagy's software and services—considering them as a complete solution—gave us the tools and knowledge necessary to maximize our design-to-manufacturing process, and significantly contributed to our ability to build the best possible race car.

Having the TC on the premises changed the dynamic in a very positive way. For instance, if we ran into a design scenario that team members were not sure how to deal with, it was much better to have the TC right at hand so she could immediately apply her knowledge of the software. While talking to someone on the telephone in technical support may be very helpful, it would be impossible for that person to have the same depth of understanding of a particular issue as a person who is working on-site with the team.

We found that by having a TC on site we were able to pick up a lot of tips and tricks of how to best use the software and how to develop the optimum composites engineering methodologies. It moved us away from just using the most basic functions, and enabled us to get the most out of the software. It was also valuable to be able to have a two-way dialog with someone who was so knowledgeable about FiberSIM and understood what we were doing. As a result, we were able to develop a much deeper understanding of the software.

### **Saving Time**

There's no question that having the TC spend a month with us during the preseason helped us considerably when it came time to move quickly to develop the new diffuser.

For the previous seven seasons, we had used FiberSIM to design and manufacture composite parts, but for the R29 we used it from the very beginning of the design process through manufacturing on our new 3-D CAD CATIA V5 system, which we used for production of the entire car.

In addition to the diffuser, the team designed a number of other composite parts with FiberSIM for the R29, including the gearbox, side pods, and wing main planes. In every case we found that FiberSIM saved us a day or two in the time it took

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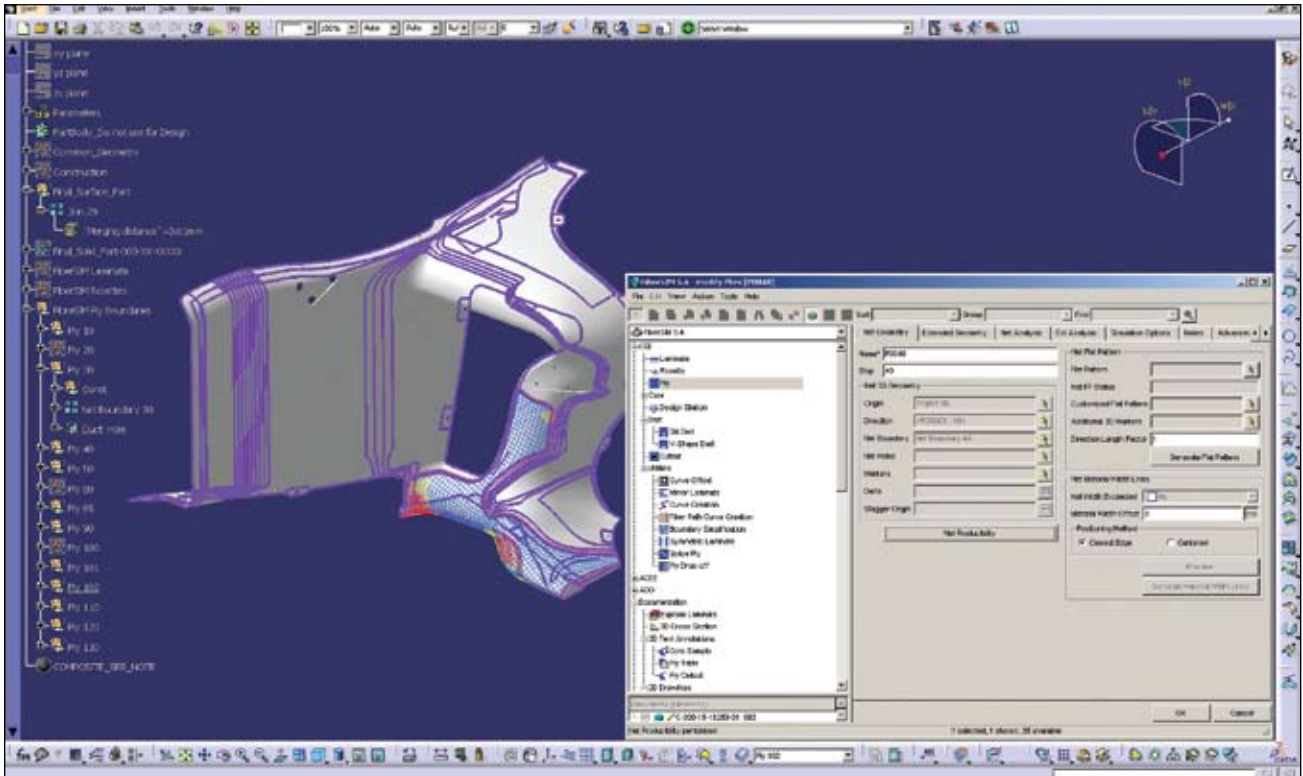
it would enable us to reduce the product development cycle time, enhance the precision of composite part designs, and increase the manufacturability of parts, that we put it into the production environment for building the R29 race car.

And we did one other thing. We brought in a Vistagy Technical Consultant (TC) to work with us for a month so that she could get an intimate understanding of what is involved in designing a Formula One car, which, in turn, would enable us to get the most out of FiberSIM.

to design these parts, which is impressive when you consider we had just implemented the new version of the software, and were working with a new user interface.

### **Gearing Up**

Using FiberSIM to design the gearbox was particularly challenging because this part has extremely complex curves and is made up of small plies—many just a few inches long and that look the same—so it is a big job to manage the plies.



**For the first time, FiberSIM was used to design a number of composite parts in addition to the chassis on the R29, such as the side pod shown here.**

The gearbox consists of more than 700 plies of carbon fiber and also plays a structural role, integral with the whole rear end of the car, dealing with extreme power transmission, suspension loads, and rear-wing aerodynamic loads.

Once the 3-D CAD model of the gearbox was complete, we used FiberSIM to enter ply specifications, such as material, sequence, start point, and orientation of the ply layup. We then used the software to simulate actual layup and check for weak points caused by fiber deviation over the gearbox curves, thus determining the optimal layup starting points and directions. Finally, our engineers used it to create flat patterns from the completed 3-D ply data, and exported ply layup patterns to an automated cutter and a laser projection machine that ensured accurate and rapid ply layup.

Since our team outsources some of the manufacturing, FiberSIM's ability to capture design intent proved very important to ensuring that the person doing the layup was clear on the design objectives. This maintains consistency in the design from car to car, a critical consideration for making the most precise performance evaluation.

We normally expect some ambiguity when using ply books to direct the manufacturing process, but our supplier was able to manufacture the diffuser just as we designed it using FiberSIM-generated ply books. In fact, they told us the quality of the manufacturing data was better than anything they'd ever had before.

That makes a big difference in the 16-week period leading up to the season, but it is even more critical during the season when a part needs to be produced and shipped in time for the next race, as was the case with the diffuser.

### **Precision Pays Off**

In Formula One, there is a race on the track and a race to the track. Most people are familiar with the race on the track, a colorful and thrilling two-hour test of driver and machine. But they are less familiar with the race to get lower-weight, better-performing components to the track as quickly as possible.

F1 teams willingly spend tens of thousands of dollars to save mere ounces to enhance performance, so we were more than a little impressed when we analyzed the R29 chassis and found that the design data FiberSIM generated for over a thousand plies was 100% accurate. Achieving that kind of precision is absolutely critical to continuously improving the car.

Perhaps equally as impressive is how our partnership with Vistagy has grown over the past seven seasons. The transformation of Vistagy from a leading-edge software company into a real solutions provider that combines its expertise in software development with a penchant for developing an understanding of its customer's challenges and goals has been key to our success on and off the track, and has established a benchmark by which we measure all our partnerships. ▽