As the tallest member of the team, Charlie Dawson is strapped into the driver's seat for part of tech inspection known as the tilt table. First tilted to 45 degrees and inspected for leaks from the fuel system, the car is then tilted up to 60 degrees and inspected again. The judge on the right raises the car (see the levers to his right), then does the fuel inspection and checks to make sure all four tires are still on the platform.

2006 SAE team, from left: Chris VanKeulen, Charlie Dawson, Justin Johnston and Nick Shatek.

Winners on wheels: small teams get big results

Some St. Cloud State engineering seniors choose to "throw their 'caps' into the ring" by entering their capstone design projects into a competition.

The results are something to cheer about.

Take the Formula SAE car, for example. It's called a "formula" car because, like the professionally built Formula One race cars, it is designed according to strict specifications — a formula — that results in a single-seat, open-cockpit, open-wheel car, with the engine positioned behind the driver. The "SAE" stands for student automotive engineers.

The capstone project of mechanical engineering seniors Nick Shatek, Charlie Dawson and Justin Johnston, who were assisted by sophomore, Chris Van Keulen, the flashy red car placed better than almost two-thirds of the entrants at the 2006 Society of Automotive Engineers' (SAE) competition in Detroit.

Some of the competition came from as far away as Germany, Japan and Venezuela.

"I think we went above and beyond our expectations by finishing every event and placing 50th out of 130," Shatek said. It was the first and, to date, only time a St. Cloud State team has entered the SAE competition.

Another example is the "by-invitation-only" unattended ground vehicle (UGV) competition sponsored and funded by General Dynamics, a major U.S. defense contractor headquartered in Virginia with offices in the Twin Cities and elsewhere. Much smaller than the SAE event, the two UGV events thus far have been held in Rogers, Minn., and Bloomington.

"We didn't even know what a UGV was," said Charles Wilson, a mechanical engineering major who worked with electrical and computer engineering majors to design and operate an unattended ground vehicle for the inaugural competition in 2005.

But the team soon learned, as General Dynamics supplied them with the motorized chassis. With that as the foundation, they designed what is essentially a robot — controlled and navigated through a wireless link, using only telemetry from the robot, including video, a global positioning system (GPS) and an electronic compass.

Although they soundly defeated the University of St. Thomas, team members had a moment of anxiety early on.

"Their UGV seemed to have all the bells and whistles, and we were scared we might not stand a chance," said James Hennessey. One of the team's electrical engineering members, Hennessey, along with Robert Nunn and Jeff Dukowitz, designed the robot's "brains" in coordination with Wilson, who designed and fabricated its "brawn."

Small enough to fit into a backpack, each UGV has to maneuver through hostile terrain (…well, OK, a golf course) and carry out a mission under the remote guidance of operators who can see only what the UGV "sees" through its camera.

In 2006, the St. Cloud State UGV team triumphed again. A team of one mechanical engineer, Martín Romero-Sánchez, and three electrical engineers, Andy Neddermeyer, Davian Richards and Wesley Herold, defeated two eight-member Minnesota State University-Mankato teams. The robot they designed was capable of deploying and retrieving four sensor pods at predetermined locations.

"The fact that the St. Cloud State team was outnumbered two to one and still managed to develop a more complex but more elegant design is a testament to the hard work of our students and our excellent engineering programs," said Mark Petzold, an assistant professor in the Department of Electrical and Computer Engineering and a 2006 UGV-team advisor.

St. Cloud State's Formula SAE team was even more dramatically outnumbered. Since the car's chassis was designed and fabricated by Steve Swedal and Kevin Faber, mechanical engineering majors who graduated in 2005, a total of six students actually produced the car. The other teams competing in Detroit averaged 30-35 members per car.

Ken Miller, associate professor of Mechanical and Manufacturing Engineering and advisor to the Formula SAE car teams, said most capstone projects are not designed for competition, but designed to meet the needs of local companies.

Such projects are advantageous to both the students and the companies, as it gives students direct experience with the kind of work they will likely be seeking upon graduation and are funded by the company, he said. In return, the company gets a quality project designed within a two-semester time frame and without extra costs.

Miller said there are plenty of opportunities for engineering competitions — SAE alone has at least six different types of car races — but these kinds of competitions require the students to do fundraising by recruiting sponsors to pay for parts and supplies.

"On the other hand, they are usually a lot more fun," he added.

Competition aspect aside, the UGV and Formula SAE projects provide other kinds of opportunity for the students. Hennessy spoke of the value of belonging to what he called a "cross-functional" engineering team.

"There are not many places in industry in which electrical engineers work in complete isolation; most projects have teams which include resources from mechanical and electrical engineering along with procurement, manufacturing engineering and other support personnel. The exposure to this cross-functional environment in school taught me skills that I use now in my career," he said.

The 2006 UGV team and their faculty advisors are all smiles after the team was named winner of the General Dynamics competition. From left: Mark Petzold, Martín Rámero-Sanchez, Warren Yu, Andy Neddermeyer, Davian Richards and Wesley Herold

Wilson also cited the value of cross-functionality.

"Granted they're engineers but we think on a totally different wave length," the mechanical engineering major said of his teammates.

"To communicate our thoughts and designs to one another, it was — I think it was — a great learning experience. Out in the industry, you are not going to be working with just a team of mechanical engineers; you are going to have computer science, electrical, mechanical — a vast array of different disciplines. So that was definitely a huge benefit of the project," he said.

Even within disciplines, these projects can require a wide range of skills. While the Formula SAE team members were all mechanical engineering majors, Shatek said the skills of Justin Johnston were especially valuable to the team.

The SAE rules require a lot of knowledge about the impact behavior of polymers, something undergraduate students don't normally work much with, Miller said. Nevertheless, Johnston was able to design the crush zone — the "nose" portion of the car that must absorb most of the energy of a direct impact.

The UGVs' mission in 2005 was to mark (shoot accurately at) targets with paint balls.

For more information on the Formula SAE car, please go online to http://www.stcloudstate.edu/news/pressrealeases/default.asp?storyID=19320.

For more information on the UGV competition, please go online to http://www.stcloudstate.edu/news/scsunow/default.asp?storyID=19000.