Better, Stronger, Faster: New Military Vehicle Will Improve Safety and Efficiency for Marine Corps

Those who recall the old Jeep, of World War II fame, may view today's imposing Humvee as a cutting-edge vehicle. Yet the 1970s-designed Humvee has been the military's all-around workhorse almost as long as the Jeep was -- and commanders today are calling for a vehicle more suited to 21st century tasks and perils.

Engineers at the Georgia Tech Research Institute (GTRI) recently took on the substantial challenge of developing revolutionary, "leap-ahead" designs for not one, but two, new Marine Corps vehicles. The GTRI researchers have been joined by an outside team that includes professional vehicle designers. The aim is to unite academic expertise with real-world, advanced engineering and production-level experience.

"What's different about this for Georgia Tech is we're partnering with very senior people from the auto industry," says Mike Dudzik, a GTRI technical fellow. "These are people who are well known for building affordable, high-performance vehicles, such as for NASCAR, with maximal use of existing commercial technology."

Georgia Tech Research Institute (GTRI) engineers are producing a technology demonstrator vehicle called the ULTRA AP (Armored Patrol). The ULTRA AP will emphasize high-output diesel power combined with revolutionary armor and a fully modern chassis.

The Office of Naval Research (ONR), which is funding the project, is eager for an improved vehicle to aid Marines in the near term. GTRI researchers are working on a technology demonstrator vehicle called the ULTRA AP (Armored Patrol). The ULTRA AP will emphasize high-output diesel power combined with revolutionary armor and a fully modern chassis.

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A more long-range project, the ULTRA 3T, will involve Georgia Tech Research Institute engineers in a ground-up rethinking of military vehicles to reshape the battlefield. The 3-ton ULTRA 3T will unite an array of advanced technologies in a single automotive package.

"The Humvee is based on 1970s technology and has been incrementally modified until it's reaching the end of its capacity." Dudzik says. "The ULTRA design matches the best of modern commercial automotive technology coupled with NASCAR experience, novel design concepts, and research advances in lightweight armor to maximize fightability and protection."

In both vehicles, the GTRI/industry team is making improvements in three key areas.

- **Safety with Performance.** The vehicle uses onboard computers to integrate steering, suspension and brakes to provide an unparalleled level of mobility and safety, researchers say. The new vehicle's integrated chassis represents a leap ahead of the most advanced current production vehicles.

- **Survivability.** This factor involves a vehicle's ability to shield occupants from hostile action. The Humvee, designed during the Cold War, incorporated a light aluminum body so it could move fast on hilly European terrain. It has since added armor packages that increase protection, but they slow a fully armored Humvee to a speed that reduces its effectiveness and increases its vulnerability. The armor's extra weight also wears out vehicle parts more quickly, and the lack of air conditioning is a burden in hot desert terrain.

  Improvised explosive devices (IEDs), Dudzik observes, are a major survivability concern. Mines accounted for more than 60 percent of vehicle losses in Vietnam and Desert Storm. Even a fully armored Humvee is vulnerable to mine blasts. The new Marine Corps vehicles must incorporate dramatically increased resistance to explosions.

- **Power generation.** Portable power is the third major issue GTRI is tackling. ONR wants the ULTRA 3T to provide up to a megawatt (one million watts) on the spot to power emerging battlefield concepts such as electro-static armor, which uses electricity for extra protection, and bunker-busting rail guns. Of course, such power could run command posts, communications gear and even power small villages.

ULTRA 3T plans call for a hybrid engine that combines diesel and electric power plants. That setup would not only aid power generation, but offer a silent
With their mission to provide security to supply convoys, military police of the 2nd Military Police Battalion roll their Humvees through a course testing their ability to react to ambushes and to shoot on the move at a training range in the Kuwait desert Feb. 26, 2004.

Image: USMC Lance Cpl. Samuel Bard Valliere

Moreover, the new engine will give the ULTRA 3T the critical ability to move more swiftly out of harm's way. Pound for pound, today's diesels develop about twice the horsepower of the Humvee's 1970s engine. Plans call for an unloaded ULTRA 3T to go from zero to 60 miles an hour in 4.8 seconds.

GTRI and industry professionals form the right match to develop these complex vehicles successfully, Dudzik says. The team includes Scott Badenoch, an auto industry advanced development and racing professional; Tom Moore, former Chrysler vice president of Liberty Operations, the company's advanced engineering center; Walt Wynbelt, former program executive officer with the U.S. Army Tank-automotive and Armaments Command; and Dave McLellan, the former Corvette chief engineer for General Motors.

"We each bring something to the party," McLellan says. "The military does not design vehicles on a regular basis, so they really don't keep in-house expertise as current as those of us in the automobile industry. At the same time, the GTRI researchers bring their unique research perspective in materials science and the more cutting-edge physics and engineering elements."

If preliminary plans hold, the ULTRA 3T will bristle with a welter of advanced "drive-by-wire" technologies designed to make driving the large, sophisticated vehicle safer than driving a sedan. Drive-by-wire is an emerging computerized approach that's analogous to the systems that allow advanced fighter and passenger aircraft to fly with more stability than any human pilot could achieve unaided.

"Drive-by-wire can enhance the capabilities of experienced as well as inexperienced drivers," Dudzik says. That's important because many Marines are teen-agers with limited driving experience facing the stress of a battle zone, he adds.

GTRI's ULTRA work is linked directly
A Humvee convoy pulls out of Camp Victory in Kuwait on March 2, 2004 en route to Iraq. Lance Cpl. Cody S. Braun, a heavy-equipment operator with 1st Force Service Support Group's Headquarters and Service Battalion, was on hand to add air to Humvee tires as soldiers departed.

Image: USMC Staff Sgt. Bill Lisbon

to "e-safety," an emerging automotive concept that combines computers and advanced technologies to make driving safer, McLellan notes. In e-safety, night driving systems and stability control add security, while radar systems -- already available in Europe -- actually slow vehicles automatically under certain conditions. Such augmented vehicles are especially important when the driver is very young, very old or impaired.

One ULTRA 3T concept that could find its way into everyday vehicles is 360-degree visibility -- a dashboard panorama available on an inboard screen. This approach would eliminate vulnerable windows in the ULTRA 3T, and it would also help many civilians, including the old and impaired who can't easily turn their heads. It should also help save fuel by eliminating wind-resisting outboard mirrors.

Designing a vehicle on a new sheet of paper is exciting, Badenoch says.

"It's very different from designing the next sport utility vehicle or even the next racing car," he adds. "There, you fundamentally know that everything has been done before and what the rules are. Here, we're taking a giant leap forward in technology to transform the battlefield."

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