Soldier Armed

Helmet Sensors

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U.S. Army/Rick Rzepka

During testimony before the U.S. House Armed Services Committee's Subcommittee on Tactical Air and Land Forces in April, senior Army leaders were asked about the service's "materiel solutions" to help mitigate soldiers' exposure to traumatic brain injury (TBI).

Emphasizing the Army's recognition of the dangers of TBI as a long-term issue, LTG James O. Barclay III, deputy chief of staff, G-8, said, "Within our strategy, we have several different initiatives that we're looking at. We're doing helmet sensors inside [helmets], which record data from blast effects. We're also equipping vehicles with sensors … that give the overpressure and concussion effects on soldiers who go through one of those incidents. That data then helps us not only with future vehicle changes, but also with the medical side of tracking those soldiers in the future."

The helmet sensors referenced by LTG Barclay are small, lightweight, low-power sensor suites mounted on combat helmets to detect, measure and record impact and blast overpressure associated with improvised explosive devices and other concussive events.

Generation I

The helmet sensor program was accelerated in 2006 as a result of a number of exploratory and developmental efforts implemented in order to support both the U.S. Marine Corps' and the Army's recognition of the TBI program.

In the Marine Corps, early sensor investigations were supported by the Naval Research Laboratory and participating contractors like Med-Eng Systems. According to Aris Makris, chief technology officer at Allen-Vanguard, which acquired Med-Eng, the prototype helmet sensor design that emerged from the Marine Corps' requirements addressed a broad range of technical challenges including unique aspects of the incident data, weight, and a mounting scheme that would not degrade the protective integrity of existing helmet designs.

Noting that the resulting engineering process led to an external sensor on the rear of the helmet, Makris said, "We developed a prototype system that we blast tested at our facilities in Ottawa, Canada, setting off different charges that we thought were representative [of what soldiers expect in theater]. Eventually, we developed a design we were confident in."

Meanwhile, the Army was exploring the possibilities of an internal headborne energy analysis and diagnostic systems (HEADS) sensor design that was emerging from BAE Systems and its collaboration with Diversified Technical Services, Inc.

Along with the external Allen-Vanguard and internal BAE Systems helmet sensor solutions, other companies involved in the Army explorations around this time included Simbex LLC, which received an August 2007 contract to deliver 20 Head Impact Telemetry System technology-enabled helmets for test and evaluation.

Makris stressed that the Army was intent on getting helmet sensors on warfighters in the field as quickly as possible and that service interest seemed to reach a peak in spring and summer of 2007. "There was a real sense of urgency," he said. "They needed to get as many sensors on soldiers' heads as possible by the end of the year. We showed them what we had, which was a working prototype at that time. We invested a few million dollars in order to ship the units by the end of the year."

Makris said the company shipped approximately 5,000 systems to the Army and an additional 1,000 to the

U.S. Army

A small, lightweight sensor suite mounted inside a soldier's helmet can continuously measure and record impacts and blasts from improvised explosive devices and other concussive events as a way to track exposure to traumatic brain injuries.

Marine Corps. The emphasis was also reflected at BAE Systems. Between 2007 and 2008, BAE Systems developed, manufactured and delivered more than 7,600 of its HEADS "Generation I" sensors to the Army and Marine Corps. Working with both companies, the Army fielded two brigades with both external and internal helmet sensor variants during the second quarter of fiscal year (FY) 2008.

Makris characterized the first few thousand sensors fielded as "first generation products. As a result of the sense of urgency and the problem of TBI, the emphasis was on gathering data that medical personnel could use. Equally important was the fact that the community wanted to gather data on what would be required for a second generation helmet mounted sensor."

Generation II

Based on that data and lessons learned from the Generation I helmet sensors, the Army released its request for proposals for a second generation sensor in the fourth quarter of FY 2009.

The Generation II system incorporated technology upgrades in areas including power management, storage capacity, data exchange methods, battery life, pressure measurement and angular rate data. In addition, stakeholder community input focused the next generation of the system on an interior helmet configuration.

Although both BAE Systems and Allen-Vanguard entered the Generation II program in the summer of 2010, the effort soon shifted solely to BAE Systems' HEADS design.

Frank Crispino, program director for vehicle protection programs at BAE Systems' Protection Systems, describes HEADS as "small enough to hold in the palm of your hand [and] imperceptible to the wearer." The system can be secured beneath the crown suspension pad inside virtually any combat helmet and positioned in line with two of the three axes of the head's center of gravity. This location provides optimal recording measures and maximum protection for the sensor from ballistic and environmental threats. Once secured, HEADS continuously measures and collects critical data, including impact duration, blast pressures, ambient temperature, and angular and linear accelerations, as well as the exact times of single or multiple blast events. Six channels of linear and angular accelerations are measured and stored in the device, including rotation and linear acceleration in all three axes (x, y, z).

BAE Systems has delivered approximately 40,000 Generation II helmet sensors, with all currently contracted deliveries completed in May of this year. It is believed that the Army has a requirement for approximately 45,000 total systems.

"There are several components in the HEADS system," Crispino said. "It's not just the sensor; there's also a package of software that's used by the field support team for maintaining the sensors, extracting the data, and determining what and when to recharge.

"The [Generation II] system is fielded and being used. We're learning from how the system is performing in the field what changes we need to make to that software package so it's easier for the field support folks to do their job."

He continued, "The government basically takes the data and has contracted another company to analyze that data. We don't get involved in that analysis, but at some point in time, they will have questions about some of the data that is coming back. We get involved on that end of the analysis to help them better understand the data.

"We're honored to be participating in the program," Crispino said. "It's very important to understand the degree to which our soldiers are being subjected to the risk of TBI. We are honored to be able to support the program so those soldiers who are subject to some form of TBI can be identified, receive the proper treatment, and live happy and healthy lives. I hope that's our legacy."

Another Army partner in these efforts is the National Football League (NFL). It uses similar technology to study the impact of head trauma on players. "They have the same issues we have with TBI," LTG Barclay said during his testimony on TBI. "It's very important for the Army [and] the NFL to try to get at this." ★