US ARMY SOLDIER SYSTEMS CENTER
Protecting Those Who Serve

THE WARRIOR

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Peak activities

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Cover photo: Capt. Leon Travis leads research assistants Army Pfc. Jesse Udy and West Point Cadet Laura Greczyn on a 5-mile hike on Pike's Peak as part of an altitude research study. (U.S. Air Force photo by 1st Lt. Greg Hignite)

THE WARRIOR
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Two Sherpas fielded in Iraq

By Maj. John M. O'Regan and Benjamin Rooney

Two Sherpa Guided Parachute Cargo Systems and associated spares were fielded in August in Iraq to accurately re-supply warfighters in isolated areas and conduct sustained container delivery re-supply missions.

The Sherpas are part of the Joint Precision Airdrop Delivery System (JPADS) Extra Light program managed by Product Manager Force Sustainment Systems (PM FSS) at the U.S. Army Soldier Systems Center in Natick, Mass., under the command and control of Project Manager Force Projection, and Program Executive Officer Combat Support and Combat Service Support. PM FSS executed a JPADS urgent operational needs statement in less than 90 days after the Department of the Army validated the needs statement to achieve the fielding.

The goals of the JPADS Extra Light program are to be able to release cargo systems from an altitude of up to 25,000 feet from C-130 or C-17 aircraft, land at a pre-determined impact point within 100 meters circular error probable and attain a 2,200-pound capacity.

This is the first time that a program of this complexity has been undertaken to turn "dumb" airdrop systems into "smart" ones. Since joint forces will be continuously in asymmetrical conditions, this capability is essential for re-supply.

To date, testing held at Yuma Proving Ground, Ariz., experienced about 175 meters circular error probable. During operational missions in Iraq, the systems landed 40, 94 and 168 meters respectively from the impact point.

The 1,200-pound-capacity Sherpa used in Iraq consists of a commercial laptop, airborne guidance unit, 900-square-foot RAM air canopy, accessory box and shipping container. The accessory box holds the handheld controller, batteries for the airborne guidance unit and handheld controller, mission planner cable, Global Positioning System repeater, tool kit, antennas and battery recharger.

The Sherpa system is easy to plan, rig and operate. The mission planner formulates a flight path based on winds from impact point through dispatch levels, total rigged cargo weight and desired impact point.

If wind information at the impact point is unavailable, the mission planner can extract a forecast from the Joint Army Air Force Weather Information Network Web site. Winds are essential as the mission planner programs a flight path dependent on all information programmed into the Sherpa laptop.

Once the mission planner determines the mission profile, he provides the pilot or navigator, and loadmaster with an optimal, early or late dispatch point. What this capability provides is a cone-shaped range in the sky to release the cargo as opposed to a single point. The canopy's RAM air design can penetrate 20-knot wind speeds.

The mission planner selects one of three modes: autonomous, beacon or manual. Autonomous mode is where the mission planner downloads the mission into the airborne guidance unit, and the system executes that mission. Beacon mode allows the warfighter on the ground to change the impact point while the Sherpa system is in flight. After the mission is changed, the Sherpa system navigates towards the beacon.

Manual mode is where warfighters can navigate the system by conducting left and right turns and flaring the system for a softer landing.

Precision airdrop allows the release of 16 systems on a C-130 and 40 systems on a C-17 that all can be programmed to land at one or multiple locations. This enables warfighters to receive supplies without exposing aircraft to enemy fire.

Further testing and evaluation is planned until a production contract is awarded in 2008 or 2009.

Editor's Note: Maj. John M. O'Regan is an Assistant Product Manager for Cargo Aerial Delivery Programs and Benjamin Rooney is the JPADS lead engineer in Product Manager Force Sustainment Systems.

Photo by Marine Staff Sgt. Bill Lisbon

A Sherpa Guided Parachute Cargo System descends from a clear sky near Camp Korean Village, Iraq, Aug. 9.

Warrior/Underhill

Faster food

Assault Kitchen saves time, hassle of serving hot meals on frontlines

By Curt Biberdorf

The ability to quickly feed hot meals to forward-deployed, fast-moving warfighters is what the Army will gain when the Assault Kitchen (AK) delivers its heat-on-the-move capability to the field.

Intended to replace the Kitchen, Company Level Field Feeding (KCLFF) beginning in 2007, the Assault Kitchen, developed by the Food Service Equipment Team under Product Manager Force Sustainment Systems at the U.S. Army Soldier Systems Center in Natick, Mass., provides a better way to feed company-sized military units.

"The KCLFF is an assortment of odds and ends. Many times, frontline units don't take it to the field other than a component here and there," said Doug Brown, a mechanical engineer and project officer for the Assault Kitchen. "They tend to not want to operate with the whole system because of the setup involved. It takes more time and effort to use when compared to the AK."

The Assault Kitchen consists of a Humvee and trailer packed with equipment that either eliminates, transfers or replaces the collection of loose KCLFF items with a setup where every component has its place on a mobile platform.

Strapped into the back of the cargo/troop carrier Humvee are six insulated beverage containers, three pan carriers to keep food trays warm, five insulated food containers, a 5-gallon fuel can, fire extinguisher, utensil box, maintenance kit for the ration heater, and a ration heater to prepare Unitized Group Ration-Heat and Serve (UGR-H&S) tray packs or No. 10 food service cans.

Pulled on a trailer are eight water cans, an ice chest, three tables, cargo netting to hold UGR-H&S boxes, stock pots, a cradle for use

Courtesy photo

An overhead view of the Assault Kitchen shows where each component is packed in transit.

Electricity for the heater is drawn from the Humvee through a power inverter (above left). Pfc. John Wild pulls out a tray ration from the Assault Kitchen's heater tank. (Warrior/Underhill)

in preparing hot beverages and an awning to cover the serving area during bad weather.

The heart of the AK is its ration heater. It uses non-developmental and commercial technology that allows operation on common battlefield fuels, and it draws electricity generated from the Humvee through a mounted power inverter.

"We used already-developed ration heaters and as many existing pieces of commercial equipment as possible," said Scott Mannka, an engineering technician, about the 1-year-old project that produced two prototypes. "It's the only way we could build AK prototypes fast."

The AK heater tank is turned on with a switch and operates for 10 hours on 5 gallons of fuel. The portable, stainless steel water tank heats up to 18 tray packs, 15 No. 10 food service cans or a combination of the two in 30-45 minutes, and it can heat them while driving, which is not an option with the KCLFF's open flame burners, according to Brown.

Thermostatic control assures the heater tank's water temperature stays below the boiling point, but a relief vent is a backup to prevent overpressure. Other safety features include sensors or switches to shut off the burner if the water depth in the tank falls below 6 inches or the heater tank exceeds pre-specified angles.

The Assault Kitchen feeds up to 250 troops in one location or as many as 500 troops daily in multiple locations, and setup is completed in as little as 10 minutes with two cooks, according to Brown. Packing up to be ready to "jump" to the next feeding site is equally as fast.

Two approaches to using the Assault Kitchen were followed during a user demonstration earlier this year. Brown said both prototypes were praised by troops who tried them.

In January at Fort Stewart, Ga., troops tried a "pit stop" feeding method, hauling the kitchen to the Soldiers with a fuel and ammunition supply convoy. Tankers and infantrymen either met the kitchen and convoy at a designated location or the supply convoy went to them.

At the National Training Center (NTC) at Fort Irwin, Calif., in March and April, the kitchen stayed with forward units at all times and was re-supplied with rations and water whenever possible.

"The vision at first was not to stay with a forward unit at NTC," Mannka said. "They liked it a lot. They were impressed. They gained confidence with it every day they used it."

The team plans on refining the system and completing additional testing during the next two years, combining the best features of the two prototypes into one prototype before production approval in 2006. Brown said current plans for production are for the Army, Marine Corps, and potentially the Air Force, to combine their requirements for the Tray Ration Heater and the Assault Kitchen into a large economical production contract.

Warrior/Underhill

Pvt. 2 Ilan Lewenberg places a heated tray ration into a pan carrier to prepare the serving line.

Acclimatized

Airmen helping researchers by living in the clouds

By 1st Lt. Greg Hignite
Air Force Academy Public Affairs

PIKES PEAK, Colo. — A handful of Air Force Academy Airmen lived in the clouds on the 14,110-foot Pikes Peak summit this summer as part of an Army/Air Force acclimatization research study July 15-31.

The U.S. Army Research Institute of Environmental Medicine, based at the U.S. Army Soldier Systems Center in Natick, Mass., and the academy's Human Performance Laboratory teamed up to study the effects of taking 18 Airmen from moderate altitudes of 6,500 feet to high alpine environments above 14,000 feet.

About 100 yards from the summit visitor center and cog railway line sits the Army's Maher Memorial Altitude Laboratory. The unassuming facility, often overlooked by summit visitors, serves as a base of operations to conduct alpine research and house study volunteers.

The academy Airmen, 10 men and eight women, lived on the summit for four consecutive days performing various cognitive and physical drills to gauge the impact of the elevation on motor skills and memory retention.

Two years ago, Army researchers conducted a similar study, but took people from sea level to the summit of Pikes Peak. This year's study will compare findings from the two study groups to determine if people from moderate altitudes acclimate faster or better to the alpine environment than people from sea level.

Typically, it takes people from sea level five to seven days to acclimate to the elevation, said Dr. Chuck Fulco, the lead scientist on the Army's research team. The level of oxygen saturation in the air at 14,000 feet is dramatically reduced from that at sea level, which causes most people to acquire Acute Mountain Sickness (AMS), he added.

Mountain sickness causes headaches, nausea and an all-around bad feeling that only gets better after the body adjusts to the lack of oxygen.

The sea-level study group participants were often sick for the first few days of the study and were only able to eat bland foods to avoid nausea, he said.

While the study is still ongoing and the final results will not be available for a few months, the researchers are already noticing a surprising trend.

"What we're seeing is the severity of AMS is much less for the people from the academy and that they are feeling nearly normal, eating well and not losing body weight," Fulco said.

Combat experience

The genesis of this study is loosely based on the military campaigns in Afghanistan. Nearly three years ago, the military was actively engaged in ending the Taliban stranglehold on the country. Scientists noticed early on that troops in that region needed a few days to adjust to the higher elevations. To further compound the situation, many Soldiers and Airmen marched high into the Afghan mountains to hunt for Osama Bin Laden and call in air strikes, further enhancing AMS symptoms.

Fulco hopes to equip Army leaders with knowledge on how to better select troops for high-alpine operations. For example, it might make more sense to have troops live for some time at moderate elevations before being deployed because they will adapt to the higher elevation more rapidly.

Overall, this study is one piece of the puzzle to help military leaders make better decisions about putting troops in certain combat zones, Fulco said.

Each volunteer for the study needed to be between 18 to 35 years old, pass the annual Air Force physical fitness test, be a nonsmoker and a resident of Colorado Springs for

Photo by 1st Lt. Greg Hignite

Dr. Ken Kambis (right) removes the headgear from Air Force 1st Lt. Jacki Grant after her VO2 max ride on the Pikes Peak summit.

at least the past three months. Airmen from various career fields and units around the base were invited to volunteer.

Along with spending four days on Pikes Peak, volunteers first had to complete an extensive test battery at the academy over a period of several days, according to Lt. Col. Michael Zupan, chief of the Human Performance Laboratory. Tests included an endurance bike ride of 45 minutes immediately followed by an 18-mile time trial ride.

On other days, volunteers had electrodes glued to their chest and rode with an oxygen-sensing mouthpiece during a V02 max bike test. These tests were then duplicated on the summit so that scientists could judge the impact of the altitude on the volunteers.

Zupan had more than enough Airmen to select from, shortening a list of more than 30 individuals to the 18 taking part in the study. It was unique that there was so much interest, especially for a study that requires a lot of time and hard exercise, he said.

Tests included both physical and mental challenges. Cognitive tests involved reaction time drills, memory skills and the eye vigilance exam, which was by far the most aggravating test to the volunteers, according to Capt. Leon Travis, an instructor with the 98th Flying Training Squadron.

Pounding headache

During the vigilance exam, volunteers were asked to stare at a gray computer screen for 30 minutes and tap the space bar each time a tiny, light gray bar appeared on the screen.

"After awhile you start seeing things in the gray screen and wonder, 'Did I just miss that little bar?'" Travis said.

Physical tests revolved around riding a stationary bike from 20 minutes to three hours, depending on the test and the volunteer's physical prowess.

"The toughest part was definitely the bike ride on Day One at the summit," said Travis. "For me it was three hours of exhaustion without pause. The pounding headache for the remainder of the day was my prize for finishing."

To further complicate the exercise routine on the first and third days, volunteers struggled through an endurance cycle test with a catheter in their forearm. Every 15 minutes during the three-hour ride a medical technician would extract a few teaspoons of blood. The blood work was immediately analyzed to determine how the body responded to the exertion at altitude.

Despite the extensive time commitment, blood work and forced exercise while overcoming AMS, volunteers remained focused on the study.

"I have never had the opportunity to deploy," said 1st Lt. Jacki Grant, an airfield operations flight commander. "I wanted to do something to help those troops on the front line."

Before traveling to the peak, Grant was nervous about how her body would handle the physical strain. Two days into the study she admitted there were times she thought about quitting, but she remained focused on finishing the grueling bike rides.

"There were great people on the research team to keep me motivated. After all, I volunteered for this," she said.

Despite hitting the gym regularly, Staff Sgt. Matt Bowen was caught off guard by the endurance bike ride on the summit the first day.

"It was a lot tougher than expected. I had no energy for the test, and once it was over, I was hit with AMS," said Bowen, the noncommissioned officer-in-charge of the cadet physical therapy clinic.

Fortunately for Bowen and the other volunteers, the symptoms of AMS dramatically reduced by the second day and life on the peak became much easier.

Research data gathered will be available to all services to help better use fighting forces worldwide.

Photo by 1st Lt. Greg Hignite

Air Force Staff Sgt. Matt Bowen wears a catheter in his arm and a meter on his index finger to measure his oxygen intake as part of an altitude research study on Pikes Peak.

Drop and roll

Air delivered supplies, equipment undergo rigors of certification

By Curt Biberdorf
Editor

Concerned manufacturer representatives, cringing at the thought of a new military vehicle undergoing airdrop certification at the Drop Tower, find that the nearly 13-foot plummet onto a concrete surface usually results in little, or more likely, no damage to their product.

The Drop Tower is one stop along the airdrop certification process managed by the Aerial Delivery Engineering Support Team at the U.S. Army Soldier Systems Center in Natick, Mass. Every piece of equipment or consumable product that the military delivers from the sky needs a stamp of approval that the cargo will safely and reliably reach the ground ready for combat.

"(Manufacturer representatives) have visions of wheels flying off and catastrophic failures," said George Moorachian, a senior aerospace engineer and manager of the five-person airdrop and helicopter sling load certification group. "We have pretty good success with things not breaking. It takes a lot of experience to learn how to do it without damaging the load."

Courtesy photo

A truck rigged for airdrop is tested at the Roller Load Test Facility. A total of 136 instrumented rollers take force measurements of the cargo, and a computer-operated data acquisition system analyzes the results from the platform moving across the rollers.

With decades of know-how, engineers and technicians have tested everything from individual Soldier items, such as fully loaded rucksacks, to a pallet of rations to heavy construction vehicles with the Roller Load Test Facility, Drop Tower or both.

For cargo delivered on an airdrop platform, engineers begin by calculating the size and shape of a honeycomb kit based on weight and contours of the equipment, which they hope will allow for a soft enough landing to withstand damage.

Honeycomb kits consist of layers of 3-inch-thick impact-absorbing, disposable paper—named for its resemblance to the thin-walled cell structures made by honeybees—and custom-designed pieces of lumber needed to maximize the honeycomb crush.

Care is also taken to protect sensitive or delicate parts, such as guidance systems, hydraulics, glass and the oil pan of a truck.

Reusable aluminum platforms range from 8-32 feet and are extended in 4-foot sections. Once configured, a series of textile Dacron straps are tightened to meet various restraint G-forces in different directions. The mode of airdrop and weight determines the number and size of parachutes used on the load, according to Moorachian.

Platform rigged, the first stop is at the Roller Load Test Facility to check load distribution. The facility, the only resource of its kind, is capable of testing loads up to 40 tons, according to John Doucette, an engineering technician on the Aerial

Courtesy photo

The Drop Tower crane certifies a Family of Medium Tactical Vehicles truck for helicopter sling load delivery.

Delivery Engineering Support Team.

The facility has a 32-foot mock-up of the roller and rail system used in an Air Force C-141 to transport cargo, which can be either unloaded on the tarmac or dropped from the air with parachutes while the airplane is in flight.

A total of 136 instrumented rollers take force measurements of the cargo, and a computer-operated data acquisition system analyzes the results from the platform moving across the rollers. A hydraulic cylinder can simulate up to 50 tons of force on cargo pulled by parachutes.

"The Air Force has limitations on force ratings. We don't want to exceed those limitations of the rollers or we'll punch right through the floor," Moorachian said, adding that the C-141 is the test model because it's the weakest airframe in the Air Force inventory.

However, changes are on the way. With the upcoming retirement of the C-141, the facility will be upgraded early in 2005 with rollers and rails that can adjust to simulate other cargo aircraft, modern computing to speed data collection and two 30-ton capacity hoists.

The hoists bring a new capability to pick up the airdrop load in place and adjust it there instead of moving it outside to the Drop Tower hoist, which is time-consuming and delayed by wet weather, Doucette said.

After passing the roller load test, the platform moves to the Drop Tower for a Simulated Airdrop Impact Test (SAIT), more commonly known as static drop test, to determine if the product and honeycomb energy dissipation kit are ready for actual airdrop testing.

Strength of fittings, used to attach straps and parachutes, are also examined.

From a 1,600-square-foot pad, the cargo platform is lifted 12.7 feet from a 39-foot tall, 40-ton capacity crane with a weighted hook. The height at which the platforms are dropped gives 28.5 feet per second vertical impact velocity from acceleration due to gravity, Moorachian said, and except for the flat landing surface, it's the worst-case scenario for a parachute-controlled descent.

When the crane releases its hold, the platform's honeycomb kit crushes to protect the cargo that slams to ground. Instrumentation on the test load measures impact shock and video recording at 1,000 frames per second captures the event for later analysis.

"(The SAIT) is the way we verify the honeycomb works as expected. Maybe we'll find some weak points, and then we'll check for damage to the cargo," Moorachian said.

For testing paratrooper individual combat equipment, the Drop Tower has a 60-foot cable that descends at a 45-degree angle to simulate the "tumble and roll" of ground impact of items at the maximum allowed wind conditions on the drop zone for paratroopers. A required 27-34 feet per second velocity at ground impact is maintained with video analysis.

The Drop Tower crane also helps to certify vehicles or cargo for helicopter sling load missions. Doucette said they check to ensure lift points are strong enough and that the load is stable for a safe delivery.

Although weapon systems are tested with the Drop Tower, all munitions airdrop is tested at Yuma Proving Ground, Ariz. At Yuma and Fort Bragg, N.C., certification takes its final test step by conducting three successful airdrops.

Moorachian said sometimes his team might need to make a few adjustments to the rigging, parachutes or slings, or even start over. Once ready, he then writes a memorandum based on the test report certifying the item for airdrop, as long as the proper rigging procedure is followed.

A Family of Medium Tactical Vehicles truck is rigged and moved to the Drop Tower (above). The honeycomb kit is examined after a simulated airdrop impact test at the Drop Tower. (Courtesy photos)

Pathfinder

Technology demonstration elevates battlefield information

By Curt Biberdorf
Editor

Laser beam trip wires, flying cameras, roving toy-sized vehicles and a local wireless network boosted by "SuperCrumbs" are shaping up into a connected system of systems under the Pathfinder Advanced Concept Technology Demonstration (ACTD).

Pathfinder ACTD, sponsored by the Special Operations Command with the ACTD and Urban Technology Office at the U.S. Army Soldier Systems Center in Natick, Mass., serving as technical manager, is an effort to integrate unmanned ground vehicles, unmanned aerial vehicles and unattended smart sensors into a mobile, self-forming and self-healing network. The network enhances situational awareness, command, control and communications to commanders and assault forces operating in urban areas.

Courtesy photo

A BreadCrumb network node is set up in a field.

"It's helped to give Soldiers reconnaissance and tie data together so that it's easily shared," said Adam Fields, Pathfinder ACTD senior engineer. "Instead of one guy getting the information that gets bottlenecked, everyone can get it at the same time."

Started in October 2002 with the War on Terrorism well under way, the ACTD is preparing for the culminating event in February 2005 and then wrapping up with an extended user-evaluation of the ACTD products through September 2006.

"The integration (of the systems) is starting to work," said Susan McKinney, ACTD and Urban Technology deputy program manager. "It's been hard to plan because things have fluctuated wildly for the entire duration."

She said the ACTD has conducted dozens of technology working group assessments to check equipment function in the field, several limited objective experimentations to enable Soldiers to use the equipment and further refine it, and one military user assessment with Rangers on a training exercise.

Fields said he and other team members were embedded with the Rangers during the user assessment because the Rangers' operational tempo is so high that they had insufficient time for new equipment training on the system. The unprecedented opportunity gave the Pathfinder team a chance to experience real field conditions while gaining a better understanding of the operation of the system and its performance.

"I wasn't feeling too good at first, but we were able to fix mistakes," Fields said. "The feedback they gave was that this has potential. They said to make the changes to see that it works and give it back to them in February to operate it themselves."

Pathfinder is focused on enabling commanders and warfighters to understand the situation and develop a decisive plan before making enemy contact for faster action and more efficient use of resources.

The system would be used in small team operations consisting of early-entry Special Operations and lightweight conventional forces. No more than 200 warfighters would be engaged for a limited duration and focused objective in a relatively small geographic area. For the culminating demonstration, Rangers will seize an airfield to accommodate arrival and deployment of a direct-action assault force into an urban area.

Specific technologies to be employed fall into five areas using mature products now available for purchase that meet Pathfinder requirements.

Networked

The network is the backbone of the Pathfinder system. Network repeaters take the form of small stationary black box sensors set known as "BreadCrumbs" or "SuperCrumbs." These network nodes can be placed almost anywhere, including on an unmanned ground or air platform, or a warfighter. The SuperCrumb is in transition to the 3rd Infantry Division through a rapid fielding initiative.

Sensing

Stationary and mobile acoustic, seismic, magnetic or imaging sensors are a piece of the reconnaissance and surveillance capability.

These sensors are hand-emplaced on the ground, in trees or any other strategic location, or can be mounted on an unmanned ground or air platform for a variety of purposes, to include increasing area perimeter security while concentrating troops where you would expect to see the enemy, according to Andy

An Eagle Telonics sensor for reconnaissance and surveillance hides in a roadside guardrail (above). A Soldier operates a Tacticomp handheld computer tied into a wireless network. (Courtesy photos)

Mawn, ACTD and Urban Technology Office program manager and Pathfinder ACTD technology manager.

"It could be a light beam that's broken when the enemy passes by to let our guys know someone's approaching," Fields said. "You can place these further out from the troops to better warn them. It makes them a more powerful fighting force."

Eyes in sky

Man-portable unmanned aerial platforms, such as the Raven, developed by the ACTD and Urban Technology Office, and Pointer, are the air vehicles capable of conducting day or night video surveillance and can relay communications for troops with broken radio signals.

Transition of the Raven to the Army via an urgent need statement and to the Special Operations Command via a combat mission need statement are transition highlights for the program, according to Mawn.

Targeted

Targeting is another technology area for the ACTD, and Pathfinder leveraged the Talon robot, which is commonly used for jobs best avoided by warfighters, such as entering a booby-trapped cave. The ACTD is integrating the Special Operations Forces Laser Aiming Module used to send a coded laser to guide smart munitions to a target.

"It's on the robot, so you don't expose (Soldiers)," Mawn said. "You can clearly identify targets without having Soldiers get into harm's way," Mawn said. He added that by using a radio relay attached to it, troops can drive it out to longer and more useful distances.

Courtesy photo

The Talon unmanned ground vehicle can allow Soldiers to send a coded laser to guide smart munitions from longer distances.

Displayed

Display tools are necessary for processing and reviewing information from the sensors and unmanned platforms.

A hardened laptop computer or similar handheld device holds the database, a single place for command and control. Pathfinder is leveraging the Tacticomp handheld computer, with its internal networking capability that could provide the functionality of several pieces of gear, such as the Soldier radio, Global Positioning System receiver and laser rangefinder in one package.

"Everybody equipped with a computer is plugged into what's going on. It's a wireless network, a little World Wide Web for all the guys on the ground," Mawn said, adding that network nodes are another technology that has transitioned to the Army.

"We're looking at tools that have multiple capabilities, and we're constantly working the transition issues," Mawn said. "By integrating existing technology they're already using, that frees research and development dollars to fill in holes in the ACTD."

Three new proposed ACTDs are in the pipeline to experiment with an unmanned helicopter, take Pathfinder to a higher unit level and further refine small unmanned aerial vehicles. Meanwhile, all hands are on Pathfinder.

"We have all these pieces that need to work together," Mawn said. "All the ingredients are good. Now we have to mix them for the final product."

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