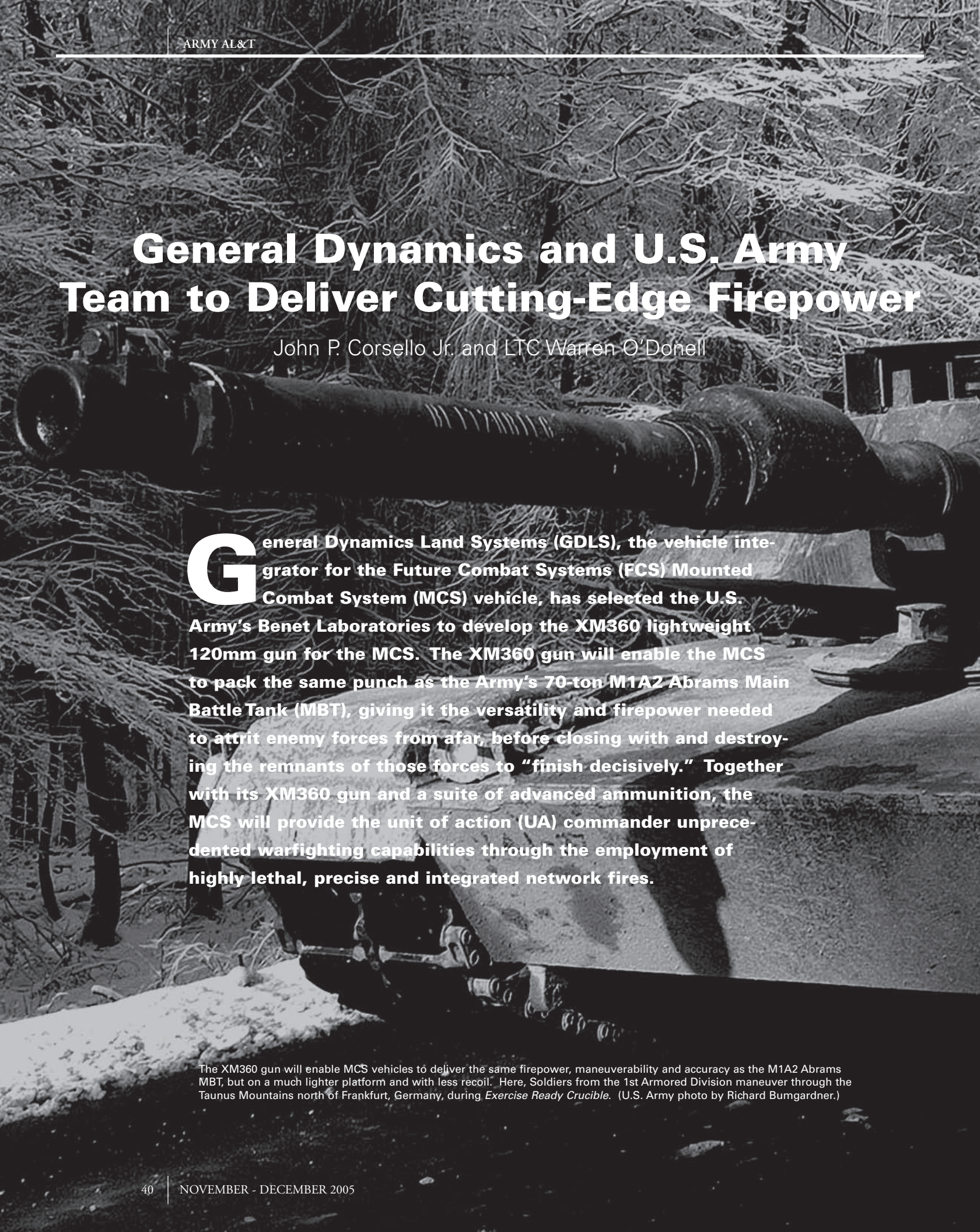


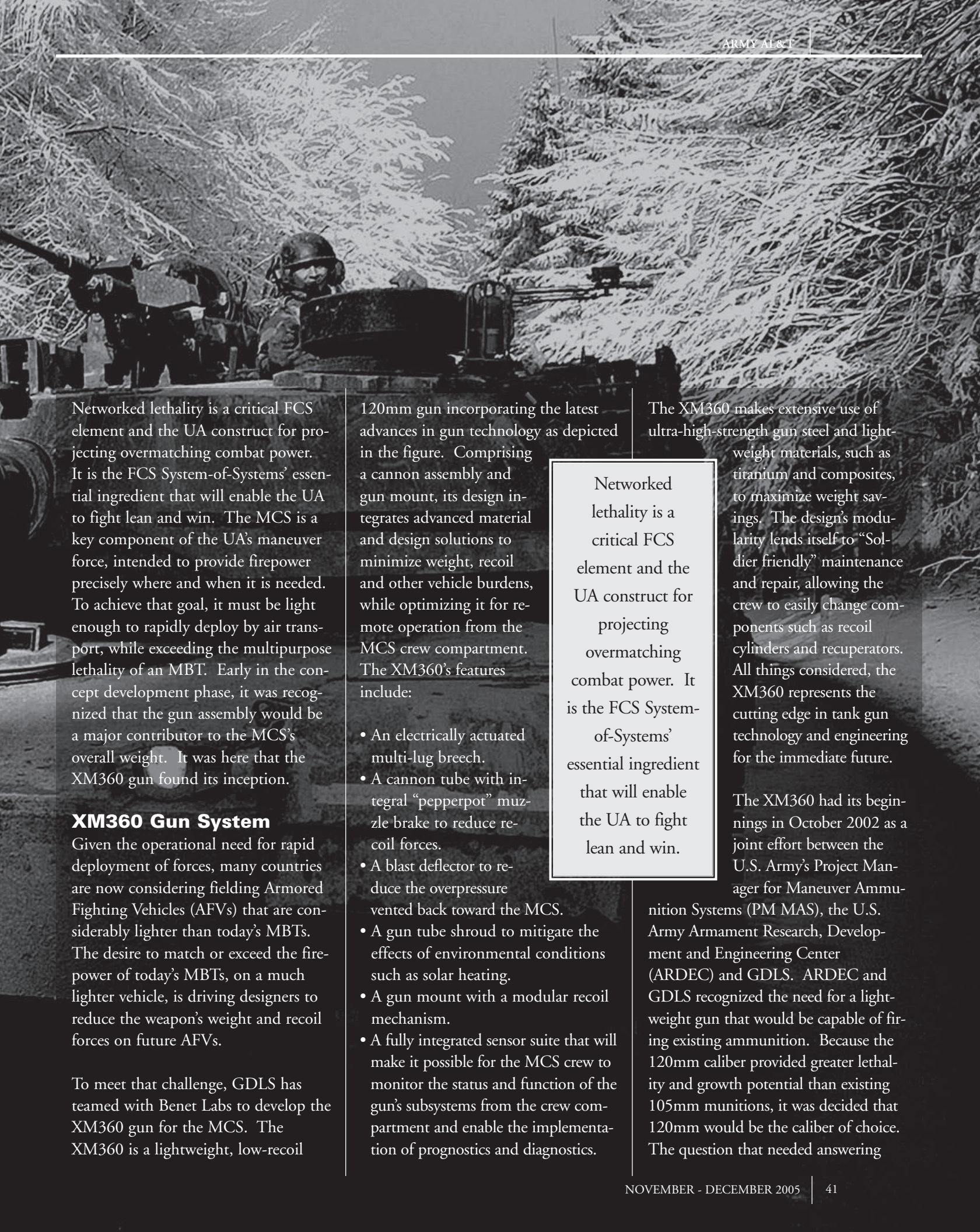
# General Dynamics and U.S. Army Team to Deliver Cutting-Edge Firepower

John P. Corsello Jr. and LTC Warren O'Donnell



**G**eneral Dynamics Land Systems (GDLS), the vehicle integrator for the Future Combat Systems (FCS) Mounted Combat System (MCS) vehicle, has selected the U.S. Army's Benet Laboratories to develop the XM360 lightweight 120mm gun for the MCS. The XM360 gun will enable the MCS to pack the same punch as the Army's 70-ton M1A2 Abrams Main Battle Tank (MBT), giving it the versatility and firepower needed to attrit enemy forces from afar, before closing with and destroying the remnants of those forces to "finish decisively." Together with its XM360 gun and a suite of advanced ammunition, the MCS will provide the unit of action (UA) commander unprecedented warfighting capabilities through the employment of highly lethal, precise and integrated network fires.

The XM360 gun will enable MCS vehicles to deliver the same firepower, maneuverability and accuracy as the M1A2 Abrams MBT, but on a much lighter platform and with less recoil. Here, Soldiers from the 1st Armored Division maneuver through the Taunus Mountains north of Frankfurt, Germany, during *Exercise Ready Crucible*. (U.S. Army photo by Richard Bumgardner.)



Networked lethality is a critical FCS element and the UA construct for projecting overmatching combat power. It is the FCS System-of-Systems' essential ingredient that will enable the UA to fight lean and win. The MCS is a key component of the UA's maneuver force, intended to provide firepower precisely where and when it is needed. To achieve that goal, it must be light enough to rapidly deploy by air transport, while exceeding the multipurpose lethality of an MBT. Early in the concept development phase, it was recognized that the gun assembly would be a major contributor to the MCS's overall weight. It was here that the XM360 gun found its inception.

### XM360 Gun System

Given the operational need for rapid deployment of forces, many countries are now considering fielding Armored Fighting Vehicles (AFVs) that are considerably lighter than today's MBTs. The desire to match or exceed the firepower of today's MBTs, on a much lighter vehicle, is driving designers to reduce the weapon's weight and recoil forces on future AFVs.

To meet that challenge, GDLS has teamed with Benet Labs to develop the XM360 gun for the MCS. The XM360 is a lightweight, low-recoil

120mm gun incorporating the latest advances in gun technology as depicted in the figure. Comprising a cannon assembly and gun mount, its design integrates advanced material and design solutions to minimize weight, recoil and other vehicle burdens, while optimizing it for remote operation from the MCS crew compartment. The XM360's features include:

- An electrically actuated multi-lug breech.
- A cannon tube with integral "pepperpot" muzzle brake to reduce recoil forces.
- A blast deflector to reduce the overpressure vented back toward the MCS.
- A gun tube shroud to mitigate the effects of environmental conditions such as solar heating.
- A gun mount with a modular recoil mechanism.
- A fully integrated sensor suite that will make it possible for the MCS crew to monitor the status and function of the gun's subsystems from the crew compartment and enable the implementation of prognostics and diagnostics.

The XM360 makes extensive use of ultra-high-strength gun steel and light-weight materials, such as titanium and composites, to maximize weight savings. The design's modularity lends itself to "Soldier friendly" maintenance and repair, allowing the crew to easily change components such as recoil cylinders and recuperators. All things considered, the XM360 represents the cutting edge in tank gun technology and engineering for the immediate future.

The XM360 had its beginnings in October 2002 as a joint effort between the U.S. Army's Project Manager for Maneuver Ammu-

nition Systems (PM MAS), the U.S. Army Armament Research, Development and Engineering Center (ARDEC) and GDLS. ARDEC and GDLS recognized the need for a lightweight gun that would be capable of firing existing ammunition. Because the 120mm caliber provided greater lethality and growth potential than existing 105mm munitions, it was decided that 120mm would be the caliber of choice. The question that needed answering

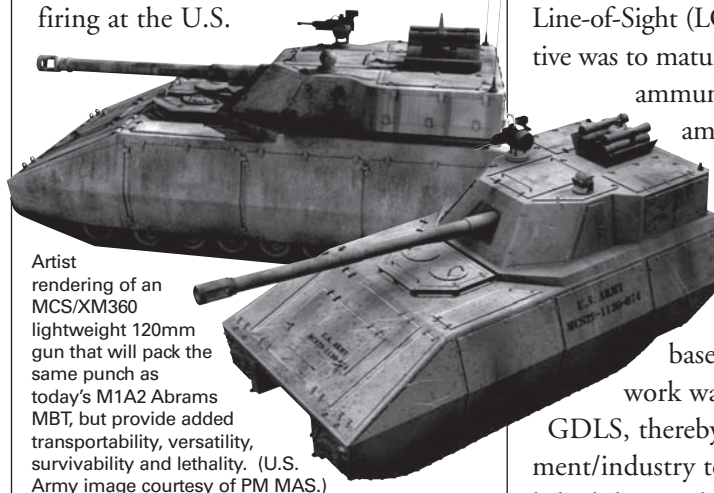
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was, "Could the combined government/industry team design a 120mm gun whose weight and recoil were low enough to meet MCS needs?"

To address this challenge, GDLS and ARDEC's Benet Labs — the U.S. Army's large-caliber gun design agency — embarked on a collaborative effort known as the Vehicle Dynamic Response Demonstrator (VDRD). The VDRD's purpose was to design, build and demonstrate a gun that could meet MCS fundamental needs. Benet Labs and GDLS agreed to a set of baseline requirements for the new gun, including its maximum weight, recoil impulse and recoil force at the gun's trunnions. Other program goals were to be able to fire the entire family of 120mm tank ammunition, and to manage the muzzle blast that would be vented back toward the vehicle by the gun's recoil-reducing muzzle brake. In designing the gun, Benet Labs leveraged lessons learned from the design of its proven 105mm M35 and developmental 120mm/140mm XM291 gun designs.

## Testing Begins

By December 2003, the first lightweight 120mm gun was firing at the U.S.



Army's Aberdeen Proving Ground (APG) in Maryland. The VDRD gun met or surpassed its baseline requirements. In doing so, it clearly demonstrated the proof-of-principle and significantly reduced risk for MCS.

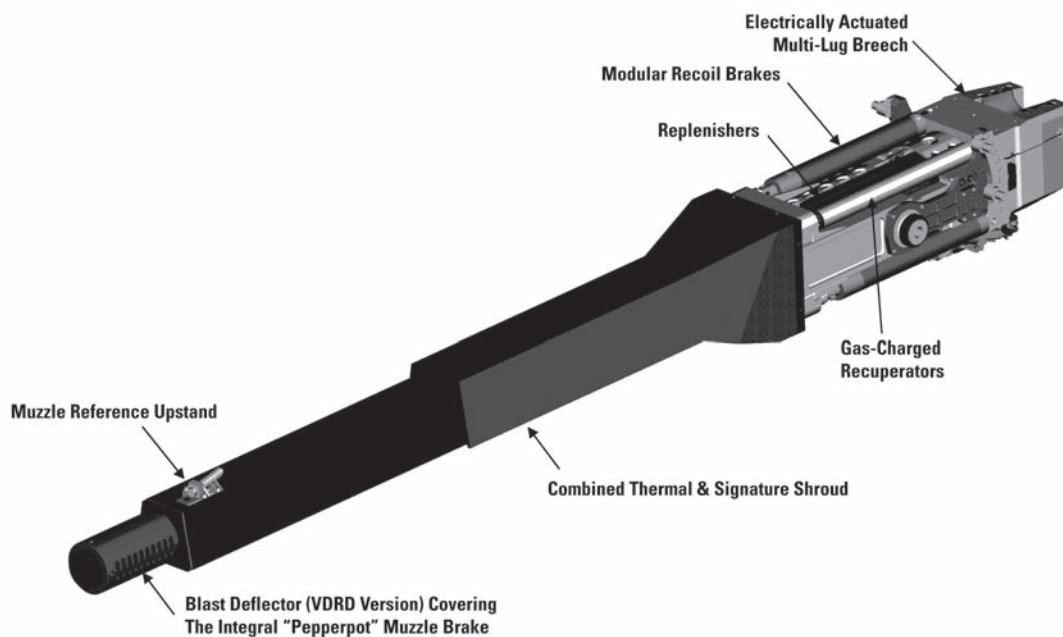
Seeing the need to further refine the VDRD lightweight 120mm gun's design and further reduce MCS armament- and ammunition-related risks, ARDEC decided to pursue an

Advanced Technology Demonstration (ATD) program as a follow-on to the VDRD. The Line-of-Sight/Beyond Line-of-Sight (LOS/BLOS) ATD objective was to mature gun, fire control, ammunition handling and ammunition-related technologies with direct application to the MCS.

Although an ARDEC technology base program, much of the work was contracted to GDLS, thereby retaining the government/industry team that was established during the VDRD. Likewise, the LOS/BLOS ATD built upon and improved the VDRD gun design. As GDLS continued to refine its MCS concepts, a complete set of gun interfaces was established, and Benet Labs updated the LOS/BLOS ATD gun design to comply with those interfaces. Watervliet Arsenal purchased ultra-high-strength gun steel to fabricate an all gun steel tube, along with an even lighter composite overwrapped gun tube. Based on input from GDLS'

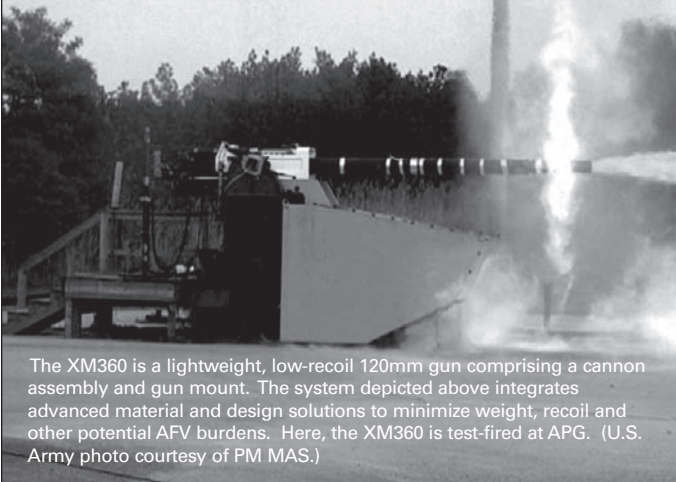
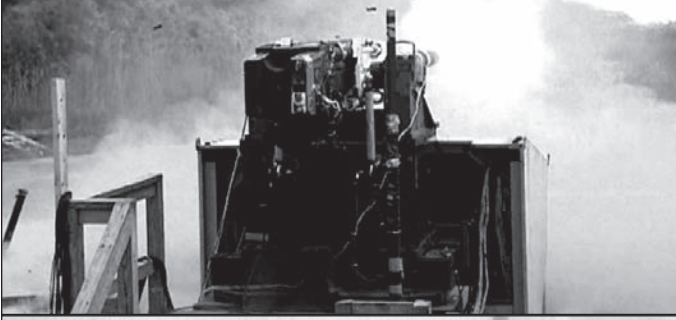
Fire Control Team, Benet Labs designed and had Rock Island Arsenal fabricate a new, stiffer gun mount cradle better suited to meet MCS accuracy requirements.

Other improvements included an electrically actuated breech mechanism and two more blast deflector designs. Advances in modeling and simulation were used to improve the design and test process's



**XM360 Lightweight 120mm Gun**

The XM360 lightweight 120mm gun completes ATD test firing at APG. LOS/BLOS ATD gun testing was also leveraged to support the Army's developmental MRM. (U.S. Army photo courtesy of PM MAS.)



The XM360 is a lightweight, low-recoil 120mm gun comprising a cannon assembly and gun mount. The system depicted above integrates advanced material and design solutions to minimize weight, recoil and other potential AFV burdens. Here, the XM360 is test-fired at APG. (U.S. Army photo courtesy of PM MAS.)

efficiency. Modeling was used to predict the blast overpressure of candidate blast deflector designs, thus streamlining the down-selection process, while specialized sensors, microphones and a mockup of the MCS front glacis were used to collect more realistic blast overpressure data.

### **XM360 Gun Mount Clears ATD**

By November 2004, the LOS/BLOS ATD's lightweight 120mm gun was installed and firing at APG. The gun met its weight allocation and successfully fired the high-pressure M829A3 at its maximum service temperature. Target impact dispersion testing with this round and others demonstrated acceptable precision. Recoil impulse and recoil forces were within the specified limits, and the ability of the blast deflectors to reduce blast overpressure was demonstrated.

LOS/BLOS ATD gun testing was also leveraged to support the Army's developmental Mid-Range Munition (MRM). The MRM provides MCS the capability to engage BLOS targets at significantly greater standoff ranges, greatly enhancing system survivability. MRM testing included:

- Firing ballistic slugs to assess pressure.
- Firing MRM finned slugs to assess any impact of the integral muzzle brake on fin deployment.
- Determining maximum range.

The testing confirmed predicted pressures and proper projectile fin deployment. In addition, the maximum range requirement was exceeded. Successful lightweight 120mm gun testing brings it to Technology Readiness Level 6 and signals its readiness for integration into the MCS' System Development and Demonstration (SDD).

The XM360 lightweight 120mm gun development is continuing under a Cooperative Research and Development Agreement between ARDEC and GDLS. This effort's focus will be a continued design evolution to support the SDD for MCS. Current plans call for the delivery of nine guns — from 2007 through 2009 — to support development, safety testing and an MCS Integrated Armament Firing Test Rig. An additional six guns will be delivered from 2009 through 2010 for integration into the MCS Pre-Production Vehicles. ARDEC is also continuing

technology base work to further reduce the XM360's weight and increase its accuracy.

MCS is a key FCS program component and, more importantly, an essential Army transformation element directly impacting the UA commander's ability to project lethal, networked fires on future battlefields. It will ensure the U.S. Army remains the most capable combat force in the world, able to face any opponent, and win decisively. With continued MCS and XM360 gun development and eventual fielding, the Army is poised to deliver the lightest and most advanced gun system of its type in the world. Together with the ammunition already fielded and the suite of advanced ammunition in development, the XM360 will provide MCS with the versatility and lethal firepower needed to engage and destroy the enemy regardless of where the battlefield takes U.S. forces.

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