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Land Combat Vehicles: Protection Comes First

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Executive Summary

For decades, western armies have been working on developing a land-combat vehicle that would address the changing nature of warfare—notably fighting in densely populated urban and rural terrains—and new operational threats like mines, side bombs, and short-range rockets for purposes of ambush. But attempts to circumvent the use of expensive heavy armor by harnessing advanced sensory-fire and mobility technologies to neutralize potential threats before their actualization has been far from successful, leaving ground forces vulnerable and exposed. Development of a new land-combat vehicle will thus necessitate a highly inventive engineering and technological approach that slashes costs and weight of protective armor without compromising its effectiveness.

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INTRODUCTION

Western armies have spent decades developing a land-combat platform that would restore operational dominance to maneuvering ground forces. Amazingly, while task-specific platforms of this kind were developed in the US during this period, some were halted after years of great technological effort and financial cost. The development of other platforms was even more restricted, as they were seen mainly as emergency projects aimed at providing immediate solutions for the operational survivability of maneuvering forces.

Developers in the US are now beginning a new project, the NGCV (Next Generation Combat Vehicle), while in Israel developers are working on the Namer and the Eitan. A new Israeli platform, the Carmel, has also been heralded as a quantum leap in land combat capabilities.

How can it be that the US army and its research and industrial institutes invested hundreds of millions of dollars and precious resources over many years into developing two new platforms, the FCS (Future Combat System) and the GCV (Ground Combat Vehicle), only to ultimately cancel them? And why did the need arise for an emergency project (the Mine Resistant Ambush Protected Vehicle, or MRAP) in the midst of the US forces' combat activity in Iraq and Afghanistan? Have the necessary lessons been learned from past US projects, lessons that could help in developing a platform that would provide a genuine solution for anticipated combat reality?

This paper describes the stalemate that the new land-combat platform is intended to overcome. The advantage of the platform lies in its survival capability and the protection it offers. The platform's design is based on the axiom that proper protection enables effective combat, and without such protection the platform has no right to exist. In the words of Maj. Gen. (res.) Israel Tal: "The protection of the platform is a basic condition for the effective functioning of the combat vehicle and is needed to augment the combat capabilities of the soldier."

The mobilized combat platform is based on protection and survivability, affixed weapon systems, maneuver capability for land features, visual sensors for threat discovery, and operational capability of soldier

displays and interfaces. The existing platforms not infrequently fulfill most of these basic requirements and also offer creative technological solutions of their own—and yet at the same time they neglect the critical aspect of total protection.

In not a few cases it appears that protection issues remain without a solution until the latter stages of research—and therein lies the error. As will be explained below, the joint functioning of all a vehicle's systems are not a substitute for effective protection. It is gravely delusional to assume that advanced weapons systems and an advanced interface of sensors and situational awareness displays can compensate for a lack of protection.

The protective armor of the platform is the main building block on which all other systems of the vehicle depend. Protection, not the complementary technologies, is the main component in devising the platform. Protection will arise solely from serious development work, intense research, and original, outside-the-box thinking.

An engineering concept for a vehicle based on an innovative form of protection will be presented below. This protected platform can serve as the baseline for adding complementary technologies. Protection first and foremost, and only after it, offense. There are no shortcuts.

A CHRONICLE OF DEVELOPMENT

In the Gulf War (1991), the land forces of the coalition armies, led by the US army, conducted substantial and successful land-combat actions, including attacks deep in enemy territory, while combined air and land forces pounded and wore down the Iraqi army until achieving unquestionable superiority as Kuwait was liberated. The successful tactical-warfare measures in this war contributed not a little to the development of the FCS land-combat platform as part of a multiyear project that began in 1995 and continued until 2009, with an investment of tens of billions of dollars. The FCS platforms were intended to be the basic building block of a family of up-to-date weapons that were designed to broaden the tactical capability of the maneuvering brigade. However, incredibly, the project was canceled without any vehicles used.

What led to the decision to terminate the project? Combat events that began in 2003 with the invasion of Iraq (and ended in 2011 with the withdrawal of US forces) might have been a factor. In that round of fighting, land forces that used US combat platforms encountered and were neutralized by antitank threats and IEDs (Improvised Explosive Devices). The American forces encountered a new combat tactic of the enemy that replaced reliance on large, maneuvering combat forces with ambush by antitank rocket and missile fire. In addition, the enemy attacked US forces with IEDs, against which the US combat platforms had no suitable solution.

This gloomy situation, in which mobile infantry forces were targeted on their mobile platforms without response, spurred the US army to launch an emergency project for the development of the MRAP vehicle. This vehicle, which weighs fourteen tons, was designed to provide a solution especially against IEDs and short-range RPG rockets. The project began in 2007, and after the manufacturing and supplying of some tens of thousands of platforms ended in 2012 after an investment of tens of billions of dollars.

Even though, at that time, this platform provided the best available protection, it was still far from providing an adequate solution to all the threats in the combat arena because of its huge weight. It was thus clear that that emergency solution, which was based on the protection technologies available at the time, was only temporary and a better-protected platform was needed.

The US army therefore began to craft an alternative land-combat vehicle. In 2009, the GCV land-combat-vehicle project was launched with the aim of augmenting protection against deadly IEDs. Despite major efforts, after about five years the developers realized the vehicle was heavier than the Abrams battle tank, which weighs seventy tons.

The platform did not meet the criteria that the Americans had set for mobility and transportation. All their logistical needs—for improved mobility and maneuver capability alongside capabilities for transporting infantry to the battlefield and for air transport, as well as the possibility of movement on civilian roads and of haulage by transporters—remained without a solution. After an investment of

hundreds of millions, the project was terminated without reaching the stage of equipping forces.

Work has now begun on the NGCV, or Next Generation Combat Vehicle. Special emphasis has been placed on the installation of task-specific sensors designed to identify and destroy threatening targets before they open fire. In addition, there are requirements for enhanced weapon systems, communication, data display, and data-transfer capability. A criterion was also set that entails equipping the platform with a remote-controlled autonomous operative capability.

It is troubling that alongside all these requirements, special emphasis was not given to the main proven weakness of past platforms: survival and protection.

The requirements do not in fact address the IED threat that has killed many soldiers, sidelined platforms, and impeded the continuity of combat. Protection of the vehicle is the key and ultimate requirement for any platform, and the fresh lessons of the past teach us that lack of protection leads to the termination of projects. A platform lacking survivability will not enable a maneuver, and without a maneuver capability there will be no pursuit of the enemy. A vehicle lacking sufficient protection cannot enable the use of advanced weapons systems to destroy the opponent. In the new battle arena the main threat stems from ambushes and lethal IEDs. It is worth internalizing the failings that led to the cancellation of the FCS and GCV projects: the former suffered from a lack of proper protection, and the latter suffered from grave shortcomings in maneuver and transport because of its great weight.

Protection technologies are the most difficult to implement. A conceptual revolution is required to provide peripheral protection at a reasonable weight.

So long as the problem of survivability remains unsolved, the plethora of advanced instruments and innovative technologies cannot endow the mobile platform with superiority on the land battlefield. Deferring the survivability issue will mean that no platform reaches the stage of equipping the forces. The lack of a survival solution will bring all

platforms back to the starting line and the anticipated leap will not occur. A platform that does not survive does not fight.

Recently, the IDF's new combat vehicle, the Carmel, was described in the media. It was presented as providing an array of technologies for achieving superiority and improving battle capability. The new elements are sensors and systems for fire, fire management, operator display, information sharing, data processing, and data sharing with neighboring forces. The new vehicle will be operable by a manned team, remote control, or autonomous operation.

The vehicle is reported to be equipped with APS active protection systems (such as an Iron Fist or Trophy), which are advanced protection technologies designed to neutralize antitank rockets and ATGM missiles. However, these systems do not provide an adequate solution to the IED threat, which, as we have seen, all platforms fighting in complex territories will likely confront. According to the media, the issue of protection against IEDs is not being dealt with yet. A technological solution for this lacuna is supposed to be provided at a later stage.

Thus the disturbing question arises: How will the Carmel vehicle, which is designed for land combat in complex territories (i.e., urban, open, and varied), in which it is likely to be attacked by IEDs, be able to fully use its capabilities and perform its tasks? If it is not designed from the start to contend with threats from the lethal environment, its fate will be like that of its predecessors—the exposed FCS and the heavy GCV.

The ballistic threat and protection technologies

Protection technologies against ballistic threats are among the most challenging, complex, and expensive that have ever been developed. The deadliness of the threats and ranges of activation require special protection techniques and rapid response times, sometimes shorter than a second.

Active protection against rockets and missiles was enabled by a highly advanced technology that relied on the fact that rocket fire mostly

takes place from ranges of more than tens of meters. The successful protection systems that have been developed over the years, such as active protection (Israel is one of the world leaders in that field), overcame a variety of technological hurdles and managed to provide efficient solutions for countering ballistic antitank munitions.

At the same time, IEDs—improvised mines that are detonated, usually by sensor, from a range in the centimeters—and roadside charges that are detonated from a range of a few meters require solutions with response times that are far shorter than those utilized against antitank threats. Protection solutions against explosive devices of these kinds require a different sort of conceptual thinking.

To maintain a survivable platform with multidirectional protection at a reasonable weight, creativity is needed in both the approach to the structure of the vehicle and the components of its protection. The kind of conceptual quantum leap that was made for active protection systems against antitank missiles and rockets is needed here as well. A structural design needs to be integrated into an innovative combat concept.

Because of its conceptual novelty, this creative technology does not yet exist in the civilian market. It cannot rely on computing technologies and algorithms that are based on a computer, communication, displays, or sensors. Experience teaches that in the field of protection, breakthroughs and capability improvements are achieved only through complex simulation work accompanied by difficult and exhausting field tests that take into account a wide variety of threats, without shortcuts.

The problem of low survivability that the Americans have encountered time after time on the battlefield indicates that there can be no compromises regarding the intensity of the threat, the kinds of threat, and the coverage area of the battle vehicle. So long as there is a threat on the battlefield that remains without an adequate protection or ballistic solution, it will defeat any future platform. A partial protection solution will leave the platform exposed and lead to the abandonment of the development efforts, as happened to the FCS. Similarly, in the case of the MRAP (Mine-Resistant Ambush Protected) project, which provided only a partial protection solution, the US Army purchased only a limited number of vehicles and looked for a different solution.

Researchers and engineers the world over are still seeking a revolutionary solution for improving the protection of the mobile platform. If this solution is to be found, it will require mobile platform developers to apply solutions that will enhance its protection and survivability. Only afterward should a solution be sought for the vehicle's complementary lethal capabilities.

A REMOTE-CONTROL PLATFORM

We have been hearing a lot about mobile platforms that are designed for remote control as a means of protecting soldiers. Vehicles of this kind are meant to be utilized as the spearhead of a combat force that will man and drive them. If the mobilized force is hit, platforms of this kind can be led without soldiers via remote control.

Although this combat conception is indeed innovative and could expand protection for missions, it is unable to improve the survivability of the vehicles themselves. IEDs will be just as fatal to a vehicle whether it is propelled by soldiers or by remote control. These explosive devices are detonated by proximity sensors and will hit any platform that passes over them. If an unmanned remote-control platform is destroyed by a roadside charge, the fighting force will remain outside the boundaries of the combat arena due to loss of mobility.

Thus, the protection of a multi-scenario platform (manned or remote-control) is critical to ensuring its survivability, which is required to ensure continuity of combat for the land force. The bottom line is that optimal and ultimate protection is not optional but a threshold condition for the subsistence of all mobile battle platforms. On the lethal battlefield, this basic condition must be met so the forces in the field can effectively decide by whom and how the platform will be activated. They must be able to do this in a manner that stems from tactical considerations alone and is not dictated by constraints of inadequate protection.

A NEW APPROACH TO PROTECTION AND SURVIVABILITY

The structure presented below is a possible example of a new engineering concept for a combat vehicle, one that illustrates the notion that improved structural survivability is a basic condition for the existence of an effective combat platform.

The proposed solution demonstrates how it is possible and appropriate to deal initially with the issue of protecting the platform, and only when this has received proper attention to add the supporting combat technologies.

The structural concept is based on three separate combat cells, one for each soldier. In this approach, the vehicle's survivability is improved by a large space between the soldier cells (spacing), with each cell shaped as a cone that protects against impact from below (mines) while having an ellipsoid side panel that protects against a roadside-charge attack. The shaping saves space and concentrates the mass toward the direction of the incoming threat. The chances of a combat cell being hit fatally from the direction of the attack (from below or from the side) are reduced by the double and unique shaping of a cone that turns both downward and as an ellipsoid toward the roadside. In this way most of the mass of the protection is concentrated in the direction of the possible attack in a manner that saves weight and enables high survivability at a relatively low weight.

Because of the shape of the vehicle, there is a high chance that IEDs will strike the space between the cells. Moreover, if one cell of the vehicle is struck, only one soldier would likely be hit directly. The other soldiers' survival chances would remain high and they would be able to continue the mission.

As noted, once a proper structural solution is provided for addressing the problem of platform protection, the rest of its components, such as vital battle instruments, can be improved and refined. A panoramic screen in each cell would address the issues of control and display by providing each soldier with a view of the outside and enabling him to share displays and data with the other soldiers in the vehicle.

It is worth emphasizing the unique way in which the soldier cells are affixed to the vehicle. Having the soldiers sit in a row, in separate cells, one after the other, is an innovative protection concept. They will no longer have to sit together in a single combat cell that would expose them all to a hit. Instead, they are compartmentalized and shielded in three separate combat cells. This means the vehicle's maximum combat capabilities are utilized and the burden optimally divided. Moreover, the concept enables the vehicle to be small and narrow, which increases maneuvering ability in urban arenas where roads are tiny.

Conclusion

The Darwinian natural selection concept states that survivability under natural conditions dictates who will make it and who will become extinct. This basic concept should be applied to the promotion of an innovative combat platform. It has been proven time and time again that combat platforms without proper protection do not live on. Their development is halted at an early stage or they are pressed only briefly into service.

Protection technology is the most important requirement for a combat vehicle's success, and protection must be the key component of new combat platforms. Common sense and the lessons of history dictate that development efforts should concentrate on imparting survivability to the platform. Only when that is achieved should the full range of supporting technologies be added, including mobility, weapons, sensors, displays, and others that complement and improve operational capabilities. The computerized technology of the future may provide the required capability for victory, and it can help the combat platform regain lost dominance in the land battle—but protection should always be addressed first.

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