By: Remy Hemez

In today's rapidly evolving security environment, and after years of COIN operations, our armies are shifting their focus towards combined-arms maneuvers, which enables them to better prepare for combat against a wider array of adversaries, including near-peer competitors. This shift implies a renewed interest in the concept of survivability, defined as the holistic capacity of a weapon system to avoid, resist or recover from damage caused by hostile action that threatens it with destruction, and the ability to pursue the mission.

The Lethality Challenge

The potential battlefield is marked by a high level of lethality. No vehicle is invulnerable as illustrated by the destruction of no less than 10 Turkish *Leopard* 2A4 around al-Bab, Syria, in December 2016[1]. The trend toward increased lethality is very clear from the middle of the XIXth century. It accelerated dramatically in the 1950s with the arrival of nuclear tactical

weapons. From the 1970s, progress in lethality can be grouped into two broad categories. The first is precision. The massive appearance of anti-tank guided missiles (ATGM) in 1973 during the Kippur War is particularly symbolic of this. Precision also surged in the field of indirect fires. For example, the last 15 years have seen the appearance of artillery and mortar shells with terminal guidance and trajectory correction systems and ground-to-ground rockets with a metric precision at a distance up to 80 km. Also worth mentioning are top attack and loitering munitions who also represent major challenges for land forces.. The second major category of progress regarding lethality relates to C4ISR. Important advances have been made in the field of sensors, their multiplication and persistence (especially through the use of drones) have increased the quality and quantity of information available to ground forces and, among other things, help to rapidly deliver precision fires in the depth.

The lethality we could face on the battlefield also increases through technological catch-up and technology diffusion. The dissemination of tactical guided weapons (G-RAMM, Guided-Rockets, Artillery, Mortars, and Missiles) is accelerating. This phenomenon even affects non-state groups (referring to the concept of "*techno-guerrilla*"[2]) and offers them unprecedented firepower. Hamas possesses, for example, *Kornet*, *Konkurs*, *Fagot* and *Malyutka* missiles as part of its arsenal, and made extensive use of them during Israel's 2014 Operation Protective Edge. Non-state irregular forces are increasingly trained and are usually equipped with small-caliber weapons, RPGs, mortars, short-range rockets and IEDs. In the middle of the spectrum, hybrid state-supported forces can be additionally equipped with anti-tank missiles, MANPADs and rockets of a larger caliber and range. At the high-end of the spectrum, advanced states have the most sophisticated weapons including ballistic missiles, anti-access weapons, and reconnaissance, surveillance or cyber capabilities.

It is, in fact, the whole "operative comfort"[3] which Western armies have benefited from since the end of the Cold War that is being challenged. Tomorrow's operations could be conducted under harsh conditions: disputed air superiority, threat of chemical radiological

and nuclear arsenals, repeated hostile actions against command centers and logistical flows, massive artillery fires, precision fires in the depth, etc.

Survivability through technology

To address these threats and enhance our forces' survivability on the battlefield, technology is important, and can be divided into two main categories. The first consists in passive measures. To detect first, a crew's situational awareness can be improved by using, for instance, video systems with 360° hemispherical field of view, like the Thales Antares. To avoid being detected too soon, signature management is crucial and employing new generation camouflage net like the Saab Barracuda's Mobile Camouflage System is an improvement. Vehicles can also be equipped with IED Jammers or add-on protection systems to face the RPG threat like the BAE System's BAR ARMOUR. Armor is still useful to avoid being pierced when hit and great progress has been made in this field, as illustrated by the use of ceramic or the development of nanomaterials. In the past years, survivability has mainly focused on the development of disposals capable of reducing and mitigating post-hit destructive factors for crews, like blasts or flying objects. This is feasible thanks to blast-resistant seats, interior bonded spall liners, etc. The second broad category of technological solutions aimed at improving combat vehicles survivability are active systems. Here, targeting detection sensors are crucial. They include, for example, laser warning receivers. Once the threat and its direction are detected, the system can launch an automated response either soft kill (smoke, lures, electronic jamming, etc.) or hard kill systems. The latter aims at targeting the incoming projectile. These Active protection systems (APS) are an attractive solution to get out of the "improved protection/weight increase" vicious circle. Some of these systems already exist and are operational, like the Israeli Trophy that has successfully been tested in operations. Nevertheless, APS are not a silver bullet solution. Their level of sophistication – mainly because of the reaction time needed to counter a threat – makes them very expensive. The Trophy costs an average of €500,000 per vehicle, although being one of the cheapest on the market. Its installation on a

modern battle tank costing €15 million may be profitable. However, the cost-effectiveness ratio is questionable for a €1.5 million APC like the French *Jaguar*. Moreover, these sophisticated equipments are not immune to simple and low-cost countermeasures, such as the shooting of a volley of inexpensive projectiles to saturate them[4]. The employability (what about collateral damages?) and sustainability of all these high-tech systems raises questions. Unlike fighter planes, armored vehicles do not routinely return to their bases after their mission, and they operate into highly abrasive environments. A glance at the condition of Syrian tanks involved in urban combats is enough to convince oneself. Finally, and for now, they don't solve the weight problem: the Marines estimated that equipping their M1A1 with the Trophy APS would increase their weight by 2.5 to 3 t. Technology has made great progress in the field of survivability, but the struggle between the shield and the sword is a never ending story and it appears that, nowadays, the sword is always one step ahead of the shield.

Maneuver and Survivability

It results that technology alone cannot be the solution to improve survivability in a contested environment. Claiming that combined arms integration is key to achieve this seems obvious, but this argument still deserves to be developed. For some authors, survivability is part of their combined arms concept's definition: "the basic idea that different arms and weapons systems must be used in concert to maximize the survival and combat effectiveness of each other. The strengths of one system must be used to compensate for the weaknesses of others."[5] This idea is nothing new. The need for combined arms integration has become more important as firepower increased on the battlefield and, as a result, the level of combined arms integration has lowered to the reinforced platoon level.

To avoid being limited to mere cooperation and deconfliction, this synergy of various capacities is far from obvious. It requires, in particular, the grouping of these capacities

under a single, well trained, command. Today, the increasing diversification and specialization of weapon systems, the complexity of the management of the 3rd dimension and the vast amount of information resulting from digitization have made the command of a combined unit more complex than ever. In order to cope with this complexity, the question of the combined arms organization – that is to say, the distribution of means within units – should be raised. Further lowering the integration level could be a necessity, for example when dealing with long range fires. Moreover, to be as efficient as possible, this combined arms integration must be made of a very diverse range of capabilities. This might be problematic for armies that have been waging COIN operations since the beginning of the 2000s and that have undergone major reforms. One very symbolic capability gap is, either in France or in the United States, short range air defense.

The most resulted forms of combined warfare, and key to achieve survivability, is maneuver. To address the new threats of the battlefield, it should be necessary to renew our tactical thinking and courses of actions. Many ways of thinking are well-known: non-linear warfare, swarming, more dispersed disposals, etc. But they still need to be tested on the ground and to be culturally accepted. Tactical surprise must therefore be promoted .Some tactical processes, such as surprise, should be highlighted here. Indeed, a very favorable loss ratio is one of the most remarkable consequences of obtaining a surprise effect. Barton Wahley[6] notes that within its 138 case studies (1914-1967), the loss rate is 1 in 1 if there is no surprise effect and 1 in 5 in favor of the initiator if there is a surprise effect. Moreover, in absolute figures, the surprise effect tends to decrease the losses of the initiator. Looking forward, new technologies offer renewed perspectives regarding maneuver. For instance, another way to increase survivability could be to differentiate a unit's heart, made up of the most sophisticated (and manned) vehicles dedicated to decisive action, from an outer layer, formed of a swarm of accompanying unmanned vehicles. The latter would protect the heart and help him engage in combat by shaping the adversary. Losses would be accepted because they would consist of numerous, relatively affordable, UGV or drones[7]. This refers to the so-called "mother ship" model, where a machine controls a network of drones and

therefore has sensors and possibly aggressive capabilities deported, but where the decision remains centralized. Without going to the swarm, the idea of a manned/unmanned teaming can already advance survivability, a UGV or a drone completing the weak points of a manned vehicle. The US Army is currently developing a prototype *Abrams* tank capable of managing robots carrying ammunitions or reconnaissance missions This prospect is very interesting. The real technological game changer should, however, be the integration of survivability, armament and situational awareness elements, thanks to distributive networking, not only within one vehicle, but among all the vehicles, sensors or platforms (including drones and UGV) of a given unit. This could change the physiognomy of warfare by introducing collaborative protection and collaborative warfare. As a result, a vehicle should be able to detect the aggressor of another one in order to allow all or part of a unit to rally their weapons towards the target to obtain a collective response in "reflex time". This requires advanced processing and evolved artificial intelligence.

Conclusion

Survivability is the clever mix of tactics (dispersion, swiftness, etc) and technology. This delicate equilibrium needs to permanently be reevaluated in accordance with the threat and forces employment context.

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