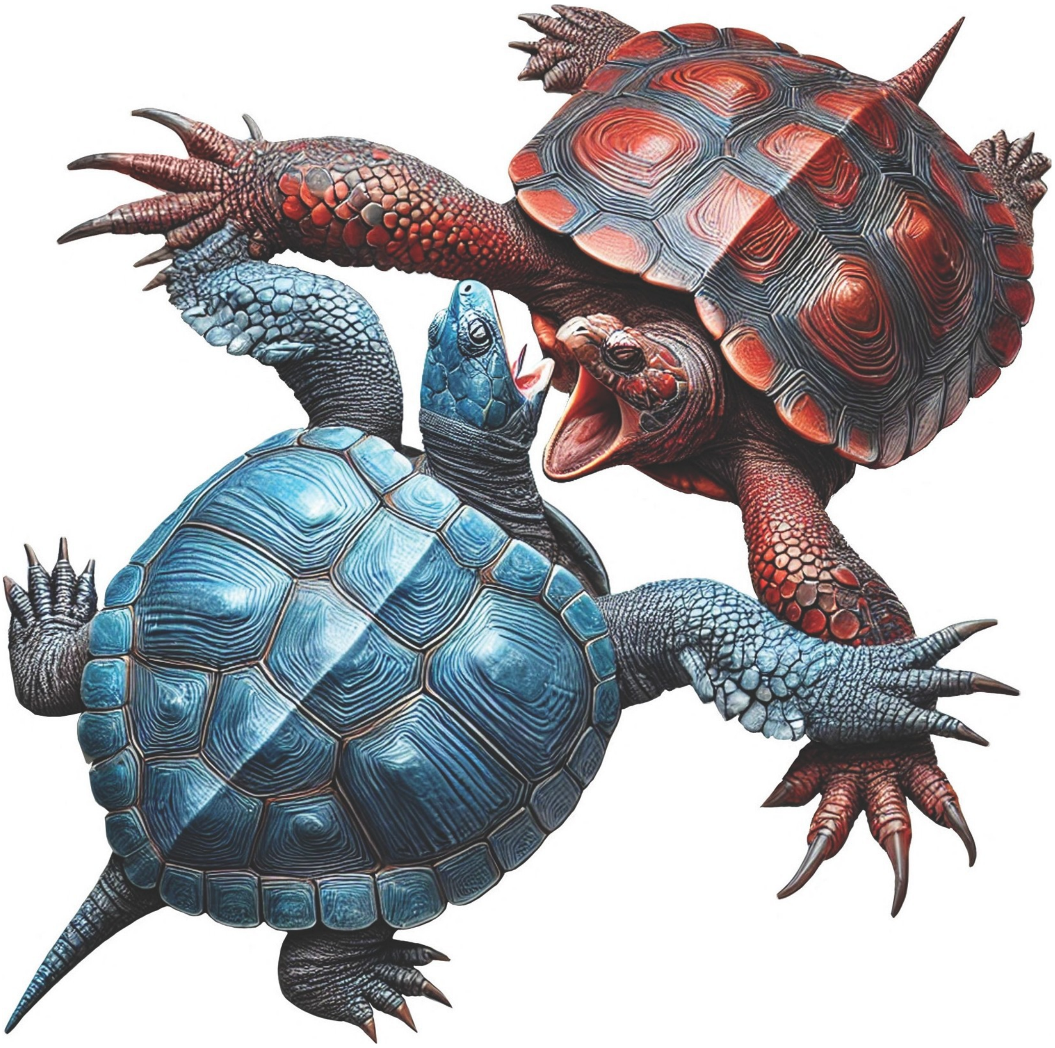
LUTZ UNTERSEHER

TANKS AND COMPANIONS



LIT

Lutz Unterseher

Tanks and Companions

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A Collection of Critical Essays

Berlin: LIT Publishing
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„Tanks are human beings too."

Shlomo Rosenblatt

CONTENT

Introduction

This volume presents a collection of essays on the history and more recent developments of the battle tank, as well as other armored platforms. In general, these contributions adopt a critical tone and occasionally resort to unvarnished sarcasm – after all, the aim is to keep a measured distance from what are ultimately instruments of killing – rather than to slip into the enthusiasm of an aficionado. Nevertheless, readers will find ample factual information and exploration of relevant contexts throughout.

The collection comprises essays published between 2000 and 2023. Some have been shortened or revised but not brought fully up to date, so as to preserve the impression they reflected at the time of their initial publication. Because these are essay-style pieces, *extensive* scholarly apparatus has been dispensed with.

The first chapter focuses on the history of the tank – with fre- quent glances at the present. Two different essays illuminate comple- mentary aspects of this subject from varying perspectives.

The second chapter deals with armored vehicles geared toward far-reaching military intervention – euphemistically labeled "crisis response" – or those that are supposed to serve that purpose. Three contributions reflect expert debates that took place at the height of this "interventionitis" in the first decade of this century.

Following the failure of major Western military interventions in Central and Southwest Asia, and given Europe's newly visible threat from the East, reflection on strategic power projection by relatively "light" forces has become less of a priority — some might say it has fallen out of vogue. Yet it is quite likely that, in the future as well, there will be a need for intervention forces – legitimized by the international community – capable of providing protection and stabilization in conflict zones. Designing appropriate equipment for such missions is anything but trivial.

Against this backdrop, this chapter includes a systematic comparison of wheeled and tracked armored vehicles, takes a satirical look at the attempt to enhance the survivability of under-armored troops by means of “situational awareness”, and touches on a problematic effort (by the German military) to keep pace internationally in terms of power projection.

The third chapter focuses on the core of protected platforms: the main battle tank, which, in light of Russia’s invasion of Ukraine, has once again become fashionable. One essay subjects Russia’s purported 'wonder tank' to a sobering critique, while another scrutinizes Western prototypes – touted as the answer to Eastern challenges – to expose their weaknesses as well.

Finally, the fourth chapter distills the essence of the argument from Chapter Three. It provides detailed sketches of armored vehicles intended to spark a discussion about robust, mission-appropriate solutions. The degree of specificity may seem surprising, yet, as they say in the Israeli army: “Draft a precise concept – nothing is a better base for making changes!”

Battle tanks and other armored vehicles will be with us for a long time to come. Tanks in particular have often been declared obsolete, only for that pronouncement to prove premature. Indeed, if they are deployed in insufficient numbers and without adequate support, their performance can be dismal.

Even so, they have remained a highly visible symbol of state power and a statement of readiness to assert claims through military force.

HISTORY

The first piece in this chapter spans an arc from the early precursors of the tank, through its birth as a relevant factor on the battlefield of the First World War and the experimental interwar period, to the key role of large armored formations in the Second World War. It then traces their subsequent evolution – from the high-stakes East-West conflict, where capabilities were measured in the currency of tank potentials, through the tank's loss of prominence during the era of large-scale strategic military interventions, and finally to its resurgence in the context of the war in Ukraine.

Originally published somewhat earlier, the second piece can be seen as a complement to the first. It provides information on tank production during the First World War and on how armor tactics and operational methods evolved. It also makes clear that the tank's diminished importance – associated with the emphasis on far-reaching military interventions – was temporary; moreover, it was largely a European phenomenon rather than a universal one.

From Leonardo to the War in Ukraine
First published as *"*Einleitung*" (Introduction)* in: *Über Panzer (On Tanks),* Berlin: LIT 2023

Invention

It all begins with the Florentine Leonardo da Vinci (1452-1519), perhaps the only true universal genius in the European cultural sphere. He can be regarded as the father of the tank – an armored fighting vehicle offering all-round protection.

Certainly, in the Bronze Age and Antiquity, throughout the Near East and Mediterranean, there were precursors in the form of war chariots (Hebrew: Merkava): two-wheeled carts drawn by horses, usually manned by up to three individuals – a driver (the coachman), a warrior armed with a lance or bow, and a shield-bearer tasked with protecting the other two. Yet even taking into account any waist-high bulwarks, the crew's protection – especially from the rear – remained scant.

War chariots were costly status symbols, affordable only for an aristocratic elite, and thus unsuited to mass mobilization. There was also the personnel requirement: of the three men, only one was truly a fighter. Eventually, cavalry – cheaper and tactically more versatile – replaced the war chariots.

In ancient Greece, war chariots lost their significance. The city-states' focus turned to citizen-soldiers – proud infantrymen who, in many ways, relegated cavalry to a supporting role. The Roman army took a similar path with its legions.

Back to Leonardo! He devised myriad machines (Heydenreich et al. 1980). His overarching goal seems to have been 'mechanization': amplifying human muscular power – or even replacing it – by technical means, thus laying the foundation of the modern age.

The tank he designed had four wheels and, in appearance, resembled a turtle (wooden shingles plated with metal in such a way as to deflect projectiles). Manned by a crew of eight, it featured 16 small- caliber breech-loading cannons directed to all sides (an intriguing choice, given that muzzle-loaders had come into vogue). The wheels were to be turned by muscular power via a simple mechanical system.

A modern attempt to realize this prototype revealed that the drive mechanism, as drawn, did not work. However, a minor adjustment of Leonardo's concept could make it functional. It has been suggested that Leonardo may have intentionally introduced a design flaw to prevent 'warmongering fools' from easily replicating his invention.

A fundamental shortcoming – insurmountable at the time – was that Leonardo's vehicle depended entirely on muscle power: there was *no primo motore*, i.e., no power source to spare humans (or animals) the labor of propulsion. Such an engine would not become available for vehicle use until the 19th century, first with the steam engine and much later the internal combustion engine.

Rediscovery

"In 1870 an ordinary shell when it burst broke into from nineteen to thirty pieces. Today it bursts into 240. Shrapnel fire in 1870 only scattered thirty seven death-dealing missiles. Now it scatters 340. …
It will be a great war of entrenchments. The spade will be as indispensable to the soldier as his rifle. The first thing every man will have to do, if he cares for his life at all, will be to dig a hole in the ground, and throw up as strong an earthen rampart as he can to shield him from the hail of bullets which will fill the air."(Bloch 1899: xxvff)

Technological progress was rapidly infiltrating warfare (or perhaps it was war intruding upon technology?). The bleak prognosis above, eerily predicting the horrors of the First World War, was penned by Ivan Bloch (1836-1902), a Polish-born banker sometimes called the "Railroad King" of the Russian Empire. In his 1899 English edition of "The War of the Future" (originally published in Russian and French in 1898), Bloch warned that the massive industrial destruction capabilities worldwide meant such a conflict could be won by no one. He was nominated for the first Nobel Peace Prize in 1901 but did not receive it. Whether his Jewish heritage played a role in the result remains speculative.

If Bloch's grim analysis proved accurate, how would one still wage war? How might one break free from omnipresent, lethal fire? How could movement on the battlefield become possible again – possibly even with a chance of victory?

The solution appeared to lie in technology itself. Fans of futuristic engineering and visionaries alike began imagining armored vehicles, powered by steam engines or internal combustion motors, capable of rough-terrain travel and equipped with deadly weaponry.

One such design is attributed to Kaiser Wilhelm II (1859-1941), who, as a young man, liked to sketch warships outfitted with oversized guns. Indeed, the Royal Armoured Corps Museum in Bovington (Wiltshire) once displayed a wooden model allegedly reflecting his concept, though it is no longer shown.

British writer and science-fiction pioneer Herbert George Wells (1866-1945) published the 1903 short story "The Land Ironclads", depicting such vehicles in terrifying action (Wells 1966: 115-138).

Above all, though, mention belongs to the visionary Austrian railway officer Gunther Burstyn (1879-1945). In 1911, he unsuccessfully submitted a proposal to the War Ministry in Vienna for what he termed a "Motorgeschütz", a motorized gun, that today looks strikingly modern. While many contemporary designs tried to resolve the ground-pressure problem of armored vehicles by adding more and more wheels, Burstyn suggested tracked propulsion, which had been only just used for agricultural vehicles. Instead of placing guns in side sponsons, as others did, he put a rapid-fire cannon in a single rotating turret in the center of the platform.

At the time, Leonardo da Vinci's pioneering work had slipped from memory, so the (re)discovery of the "tank" concept emerged largely from the needs and conditions of the day.

Establishment

But that rediscovery had to happen twice, in a sense. Early advocates made little impact, and their ideas were often dismissed as hare-brained. The breakthrough came soon after the outbreak of World War I, initially in England and then in France, where trench stalemate cum massed artillery made such an innovation seem urgently needed. Be- ginning in 1916, the armored vehicle, called the “tank” in England and “char d’assaut“ in France, established itself as a relevant factor on the battlefield (Messenger 1978: 14-17).

This novelty was soon caught in the crossfire of debate during the interwar years, much of it fueled by traditionalists. Meanwhile, various experiments proceeded in search of the 'right' kind of tank. Designers dabbled in minuscule and gigantic multi-turret vehicles. Questions also arose over how to incorporate tanks organizationally and use them at the operational-tactical level.

Amid these evolving ideas – particularly in Germany – the concept of self-contained large-scale armored units prevailed and shaped World War II. Medium to heavy tanks formed the core of these formations, which included integral mechanized infantry (Panzergrenadiers) and corresponding artillery, working in close synergy: the doctrine of “combined arms” (Jahn 1996/97).

A major architect and champion of this new style of mobile warfare in the German Wehrmacht was Heinz Guderian (1888-1954), an ardent admirer of Adolf Hitler (Guderian 1937).

World War II on Europe’s battlefields was largely characterized by major tank operations: thus solidifying the heavy-armored-division model, principally geared to broad offensive maneuver, as the basic pattern for the Warsaw Pact-NATO confrontation during the Cold War.

During this protracted rivalry, the West consistently asserted that the Eastern bloc possessed far greater numbers of tanks in armored and amored infantry (motor-rifle) divisions. It was from this that NATO derived its argument that reliance on (U.S.) tactical nuc-lear weapons was essential to Western defense – cementing a considerable measure of American military-political dominance in Europe.

Disenchantment

As the Cold War drew to a close and in its immediate aftermath, a dual disenchantment with heavy armor set in:

First blow: The supposedly mighty Soviet tank force took a hit. A Scottish-German team, building on the analytical work of a U.S. Army research institute and numerous expert interviews, demonstrated that NATO's official threat assessments of Warsaw Pact armored power had been grossly exaggerated (Chalmers/Unterseher 1988). "NATO as the mother of all fakes," so to speak.

Published multiple times and adapted into a U.S. educational TV documentary, these findings pricked the balloon of NATO and Pentagon claims – just in time to lend a sober perspective to the Vienna negotiations on Conventional Armed Forces in Europe (CFE). Main takeaways:

"The Warsaw Pact's superiority in tanks in Europe has usually been considerably overstated. Its actual numerical advantage is relatively small, ranging from 1.24:1 to 1.64:1, depending on the stage of mobilization and area covered. In addition, the superior quality of NATO tanks as fighting machines largely offsets even this modest lead, and may even mean that NATO's tank force has greater combat potential, despite the high priority that the Soviet Union has given to its ground forces over the last four decades." (ibid.: 48)

Second blow: This one struck Western armored forces. The demise of the Warsaw Pact sparked "interventionitis", as NATO searched for a new raison d'être. Some prominent political scientists from Germany, Israel, and the UK, relying on empirically shaky claims (AKUF 2006), imagined an era of proliferating internal wars at Europe's periphery and in the Global South ("new wars").

The argument held that the West should intervene militarily, to restore order and also for its own good. For these large-scale, rapid-deployment operations, light and medium-weight forces seemed more suitable than heavy armor – regarded as too ponderous. As a result, tanks lost considerable significance.

Hope of Salvation

In 2014, when Russia annexed Crimea and – indirectly – parts of Ukraine's Donbas, the specter of an interstate war returned to Europe, and many observers once again saw a pivotal role for heavy main battle tanks. Russia flexed its muscles, unveiling a purported 'wonder tank' (analyzed in a separate essay in this volume), and announced a sweeping modernization of its armored forces – though the resources for such a transformation were in fact not available.

By the time the invasion of Ukraine, launched in 2022, unfolded, it became clear that Russia's actual tanks, still based on Soviet-era designs, were of poor quality. The grand modernization had been a bluff. Within that context, the idea arose that modern Western tanks might tip the scales on the ground if provided to Ukraine. Among Germany's political parties, the Greens in particular championed this stance: apparently the only group genuinely committed to restoring Ukraine's territorial integrity.

That the Greens – once rooted in pacifism and often distant from matters of war – would stake so much on the tank, of all weapons, is indeed striking. Even more so because the tank is widely viewed as a symbol of aggressive warfare. Yet they elevated it to a kind of 'miracle cure', with a leading Green politician going so far as to call on the German government to provide Ukraine with thousands of them – an impossible quantity, whose production would require years. In any case, the Greens saw it as time to "go big, not in dribs and drabs," reminiscent of Heinz Guderian's offensive tank strategy, rather than Chancellor Scholz's more cautious approach.

Anyone seeking to "go big" with armor would do well not to treat the tank as an abstract symbol but to consider it in the context of rational military operations. If tanks really are expected to reverse the situation on the ground, their use must fit into the "combined arms" concept, integrating sizeable numbers of main battle tanks alongside infantry fighting vehicles, self-propelled howitzers, and air support.

However, the Greens have not taken that step. Going that far would mean wholeheartedly engaging with the realities of this war – including the possibility of Ukrainian troops pushing deep into Russian territory (defined as pre-2014 borders), thereby creating new escalation risks.

Moreover, as Ukraine's forces demonstrated in the late summer of 2022, territory can be retaken without placing tanks at the heart of the operation – namely through an ingenious tactical combination of precise indirect fire (tube and rocket artillery) and highly mobile light infantry (Unterseher 2023: 50). But that mix seems less exploitable for symbolic politics

By summer 2023, the 'tank hype' had largely subsided – likely because the piecemeal delivery of Western armor dampened hopes for a major tank-led offensive breakthrough, but also because policy makers had begun to recognize the potential escalation hazards in a full-blown armor offensive. A newer fix now lies in high-precision deep-strike weapons (e. g., the German Taurus cruise missile), which Ukraine has requested and whose delivery the German government has refused. However, any such deliveries would likely be just as symbolic – due to cost and fears of unwanted escalation – as the story with the tanks. It signals a tacit acknowledgment that, after unsuccessful counteroffensives, there has been little or no progress or even limited retreat along the main front.

The logic of such deep strikes is akin to an overmatched boxer resorting to a low blow, hoping the opponent will crumple: aiming to degrade rear-area support and thereby starve frontline units of vital supplies. Yet whether these new munitions could truly overwhelm enemy defenses remains highly questionable.

A historical parallel: When, in World War I, the Western Front in France bogged down in trench warfare, the German High Command, at enormous expense, embarked on using Zeppelins and then large twin-engine bombers to attack England's east coast (and even Lon- don).

The most memorable damage was the destruction of a children's hospital in Chelsea (Unterseher 2013: 87-94). Here again, we see the belief that more advanced technology might finally break the deadlock – often with devastating but not necessarily decisive results.

Tanks:
In the First World War and Today

First published in: *Wissenschaft & Frieden* 4/2014 (“Panzer: Im Ersten Weltkrieg und heute“)

The Tank’s Debut in the Great War

The tank made its first appearance during the Great War, after the fighting on the French front had seemingly bogged down. The defense, armed with machine guns and newly developed field guns capable of high rates of fire, was too strong for the typical infantry assault – moving forward in broad formation after artillery prep.

That gave rise to the idea of a vehicle that could traverse the trenches soldiers had dug for protection against incessant enemy fire, while providing its own crew the ability to operate weaponry under armor plating. By early 1915, a prototype had been developed in England – still unarmed, bulky, but functional. It was nicknamed Little Willie (slang for 'little penis', and also a derisive nickname for the German Crown Prince).

Next came the Mark I, intended for actual field use and arriving at the front in summer 1916. Much larger than its predecessor, with a long chassis and tracks angled at the front to help it cross trenches, the Mark I had no turret. Instead – and somewhat inefficiently – it carried a dual armament of machine guns and light cannons installed on its flanks. At 30 tonnes, it was considered heavy; yet despite having a larger volume, it weighed only half as much as a modern main battle tank. It offered protection only against infantry weapons (and against shell fragments of relatively low kinetic energy).

Meanwhile, similar initiatives had emerged in France. The first two French models, classified as medium tanks, arrived somewhat later on the battlefield, as early production runs were delayed by technical hurdles. Like the British design, they lacked a turret. They also had poorer off-road mobility compared to their British counterpart.

Before long, French factories stopped making these medium models as production responsibilities were split: Britain continued refining the Mark series (and introduced a new medium tank called the Whippet), while France concentrated on producing a light tank. By 1917, they were mass-manufacturing the lightweight Renault FT 17, equipped with a turret-mounted gun.

By the end of 1918, around 1,300 tanks of the Mark series had been produced, plus several hundred Whippets. The two medium French models had each reached about 400 units, and the French turned out a full 3,600 Renault light tanks (Zetschwitz 1938: 224, 235). By contrast, Germany built a mere 20 heavy A7V tanks – also with no turret (Unterseher 2014: 75–77).

Ending Trench Warfare

France and England thus produced about 5,500 tanks in a productive division of labor, while Germany's contribution remained negligible. That demands an explanation:

One cannot simply argue that Germany was out of resources and its army therefore couldn't afford tank production. The resource shortfall was largely tied to the navy swallowing massive funds: continuing to build capital ships after the Battle of Jutland (which did nothing to break British naval supremacy) and ramping up a large submarine fleet, which ultimately helped push the United States into the war.

In concrete terms: The steel consumed by building just one capital ship could have produced over 3,000 light tanks.

Besides this flawed strategic direction, the army high command's particular mind-set also led it to reject tanks. On the Western Front, both sides sought to break free from stalemate to restore their prospects of victory. How to reintroduce mobility?

Germany aimed for a combination of the 'wonder weapon' gas, suited to its own hubris, and new tactics, hoping for a breakthrough into the enemy rear. Two tactical innovations were key:

1. Artillery Concentration: In every caliber, artillery was to be

massed unexpectedly at a chosen point of breakthrough and then advance its barrage in tandem with attacking infantry.

2. Stormtrooper Concept: Instead of a frontal infantry charge, there would be fluid movements by elite units. Concentrated on a focal point and exploiting enemy weak spots, they would drive deep into enemy lines, disregarding threats on the flanks, supported by a steady flow of reserves from the rear.

This focus on tactics was rooted in the dual character of the Prusso-German military: on one hand highly professional, on the other profoundly non-bourgeois (pre-industrial mentality). Some modern weaponry (e. g., the machine gun) was acknowledged for its impact, but overall the high command kept its distance from the 'bourgeois' world of machines.

The notion that a machine might solve a tactical problem met with skepticism. (By contrast, the more bourgeois-minded Imperial Navy was rather technology-friendly.)

France and England held a different view, less influenced by pre-industrial outlooks. There, the tank became a central instrument for planned breakthrough operations, though these fell short of expectations. While the Entente powers deployed tanks in ever-greater numbers (50 at the Somme in 1916; 500 at Cambrai in 1917), they remained wedded to linear frontal attacks.

Even so, the relentless series of tank assaults and the resulting drain on German manpower contributed significantly to Germany's eventual defeat.

After the Great War, 'progressive' military leaders in some countries began applying the new German-style infantry tactics to the tank itself, thus shaping the concept of large-scale mechanized operations in depth. The career of Erwin Rommel (1891-1944) exemplifies this development: he led stormtroopers in the First World War and armored forces in the Second (Rommel 1990).

A Tenacious Machine

The tank has always been something of an oddity. Almost from the moment it appeared on battlefields, analysts were predicting it wouldn’t survive long. In the aftermath of the Great War, conceptual uncertainty, frustrating debates on optimal usage, and the bureaucratic and media pushback from branches eclipsed by the tank sowed wide- spread skepticism.

The emergence of specialized anti-tank weapons made tanks seem more vulnerable. Thus many doubted they had much of a future at all. Yet in World War II, the new weapon established itself. The European theater was shaped largely by tank combat.

Nazi Germany paved the way. There, more than elsewhere, it was recognized that when used 'according to their nature' – like WWI stormtroopers but with even greater concentration – tanks proved excellent for wide-ranging offensive operations. Moreover, it was understood that if these tank formations were to keep advancing, they needed immediate support from dive bombers (or fighter-bombers), mechanized infantry, and artillery.

After World War II, tanks and tank-heavy formations became the central 'hard currency' of East-West confrontation. NATO repeatedly claimed that the Warsaw Pact’s substantial tank and armored-division force conferred a conventional superiority on the Soviet side, which then justified reliance on tactical nuclear arms in Western defense. They conveniently ignored the West’s qualitative lead in technology and the Soviet Union’s logistical difficulty in deploying deep reserves to Central Europe in a timely manner (Chalmers/Unterseher 1988).

In the 1990s, after the Cold War many Western countries looked toward a new world: the alleged Soviet threat had evaporated, while unrest was seemingly growing on Europe’s periphery and in the Third World. European political leaders now envisioned their militaries, as well as those of partner nations, acting as a stabilizing force. The notion of multinational intervention troops flourished, and everyone wanted to participate, not least for reasons of prestige. A distinct 'interventionitis' set in, restructuring Western armies.

Large-scale tank formations were still used effectively in the Second and Third Gulf Wars, but such conventional interstate clashes soon seemed unlikely in the future. It was thought that stabilizing interventions in unconventional domestic conflicts would become the new priority. Tanks seemed ill-suited to that mission.

Hence the Netherlands did away with its tank force entirely. Germany's army, still holding more than 5,000 main battle tanks in 1990 (IISS 1990/91), gradually reduced to fewer than 300. Instead, the focus was put on lighter, more easily deployed forces capable of wide- area control in distant theaters. Does this signal the end for tanks, these strange beasts? Probably not. Maybe we just see a particularly European phenomenon.

Indeed, most militaries worldwide still field tanks. In 19 count- ries, the inventory surpasses 1,000 each. Russia, the United States, China, India, Turkey, Egypt, Israel, and North Korea lead this group, each possessing at least 3,000 – and some far more (IISS 2012/13).

Granted, in over half these countries, the tank fleets tend toward obsolescence but remain in service nonetheless. And modern or modernized tanks do exist in large numbers as well. *Army-Technology.com* lists 29 relevant designs worldwide. Even after removing variants of the same model, one is left with 15 distinct tank types.

Moreover, since 2000, new tank designs or comprehensive up- grades have been undertaken or completed in China, India, Iran, Israel, Japan, Poland, South Korea, and Turkey. Russia has reportedly been doing likewise, though details are unproven (see this volume's essay "Debunking a Wonder Tank").

In the U.S., after various setbacks, development continues on vehicles meant to outperform standard tanks in protection, mobility, and firepower, yet be significantly lighter for easier power projection. (*Author's note from a 2025 perspective: It appears the U.S. Army has largely abandoned these ambitions.*)

Many political elites around the world have not followed Eur- ope's course. They continue to think in conventional interstate-war terms – sometimes for good reason. Another factor in holding onto or developing new tanks might be that these rattling juggernauts serve as striking symbols of state power, and having a national tank design can highlight a nation's industrial prowess.

In spring 2014, German media reported that Russian mercenaries – perhaps even regular soldiers – had entered eastern Ukraine, raising local militias calling themselves "separatists", all receiving ample logistical support, weaponry, and equipment. Large numbers of Russian tank variants, derived from Soviet designs, were said to be among the materiel delivered.

Speculation ran high that Russia might deploy bigger, regular units to seize another part of Ukraine, prompting the question of what NATO, seen as Kyiv's potential savior, could do militarily. Immediately, observers compared the size of Russian tank fleets with those of European NATO members, concluding that Russia had quite a lot (*the glaring evidence of qualitative shortfalls did not emerge until 2022*), while NATO-Europe had relatively little. So, the ghosts of the past still linger ominously.

MILITARY INTERVENTION

The first study in this chapter offers a systematic discussion of the pros and cons of wheeled and tracked armored vehicles with respect to their suitability for strategic power projection aimed at regional stabilization. The conclusion proposes a pragmatic blend: a core of heavy tracked vehicles for high-intensity missions; a relatively large contingent of light wheeled platforms for defensive control of territory – valuing high tactical, operational, and strategic mobility plus 'agility-based' protection; and, in addition, medium wheeled vehicles (operationally mobile but tactically problematic) as carriers of indirect-fire weaponry.

The second contribution centers on a concept that originated in the United States – namely deploying only light- to medium-weight forces for wide-ranging power projection. Given these forces' shortcomings in armor protection, their survival is supposed to be guaranteed principally by high-tech-based "situational awareness". Yet this raises the possibility of "information overload", particularly under wartime stress, potentially overwhelming vehicle commanders. The essay addresses this prospect with satirical flair.

The third piece likewise adopts a sharply critical tone, examining the German Bundeswehr's ambitious but troubled attempt to 'marry' a medium-weight infantry fighting vehicle with a strategic airlifter.

Wheels or Tracks? On the 'Lightness' of Military Expeditions

First published in: *Project on Defense Alternatives, Briefing Report No. 16,* Cambridge, MA, 2000

The Cold War and After

Most armies with fighting experience in World War II drew the lesson that in future ground combat the hard currency of power would be medium to heavy tanks – accompanied by tracked platforms carrying infantry and artillery. Wheeled armored vehicles, if used at all, would be confined to the roles of light reconnaissance and armed area control. Among the armies following this line of thought were both the British and the French, due in part of their long tradition of expeditionary activity.

One notable exception to this trend was the Soviet Army. During the 1950s the Soviets put the bulk of their infantry on wheeled armored carriers. Even after the advent of tracked infantry fighting vehicles during the 1960s (for instance, the BMP and its forerunner the BTR 50), a large part of the Soviet infantry continued to ride on wheeled platforms. Indeed, two out of four regiments in a motor-rifle division rode on wheels (BTR 60/70/80). In addition there were relatively strong components of armored reconnaissance that to a large extent also had light wheeled vehicles, including the BRDM 1 and 2.

The Warsaw pact leaders had two reasons for giving wheeled armored vehicles a big role. First, they thought that wheeled transport would be better than tracked in moving masses of soldiers over long distances; second, they thought these vehicles could do the job at relatively low cost.

Since the end of the East-West confrontation, there has been in NATO and in non-aligned countries as well a general drive to develop expeditionary forces in order to deal with regional conflicts.

In this context, light ground forces, and especially those riding on wheels, have gained a more prominent role (Hilmes 2000).

Underlying this development is the assumption that such light units are more appropriate than the traditional 'heavy mix' for patrolling and controlling relatively large stretches of land. They supposedly are well suited to establishing a sort of 'military omni-presence' which is essential to the restoration of law and order in peace support/peace enforcement operations.

A Systematic Comparison (Ogorkiewicz 1986)

1. Mobility

1.1 Strategic Mobility

Today's tracked armored vehicles weigh between 3.5 and 65 tonnes. The respective figures for wheeled armor are 3.5 and somewhat over 35 tonnes. An important qualification is that most wheeled types fall into the category of 'up to 20 tonnes“. Only about 10 percent are heavier. In the case of tracked vehicles, roughly half of current types are in the lower weight category, whereas the other half consists of heavier machines (mostly between 35 and 65 tonnes).

In addition to their relative lightness, wheeled vehicles tend to consume significantly less fuel and other lubricants than tracked armored vehicles of equal weight (to be elaborated on below). Their relative lightness and reduced logistical needs together give the wheeled family an edge over the tracked in strategic mobility meaning the transport of forces over continental and intercontinental distances.

1.2 Operational Mobility

Operational mobility refers to the ability to swiftly allocate and relocate forces quickly within a theater of crisis or war. The challenge it poses is more on a regional than a continental scale.

One factor relevant to operational mobility is the 'rolling resistance'. On roads, the rolling resistance of tracked vehicles equals four percent of their weight, on average, while that of their wheeled counterparts (fitted with cross-country tires) equals only two percent. Consequently, wheeled vehicles need less fuel and can cover longer distances by road before they have to be refueled.

This advantage of wheeled vehicles disappears, however, when they move off rads. Then their fuel consumption may be at least as high as that of tracked vehicles of equal weight. Still, if patrolling and area control missions are emphasized, road travel predominates and, thus, the advantage of fuel fuel economy accrues to the wheeled class.

Even in the context of typical warfighting scenarios, off-the-road activities constitute less than 50 percent of overall travel. This is because, within a sizeable theater, many movements have to be de- voted to marching the troops to the combat areas in a timely fashion, rather than to maneuvering in the thick of battle.

There are two reasons that forces equipped with wheeled armor are more likely to deploy operationally in a timely fashion:

- First, there are fewer and shorter refueling stops. (The average road range of wheeled vehicles exceeds that of their tracked counterparts by 50-100 percent.)

- Second, the average marching speed of wheeled vehicles is, on roads, also 50-100 percent higher than that of tracked vehicles.

The fact that wheeled armor can cover longer distances faster than tracked vehicles is complemented by yet another advantage: there is much less crew fatigue for their occupants because the wheeled platforms do not suffer the vibrations generated by tracks.

In actual practice most armies recognize the overall advantages of wheeled vehicles with respect to operational mobility. Typically, they use wheeled low loaders – tank trailers – for the theater-wide allocation of tracked armor. This measure, which temporarily puts tracked vehicles on wheels, makes sense only as a stopgap; its dis- advantages are quite obvious: It is expensive und makes marching columns clumsier and more vulnerable.

1.3 Tactical mobility

Tactical mobility is needed when a force is in immediate contact with its adversary. Direct confrontation with an enemy imposes at least two mobility requirements:

- Good off-road mobility is an important prerequisite for evading enemy action and exploit unexpected avenues of approach.

- Agility – a combination of high speed, good acceleration, and the ability to 'zigzag' – is also key to being able to respond flexibly to rapidly changing opportunities and challenges.

Relevant to off-road mobility, wheeled vehicles tend to have a ground pressure considerably higher than that of their tracked counterparts. The Mean Maximum Pressure (MMP), which is the average pressure under tires of wheeled vehicles and under the road wheels of tracked ones, varies between 200 and 270 kN/m² for the latter and 300 to 450 kN/m² for the former.

There is at least one notable exception, however. The French Panhard VBL M-11 (a 4x4 vehicle weighing 3.5 tonnes) has an MMP of only 220. Only in this case, a very light wheeled armored vehicle achieves an MMP in the range of tracked platforms.

Generally speaking, the ground pressure of wheeled vehicles rises significantly with the platform's weight. In the case of tracked vehicles this correlation is not so evident. In light of this, the re- nowned British tank expert Richard Ogorkiewicz has argued to abandon concepts of wheeled combat vehicles weighing significantly over 22-23 tonnes. Even a multi-wheeled configuration (8x8: eight powered wheels) with variable tire pressure, he claims, cannot solve the problem – resulting only in a very complex, hence expensive, de- sign.

This is a principal matter: it is difficult, if not hopeless, to conceive of technological solutions that could radically solve the problem of wheeled armor's relatively high ground pressure.

Although wheeled armored vehicles cannot escape their principal dilemma, there have been some interesting examples of such platforms in the 30+ tonnes weight range. One is the South

African mechanized howitzer, Rhino, with a weight as high as 36 tonnes. Several other vehicles of interest, mostly in the experimental or blueprint stage, may achieve around 30 tonnes – for example, the new Dutch/German infantry carrier (later known as *Boxer*).

But the willingness of advanced militaries to invest in such ve- hicles does not mean that Ogorkiewicz's concerns are being over- turned. These programs do not indicate a belief that wheeled armored vehicles could generally be heavier than he argued and still exhibit good cross-country performance. Instead, in most cases, the fielding of heavier wheeled vehicles reflects special, limited circumstances or goals:

- In two cases, the south African *Rhino* and the Slovak *Zuzana,* the systems in question are mechanized artillery. For these, tactical mobility is not a high priority. They are wheeled because the resulting operational mobility facilitates the flexible allocation of fire – a key concern for artillery.

- In the cases of France and Germany, and some other nations, military planners and designers appear to have deliberately down-rated soft-terrain-capabilities. This probably has to do with increased emphasis on peace-support and peace-enforcement missions, which also put a premium on operational mobility for vehicles of relatively high payload.

Turning to the question of agility: Wheeled armored vehicles tend to excel in speed – on the road of course, but also in open terrain, if it is fairly negotiable. When it comes to zigzagging and acceleration, the advantage also seems to go with wheeled armor. It is true that most tracked vehicles can pivot in place, while wheeled vehicles cannot (except for those with brake-steering). Otherwise wheeled vehicles are more easily steered and their running gear is more responsive.

Compared to a tracked counterpart of equivalent weight and engine output, we can expect a wheeled platform to have not only much higher speed, but also better acceleration.

Interestingly, these advantages are especially pronounced with respect to relatively light armored vehicles. It is plausible that high agility is associated with 'smallness' and 'lightness'.

Tactical mobility has yet another important precondition: pro tection. As one legendary expert, General Israel Tal, has argued: Without proper protection even the most agile and cross-country capable vehicle could not move forward in harm's way. We will deal with protection and survivability in the following section. Suffice to say that there seems to be a dialectic interplay between tactical mobility (in the narrow sense) and protection.

2. Survivability and Protection

If strategic and operational mobility contribute to the capacity to overwhelm an opponent 'on the spot', then they certainly also augment the chances of the superior force to survive. The same can be said of tactical mobility: as evasive movements tend to neutralize the impact of hostile action, they indirectly contribute to survivability.

Survivability is further enhanced if the weaponry of the plat- forms in question makes it possible to fire from detached positions – so that the platforms cannot be easily detected or shot at.

All these systematic interactions are important, but the discussion of survivability usually centers on protection. Of course, protection itself is a complex matter. It can be achieved through active and passive measures as well as by the reduction of a vehicle's sig- nature.

2.1 Active Protection

The active protection of armored platforms was already being pioneered by the Soviet Army in the 1970s. It was regarded as necessary to compensate for perceived weaknesses in the armor of Soviet main battle tanks. Although the work started decades ago, systems ready for field use did not appear before the 1990s (Meyer 1998).

Active protection involves soft- and hard-kill techniques. Soft- kill methods aim to divert incoming guided missiles to a non-lethal path using, for instance, anti-laser smoke or infrared jammers against an anti-tank guided weapon's steering system. Hard-kill methods aim to neutralize guided and non-guided missiles, including shoulder-fired rockets, close to their target. A typical hard-kill system employs a radar-controlled array of small fragmentation-grenade launchers (Bonsignore 1993).

The implementation of such systems is not 'design-dependent'. It does not matter whether they are mounted on a tracked or wheeled vehicle. However, in the case of hard-kill systems, which weigh considerably more than soft-kill ones, it is advisable to put them on vehicles heavier than 25 tonnes. Only above 25 tonnes does their weight, which can be considerably more than one tonne, become negligible.

Interestingly, the advent of such techniques has already provoked the development of countermeasures. Anti-tank missiles are being made stealthier, and the Russian army has been field-testing a tank destroyer firing two missiles in a very short sequence (for defense saturation).

In light of the methods so far active protection suffers some inherent problems. It appears to be very difficult to deal with high- velocity armor-piercing rods (APDSFS) fired from heavy tank guns. Nor is there a truly convincing recipe for defeating rapid-fire machine-cannon, whose caliber and punch has been increasing in modern armies. (*Note from a 2025 perspective: there are now initial solutions that allow a **limited** defense even against APDSFS.)*

2.2 Passive/Reactive Protection

When we consider the full spectrum of threats to vehicles, there seems to be no viable alternative to armor protection proper. And since the 1970s there have been quite a few innovations in this field. First, the development of Chobham (sandwiched) armor in Britain, and soon after, the evolution of 'reactive' armor in the USSR and Israel (Schwartz 1991).

Reactive armor can be added to a vehicle's armored skin. It consists of explosive elements designed to neutralize incoming (guided and unguided) missiles equipped with shaped charges. Currently, there is work in progress to even deal with kinetic energy projectiles. These cannot be neutralized, but they probably can be rendered some- what less harmful.

For reactive armor to be optimally effective a rather solid embedding is needed, which rules out vehicles much below 30 tonnes. Most experts agree that, in addition to reactive armor's limitation with regard to kinetic energy projectiles, there remains considerable vulnerability to tandem charges and saturation attacks. In sum, re- active armor can only be an add-on, applied in high threat scenarios.

In the end, what counts is the strength of a vehicle's skin. And, indeed, there continues to be a direct correlation between volume and weight of armor on the one hand and the level of direct protection on the other.

British tank designers have been hoping to develop a future MBT (project *Modifier*) with a weight of less than 50 tonnes, but with considerably better protection, firepower, and automotive characteristics than current monsters (with more than 60 tonnes). However, the leading German tank expert Rolf Hilmes, estimates that if the British stick to their specifications, they will end up with a vehicle of 70-75 tonnes.

By contrast, Israeli tank designers accept an MBT concept of well over 60 tonnes. They place special emphasis on all-round pro- tection because they are planning not only for warfighting scenarios, but also for peace enforcement and counter-insurgency contingencies, which are more likely to expose vehicles to threats from all sides. This is one reason why the *Merkava*-series tanks have a frontal power pack; it allows for additional armor for flank and rear protection.

In Germany the cautious hope is that the future generation of main battle tanks can be confined to a weight not much more than 50 tonnes. Unlike the British, German expectations are rather modest: The Germans are aiming for some improvements in armor protection, greater improvements in firepower, but no advance in tactical mobility over the *Leopard 2*.

It is noteworthy that the Germans are also planning for a a new infantry fighting vehicle (IFV). The vehicle is being conceived to have adjustable armor with modular packs to be added according to threat. Minimum weight is to be 32 tonnes and maximum weight in excess of 40 tonnes (see: „A Misalliance ...“ in this volume).

Its level of protection is simply not available to wheeled combat vehicles, due to weight limitations. The South African 28 tonnes *Rooikat,* a compact reconnaissance tank, is frontally protected only against 23 mm-machine weapons! It is unrealistic to expect wheeled armored transport vehicles of 20-25 tonnes to have protection against anything more powerful than infantry weapons up to heavy machine guns, 12,7 mm to 14,5 mm (against the latter only in the frontal arc).

Paradoxically, almost the same level of protection is possible in a weight class much below. For example, the German-Dutch *Fennek* (4x4, 10 tonnes), an armored scout vehicle, can be frontally protected against heavier machine guns if only a fraction of its sizeable payload is used for additional armor. The reason is that it is far more compact than the armored 'buses' of 20 tonnes or more, due to a smaller crew and a less voluminous running gear (heavier wheeled armored ve- hicles need 6x6 or 8x8 configurations, while lighter ones can do with 4x4).

Six-by-six and eight-by-eight configurations do have an advantage, however: they are somewhat more robust with regard to mine damage. If one or two tires are destroyed the vehicle can still limp back to base. This would be impossible for a 4x4 vehicle. (In the case of a tracked vehicle, mine damage also incurs instant immobilization.)

Modern sensor-triggered mines are not exclusively directed against tracks or wheels, however, but against the whole bottom of a vehicle.

Relying on clever design, some relatively small and light armor- ed wheeled vehicles can achieve an 'under belly'-protection level superior that of much larger and heavier vehicles. A good example is the South African-inspired German personnel carrier (ATF). It carries 5-6 occupants, weighs 8 tonnes, and is reported to have substantially better mine protection than the much larger 6x6 *Fuchs* (Fox) with its 12 ocupants and a weight of 20 tonnes.

2.3 Affecting the Signature

If one vehicle is more compact than another, its chances of not being seen, and if seen, of not being hit are greater. In the past, wheeled armored vehicles – especially those with a multi-wheel, rigid beam-axle running gear – tended to be considerably less compact and, in particular, significantly higher than tracked vehicles of similar weight.

Due to the introduction of advanced running-gear features (such as power trains with H-configuration and trailing arm suspension) the difference in compactness and height has been reduced.

Whereas in respect to their silhouette wheeled and tracked vehicles are almost on a par, there is another aspect in which the former will always be superior to the latter: Due to reduced friction and rolling resistance the acoustic signature of wheeled vehicles is much smaller. (*Note from a 2025 perspective: Ever since the first publication of this little study, there have been numerous, not always convincing attempts at rendering armored vehicles 'stealthier", in the narrow sense of the word, mainly by affecting their optical appearance*.)

3. Firepower

Some wheeled armored vehicles in the heavier class (25-30 tonnes) are equipped with 105 mm tank guns – for instance, the Italian *Cent- auro* and a variant of the South African *Rooikat*. And this arrangement works.

A German experimental wheeled vehicle weighing slightly over 30 tonnes is reported to have been successfully equipped with a 120 mm gun! However, in this case, doubts about the platform's stability are unresolved. This indicates that we may be reaching a design limit.

In this light, the prospect of mounting the next generation pow- der gun (130 or 140 mm) on a wheeled vehicle should be regarded as totally illusory. Given the recoil of this gun and the armored volume needed, the platform may have to weigh 50 tonnes or more.

Much hope is being invested in the development of powerful electro-magnetic guns, with efforts underway in a number of countries including Britain, Germany and the United States. Such weapons (of the rail-gun or coil-gun approach) could be lighter than contemporary powder guns and convey much less impact to the firing platform. (Ogorkiewicz 1999). But the related facilities for storing and generating energy are estimated to have a volume of 5 cubic meters (without high-performance cooling and other periphery). For comparison: 32 rounds of 140 mm ammunition need about 3 cubic meters.

Thus, all told, it is not likely that an electro-magnetic gun-tank could be very compact or particularly light. Lightness could only be achieved if one accepts unarmored volume. It is presently impossible to confidently estimate the final weight these systems will achieve. Nonetheless, it is difficult to imagine the eventual product being light enough to ride on wheels.

The firepower story is different for mechanized artillery plat forms, however. As noted above, there presently are two examples of series-produced and successfully fielded wheeled armored howitzers (155 mm). Firing such heavy weapons does not cause serious problems since this is not being done on the move, but from a halt position.

Of course, the tactical mobility of such vehicles is quite limited. However, because firing takes place at stand-off distances, this handicap has been acceptable. The same applies to armor protection. Its relative weakness may also be justifiable because direct enemy contact is normally avoided and usually avoidable. It would be advisable, though, to employ some add-on elements of reactive armor to protect against top attack by indirect fire.

A final point: although wheeled armored carriers are not really suited for being equipped with very powerful weapons for direct fire, they might be able to do a better job than their tracked counterparts when equipped with lighter weapons, such as machine cannon and line-of-sight missile launchers. This is because the running gear of wheeled vehicles has a 'pre-stabilizing', softening effect. Firing lighter weapons on the move should normally be easier from a wheeled platform than a tracked one.

4. Costs

Wheeled armored vehicles used to be cheaper than their tracked counterparts. They were simpler and made more use of relatively inexpensive parts or sub-systems (such as engines and tires) from large-scale civilian production. Things have changed. Wheeled armored vehicles, especially the large, multi-wheeled ones, have become more sophisticated and 'militarized'. As a result, the former advantage with respect to procurement costs has disappeared – with the notable exception of some very light and compact wheeled armored carriers.

Wheeled vehicles enjoy another cost advantage, however: They tend to be less expensive to operate. As noted above, they travel farther than tracked vehicles for the same quantity of fuel. And maintenance requirements are alo less burdensome – provided that most of the vehicles' travel is on roads and not over soft or rugged ground.

Composition of Future Intervention Forces

In light of the previous considerations, we can ask: what mix of platforms would best serve the purpose of the ground-mobile elements of future intervention forces? To answer this question even minimally, we must first specify the military functions that the force will perform, which derive from its likely missions. In brief overview, the likely functions of the intervention force would include:

a) attack or counter-attack on centers of gravity,
b) extrication of friendly forces (also civilians) under optimal protection,
c) the beefing-up of escorts that are marching with humanitarian convoys through high-threat areas,
d) containing and resolving pockets of resistance in the context of peace enforcement,
e) the routine escort of humanitarian convoys,
f) the creation and, if necessary, strengthening of sanctuary defense,
g) the routine protection of humanitarian sanctuaries,
h) cavalry screen (to cover the movement of other forces),
i) delaying action, and pursuit,

j) general reconnaissance,
k) target acquisition and designation for indirect fire,
l) protection of secondary axes,
m) the conduct of initial defense, area control and demonstrations of interest (showing the flag),
n) urban warfare.

This set of activities and functions would be optimally covered by having three families of vehicles:

A heavy family that would be mainly in charge of a), b), c), and d) and, to a lesser extent, g) as well as n). Its vehicles should be relatively heavy (around 50 tonnes) and, consequently, tracked. Typical examples would be a main battle tank utilizing new technology and an IFV with similar protection (Hilmes 1999), both on the same basic platform.

The medium family might be based on a multi-wheeled platform (8x8) whose different variants (weighing 25-35 tonnes) might carry heavy tube artillery, a multiple-launch rocket system, a fiber-optically guided missile array and an air defense system. Besides air protection, its main function would be to give indirect-fire support to a), f), k), l) which also might imply engaging in follow-on forces attack. Emphasis would be placed on ensuring optimal fire allocation, which requires good operational mobility.

The light family (4x4) would have relatively many members. There should be special versions for reconnaissance (equipped with machine cannon), infantry transport, an anti-tank missile system, a rapid-fire mortar and a short-range air defense missile system. All vehicles of this class should be very compact and relatively light (up to 10 tonnes) They should have acceptable ground pressure and a high degree of agility. Compactness and agility would enhance their survivability. This would be combined with unrivaled operational and strategic mobility. The main functions to be performed are e), g), h), i), j), k), l), m); secondarily n) as well.

The variables 'low weight' and 'compactness' imply that the infantry carrier belonging to the light family cannot have more than 5 to 7 occupants. This would suffice for patrolling missions, but in a warfighting scenario the vehicle's complement may be too small to form a viable tactical entity.

However, the currently common practice of loading 10, 12, or even more soldiers into a large 15-25 tonnes wheeled carrier puts 'too many eggs in one basket'. This is especially worrisome because large multi-wheeled vehicles are particularly vulnerable. For this reason, the small-crew/compact-vehicle approach demands further study. One possibility would be to team pairs vehicles closely together.

In sum, the bulk of the forces would be in the light class. Along with the medium-weight assets of indirect fire, they could be used to quickly stabilize a situation. Of course, when the going gets tough, the heavy element becomes indispensible.

On “Situational Awareness”

First published as “Vibrator im Enddarm” (*Vibrator in the Colon*) in: *Mögliches und Unmögliches* (*The Possible and the Impossible*), Berlin: LIT

An Ambitious General

Eric K. Shinseki is the son of a Japanese-American family living in Hawaii. He was born just under half a year after the attack on Pearl Harbor – a circumstance suggesting that his childhood was likely no bed of roses. Even so, he grew into a patriot and joined the officer corps of the U. S. Army. His career rose swiftly. From 1999 to 2003, he served as Chief of Staff of the U.S. Army – under President George W. Bush and the energetic Secretary of Defense Donald Rumsfeld.

At that time, military interventionism was the order of the day: the United States as world police, a power obliged to (re)direct recalcitrant states toward democracy and free-market capitalism – by force if need be.

The disappointments and disasters this policy would later bring had only begun to dawn on a few astute observers.

If these interventions were to involve ground troops, then the U.S. Marines seemed the logical choice: they specialized in rapid, long-distance engagements. This spelled a loss of status for the Army, since conventional wars between nation-states – such as the U.S.-led coalition’s 'liberation' of Kuwait – were now viewed more as exceptions. The future appeared to lie in strikes across vast distances.

Historically, the Marines had been the Army’s main rival: ranked even ahead of the Soviet Army in that regard. It was the Marines, more than anyone else, that the Army sought to outdo in terms of equipment and military competence. Under the era of interventionism, the Army risked being outperformed by naval infantry, whose strategic mobility was superior, and thus receiving a smaller share of the defense budget pie.

A Technological Fix

General Shinseki sought a remedy. A committed American, he be- lieved he had found the solution in a technological concept. He envisioned reshaping the Army into a force that, deployable by air within a few days, could operate anywhere on the globe. The price of this greatly increased strategic mobility was the Army's overall abandonment of heavy armor.

To test the concept, lightly armored formations using conventional vehicles were fielded – much to the chagrin of the troops who, serving as guinea pigs, were deployed with them in Iraq or Afghanistan, theaters where threats come from all sides.

For a new family of vehicles, each with a combat weight of 20+ tonnes, futuristic protective measures were meant to largely replace old-fashioned armor. These efforts, however, failed miser- ably. Decent protection – including modern composite plating – inevitably weighs a lot. Nevertheless, Shinseki held fast to the notion of a rapidly deployable expeditionary force and supported another – again technological – way out of the protection dilemma.

By networking all of the information sources relevant to a mission, each vehicle commander, or at least each sub-unit leader, was to receive a sufficiently realistic picture of the situation (*situational awareness*) to have a double opportunity in a crisis: first, to evade danger via a quick maneuver and second, to call in supporting fire from various platforms – jets, attack helicopters, artillery, and so on – in time to neutralize the threat.

Information overload

The only snag is that if, for example, the 'famous Taliban' is ming- ling among civilians, even the best electronic and data-sharing technologies cannot clearly distinguish him. And if relevant info does exist, the data can come from so many sources that they may conflict or swamp the recipient with volume and complexity.

Imagine the plight of some poor young soldier who, in hostile territory, must command a combat vehicle. Let's assume it's a wheeled infantry fighting vehicle with a standard crew of three plus an infantry squad of six to eight, who, under certain circumstances, will dismount and fight on foot.

Our man must keep track of the threat environment, based on what he observes firsthand, plus communications within his unit, plus any information fed in electronically. He must lead the vehicle in concert with his neighbors, manage weapons usage – a machine cannon, perhaps a guided missile launcher – and also help direct his infantry squad. He might also be responsible for calling in supporting fires. And naturally, he has to keep everyone motivated as well.

His job is hyper-complex. Any extra burden may drive him over the edge. If more data are to be provided via the network, it had better be packaged in a readily digestible form!

Hence the importance of ergonomics and perception psychology. Unfortunately, experts in these fields often lack military insight or genuine commitment. It also remains insufficiently recognized that our vehicle commander is already at – or near – his limit in terms of *visual* stimuli: an array of optical devices, video screens, and displays with readouts of all sorts.

He might still cope with audio stimuli, though caution is advised before adding too many bleeps. And for obvious reasons, olfactory signals are probably unwise for conveying information.

A Splendid Solution

Hence I stepped into the breach, proposing a vibrator be installed in the vehicle operator's rectal area, set to emit a deep, gentle droning – triggered by millimeter-wave signals – whenever a sensor detects an immediate threat to the vehicle's rear. I first published this idea nearly two decades ago in two military journals (Unterseher 2003: 10-13; 2004: 327). Although I embedded it in somewhat serious arguments and refrained from detail, I was explicit enough – yet nobody seemed to notice this mean and utterly distasteful joke.

A Misalliance in Germany's Arms Procurement

First published as „Eine Mesalliance“ in: *Krieg und Kriegsvermeidung (War and War Avoidance),* Baden-Baden: Tectum, 2019

The Idea of a Wedding

To illustrate the irrationality of entrenched arms procurement planning, let us examine a misalliance! The parties to be wed were the A400M, a medium-weight transport aircraft for strategic distances, and a new infantry fighting vehicle (IFV) which – after multiple renamings betraying conceptual uncertainty – ended up being called the *Puma*. During the years of Germany’s two Red-Green coalition governments (1998-2005), both projects repeatedly hit stumbling blocks.

The representatives of industry, military policy, of Air Force and Army who cared about these projects managed to keep them from early cancellation by employing a tactic of mutual support. What does that mean exactly?

The IFV, which had quite ambitious performance specifications by international standards, was supposed to weigh about 32 tonnes once its removable add-on armor was stripped off. According to the planned technical data, that would enable the so-called “MilitAirbus” (A400M) to fly it into remote crisis regions. For deployment, the previously detached armor would then be re-attached.

Building on this idea, the argument took shape that only both together – aircraft plus IFV – made sense. Implying at the same time, that both branches of the armed forces would be wise to support each other’s project: an inter-service alliance, so to speak.

Talk of 'synergy effects' arose, with a certain underlying intention: This system combination promised an impressive show of force in distant operations, surpassing allied competitors.

Essentially, it was about prestige – "whose is bigger?"

No-one else, it seemed, would have such a flexible yet formidable duo, nor be able to deploy so rapidly and so powerfully overseas. Or if they did, it would mean mimicking "us Germans". But both programs ran into major technical and financial difficulties: so major that it soon verged on the absurd to keep touting their "synergistic union."

A400M

The A400M project harks back to the Cold War, aiming above all to replace the aging *Transall* fleet in the long run. Under the first Red- Green coalition, concrete plans emerged to procure 288 of these new planes in collaboration with other European partners.

Seventy-three of these aircraft were meant for the German Air Force, with each system's price officially stated at 50 million U.S. dollars in 1998.

Budget constraints during the second Red-Green administration reduced the Luftwaffe's allotment to 60 planes (and later to 53). By 2002, total orders from all partners had already dropped by about 100 aircraft, apparently due to funding troubles across allied nations. Estimated unit costs of the European plane had risen to 100 million
U.S. dollars.

Developing the A400M then turned into a lamentable tale. Outside the former Soviet Union, Europe had never before undertaken a military cargo plane of this scale, so fundamental capabilities were lacking:

- The newly designed engines did not deliver the required output.
- The wings lacked structural stability.
- The fuselage suffered from intense vibration.
- And the *Puma*, at its planned minimal weight, could not be flown the envisaged 4,500 kilometers.

System costs for the MilitAirbus soared beyond 175 million U.S.

dollars. Truly mission-capable aircraft only began reaching the Luftwaffe in the second half of the past decade. *Note from a 2025 perspective: the deliveries for the Bundeswehr are scheduled to end not before 2026.*

Puma

Puma, too, has faced (and continues to face) very serious problems. Towards the late 1990s, the vehicle was called “SPz 3” (*Schützenpanzer 3*), then successively the “New IFV,” “Panther” (hello Wehrmacht), and “Igel” (*hedge hog*). As already said, these name changes reflected conceptual indecision. Indeed, before the “Puma” label emerged, it was decided to tone down the project’s technological ambitions and cut the planned order from around 1,150 vehicles to about 400.

Despite scaling back ambitions, the plan was for the finished product to be a genuine 'jack of all trades': a highly protected vehicle to back up lighter expeditionary units, capable of taking on insurgents, as well as fighting off helicopters and even engaging enemy main battle tanks at range.

During development, serious issues arose with stabilizing the autocannon – above all with the power train, chassis, and onboard electronics. And the vehicle, even without add-on armor, exceeded the originally specified weight limit. Such large challenges gave rise, behind closed doors, to talk of a flawed design.

Fixing these flaws does not come cheap. From an initial system price of five million euros, it first rose to eight million, then to almost twenty million (!). And the necessary upgrades still aren’t finished.

No “Piggyback” Transport

Against the background of fewer A400Ms overall and the degraded payload/range performance of those that remain, coupled with the Puma’s woes, it is obvious there will be no strategic piggybacking of the IFV via the new transport.

The marriage plan, then, has fallen apart – but it kept both partners afloat just long enough that they can now stumble forward separately into the future.

NOVELTIES CRITICIZED

First under scrutiny is Russia's 'wonder tank', the T-14, unveiled to the public for the first time in 2015 and touted as a challenge to Western tank designers. The T-14 appeared highly advanced technologically, and announcements of impending large-scale production seemed designed to underscore Russia's superiority in a core area of conventional armaments. However, the project has continued on a small scale at best: likely due to conceptual issues, and the inability to master its complexity.

Excessive technological complexity is also the central criticism, addressed in another essay, of three Western tank projects (from the US and jointly from Germany and France, or purely German in origin), which some see as an answer to Russia's innovation.

These designs may suffer from problematic complexity too. All sport an unusual multitude of weaponry and two of them envision a fourth crew member dedicated to 'systems management', even though many international tank programs have managed with just three personnel thanks to automatic loaders. Increasing crew size by a third under conditions of limited military manpower seems counter-intuitive.

The Debunking of a Wonder Tank

First published as „Die Entzauberung eines Wunderpanzers“ in: *Österreichische Militärische Zeitschrift* (*Austrian Military Magazine*), Issue 2/2019

A Sensation on Parade

May 9, 2015, Red Square in Moscow. Just over a year after Russia’s annexation of Crimea and its orchestration of rebellion in eastern Ukraine. At the parade marking the 70th anniversary of the Red Army’s victory over Nazi Germany, several new-type main battle tanks drive past the VIP tribune: vehicles designated *Armata T-14*.

Soon afterward, Russia’s Ministry of Defense ascribed to these tanks almost fantastic capabilities, while Moscow’s PR channels amplified the message. It reached the West, where media reported that many experts considered the T-14 “the most advanced main battle tank in the world.”

The editorial team of the German magazine *STERN* even wrote of its “stealth paint” and fell for rumors, sown by Russian “experts”, that the T-14’s newly developed 125 mm main gun could soon be replaced by a powerful 152 mm weapon. The British intelligence service also joined the chorus of the impressed, perceiving major advantages for Russia over Western MBTs – and, by extension, advocating that the West rearm urgently. It was the familiar Cold War dynamic all over again.

What are the key characteristics of this 'wonder tank'? The T-14 is described as a third-generation post-World War II design, primarily because of its separation of crew and turret; the latter is unmanned and fully automated. Until now, Western tank development has clung to the concept of a manned turret, automating only the loader mechanism in certain cases.

Thanks to supposedly superior protective measures, especially the thick front armor plus the three-man crew placed in an armored "capsule" (in front of the turret), the "human factor" is said to be safer than in any other MBT.

And for a combat weight of around 50 tonnes, this tank is allegedly much faster than its Western counterparts, which typically weigh significantly more for roughly the same engine output. *(The notion of a speed advantage has, however, since been qualified.)* In terms of firepower, too, the T-14 is said to have an edge. Its 125 mm cannon apparently boasts higher muzzle energy than the Western- standard 120 mm gun of the Leopard 2.

Combined-Arms Concept

Western observers also noted that along with the T-14, a new infantry fighting vehicle, the T-15, was being developed on the same chassis – except that engine and transmission are in the front rather than the rear
– thus sharing similar armor and mobility. In theory, that is ideal for close cooperation between tanks and mechanized infantry. It appears that Russia initially also planned to mount the *Koalitsiya* heavy self-propelled howitzer on the Armata chassis. Judging by the May 2018 parade, however, that idea seems to have been abandoned.

Otherwise, the ideal of a heavy universal platform for both tanks and infantry carriers has only been realized in Israel: in the technical affinity between the Merkava IV MBT and the *Namer* heavy IFV.

Heinz Guderian, *spiritus rector* of the Wehrmacht's Panzer Corps, would have been thrilled with Russia's innovation. In his concept of integrated combined arms, he had demanded that the main battle tanks and their key accompanying vehicles have armor and mobility as similar as possible.

This never came about in World War II – mainly, it seems, due to resource constraints. The Wehrmacht's Panzergrenadiers, equipped with lightly armored but far less protected vehicles relative to main battle tanks, paid a high price in blood.

Even during the Cold War – when heavy armor was the spearhead for offensive operations as well as the backbone of mobile defense, and when *combined arms* was the standard doctrine –

Guderian's ideal solution never took shape. Although some Western armies did increase the weight of their IFVs, the gap in protection has not been not closed.

It is thus all the more surprising that Russia intends to take this step toward a universal platform precisely when large-scale tank operations appear passé. *(From a 2025 vantage point, it should be noted that T-15 has mysteriously faded into silence.)*

Copying Beats Studying

Though praised for its originality, the T-14, in its essential design, is a 1:1 copy of the U.S. Army's TTB (Tank Test Bed) from the mid-1980s (Kotsch 2019). Without the T-14's add-on armor, the two vehicles look virtually identical. The American TTB prototype was never pursued further: left to rust before eventually being refurbished and placed in a museum.

Why was the TTB abandoned? Its innovation was practically revolutionary and required numerous complex technical sub-solutions that promised to be very expensive. Once the Cold War ended, these costs appeared unjustifiable. A special challenge arose from separating the crew from the turret, requiring all-round observation, target acquisition, and tracking to rely solely on optronics. At that time, the available electronics/TV technology required considerable space, proved unreliable, and offered only limited performance.

And there was yet another reason for shelving TTB. Tank soldiers worried that relying exclusively on cameras and screens for outside awareness would mean losing the "real feel" of the battlefield, thereby undermining tactical judgment. Today's T-14 faces similar concerns.

Also in doubt is the claim that the T-14's protective measures truly surpass all others. To start with, it stands tall, with a high silhouette and many "catch points."

What's more, it is nearly 15 percent longer (at similar width) than Western counterparts, thus a bigger total "skin" to armor. Combined with the fact that the T-14 is at least 15 percent lighter than its competitors, it follows that the mass available for protection *per unit of surface* is significantly lower.

If the T-14 crew capsule is truly that well protected, then the rest of the vehicle's armor must be considerably thinner, trailing Western standards and rendering the entire tank vulnerable. Arguing that shortfalls could be offset by "stand-off" active protection is only marginally convincing, given that such systems, if unarmored themselves, are easily knocked out by stray fragments or other typical battlefield hazards.

Lastly, a note on firepower: Even if the muzzle energy of the new Russian gun is higher than the standard Western 120 mm, muzzle energy is only part of the story. Effective firepower also depends on accuracy, traditionally a major Western advantage. Whether the new Russian gun truly poses a serious challenge remains to be seen; so far, the West has not deemed an up-gunning to a higher caliber an urgent priority. That said, some very impressive solutions are emerging – for instance, Rheinmetall's 130 mm gun, which could well outclass the Russian model.

Plans Revised Downward

Following the official fanfare came a sober reality. The intended display of military might fizzled out at least initially. The production goals for the Armata family (2,300 units by the start of the next decade) were drastically lowered.

It was announced that the testing phase would last until the end of 2019, after which a production run of only 100 vehicles was planned. Then came talk of cutting it to 70. As of 2019, the plan from 2020 onward was to equip two tank battalions with T-14s and one battalion with T-15s: again, about 100 total. To compensate for these cuts, Russia would further modernize many 2nd-generation main battle tanks.

Why scale back such an ambitious, expensive undertaking? The main reason seems to be that Russia has fewer resources to spare. Between 2011 and 2016, Russian defense spending soared significantly, only to drop dramatically in 2017 (down 17%) and 2018 (down ~20%).

Possibly, with the modest economic recovery spurred by rising global oil prices – while structural reform of industry still lags – the

Kremlin sought to allocate funds back to the civilian economy. Popular consumption demands might also be a factor. A regime that prevents free elections cannot be sure of its legitimacy. If overt terror is out of fashion and nationalist fervor alone proves insufficient, it cannot overburden its population too greatly.

Skepticism and Substitution

Purely military and technical concerns also factor into the Armata reconsideration. The issue of tactical orientation has already been mentioned. Likely, there have also been problems in managing the "quantum leap" in complexity.

Indeed, the modernization of Russia's ground forces begun in the years leading to 2016 appears to have favored lighter mechanized units. For example, large-scale procurement of 4×4 wheeled armor better aligns with new intervention scenarios than do heavy, bulky platforms. Such vehicles have found uses in Syria, even as a smaller contingent of Russian MBTs cooperated with the Syrian Army (McDermott 2018).

While Moscow's media once glorified existing Russian MBTs (the T-90/80/72 families) prior to Armata's arrival, they are in truth quite dated, originating in the 1970s, with limited modernization potential (Chalmers/Unterseher 1988).

Russia's chosen path of up- grading these older tanks may only postpone the inevitable general overhaul. So despite difficulties with its wonder tank, Russia must at some point undertake a more thorough renewal of its heavy forces.

Meanwhile, easing back on ground-forces procurement hardly indicates an overall retreat from confrontation. Consider, for instance, hybrid warfare, in which propaganda, cyber attacks, or men in unmarked green uniforms can be decisive tools!

Yet in the medium term, the drive for major new land grabs could reemerge, given a complex scenario: deepening rifts in the West, political crises in Russia's periphery, another surge in global commodity prices that emboldens Moscow, and a continuing need to stir nationalist sentiment to secure the regime.

Western Developments in the Crosshairs

First published as „Westliche Entwicklungen im Fadenkreuz“ in: *Über Panzer (On Tanks),* Berlin: LIT, 2023

Three Projects

Nearly 20 years before Russia unveiled its T-14, conceptual studies for new Western main battle tanks were already underway. In Germany, for example, there were plans for a Leopard 2 successor that would be part of a broader vehicle family, including a new IFV. But those ideas fizzled out (Wessels 1997).

After decoupling the projects, Germany made the *Puma* IFV its priority – a result that remains unsatisfactory even now due to excessive complexity. Preparations for a new main battle tank continued on a low flame. Rheinmetall made notable progress with a 130 mm gun, whose development may have been spurred further by Russia's "wonder tank."

Nonetheless, Western decision-makers appear less impressed by Russia's efforts than the *STERN*'s editors or British intelligence were. *(Subsequent fighting in Ukraine would confirm that skepticism.)*

As a result, planning timelines remain long. The existing tank fleets of key Western nations are still deemed robust enough, and better suited for modernization than their Russian counterparts, at least for the medium term.

Below are three Western tank concepts (long-range planning) to be briefly outlined and analyzed – their 'design philosophy' is of particular interest. Non-structural details are still too early to judge. Each is a technology demonstrator whose transformation into a production model, if it happens at all, will likely occur well after 2030.

1. Abrams X: Concept Study
   (General Dynamics Land Systems)

This project concerns a potential successor to the U.S. Army's standard MBT introduced around four decades ago and produced in large numbers. The demonstrator uses the previous tank's hull and running gear, with similar dimensions but a slightly lower-profile turret. Weight, compared to the final Abrams variant (almost 70 tonnes), has dropped by about 15%, aiding operational mobility. With similar power output, this also improves tactical mobility – albeit modestly.

Propulsion comes from a diesel-based hybrid, consuming about half as much fuel as the old Abrams gas turbine, also helping operational flexibility. On shorter routes, all-electric and thus quieter movement is possible.

Lower weight implies that maintaining the old level of protection requires relying heavily on modern protective tech, including 'active' systems (which face the 'saturation problem').

The protection of the reduced three-person crew is enhanced by placing them in a compact cell at the front of an *unmanned* turret – picking up on lessons from the 1980s TTB, later faithfully copied by Russia.

The turret carries a new 120 mm gun, lighter and more powerful than the old one, with an autoloader in the rear, plus a remote-operated 30 mm cannon (high fire rate) on top. Additionally, the turret can launch drones for reconnaissance or combat beyond line of sight.

One fears a "jack-of-all-trades" with potentially sky-high costs and questionable complexity. The three-person crew – wholly dependent on inherently fallible electronics, with the commander lacking a direct 360° view – might be overwhelmed even under usual stress conditions.

Most concerning is that a platform intended for direct combat is now equipped to operate well into artillery's domain. What about the traditional, and well-proven, division of labor?

Moreover, the crew's chance of escaping in a disaster scenario is no better than in earlier MBTs: via hatches, top or bottom.

2. Panther (KF 51) "Medium Main Battle Tank"
Rheinmetall

This is effectively a *"protest tank."* By developing it nationally, the manufacturer seems to protest the troubled German-French defense cooperation. The term "medium" presumably signals that at 59 tonnes, it breaks at least somewhat from the escalating weights of the last MBT generation, though not dramatically, thus promising modest gains in tactical and operational mobility. Yet that also entails a heavier reliance on next-level protective technology and its inherent complexities.

The KF 51 is based on the Leopard 2 hull/running gear/engine block – tried and true, but five decades old. The turret is somewhat lower in height but noticeably longer than the old design, likely increasing the total area that needs to be armored.

The turret is manned by a commander (allowing optical 360° vision) and a gunner, featuring a high-performance 130 mm main gun with autoloader, a coaxial heavy machine gun (12.7 mm), a roof-mounted radar-guided MG (7.62 mm) for drone defense, and a launcher for long-range combat drones.

As with Abrams X, the tank is being pushed beyond its principal mission, risking potential overlap or competition with artillery.

Additionally, a fourth crew station in the hull, a "subsystems specialist", indicates the perceived risk of operational overload from high overall complexity.

The scattered crew layout complicates protection more than a compact-capsule design would. As for emergency evacuation, see the Abrams X comment above.

3. EMBT (Enhanced Main Battle Tank)
Nexter (France) & Krauss-Maffei Wegmann (Germany)

A joint project (though a French withdrawal remains possible), the EMBT weighs 61.5 tonnes, again using a Leopard 2 hull. A new, compact diesel of roughly equal power frees up interior space for a four-person crew – two in the turret, two in the hull.

As above, that extra occupant is there to "share cognitive workload," as the producers' brochure says, bringing the same protection challenges (escape issue: see above).

Its current armament concept comprises four calibers: 7.62 mm, an optional 12.7 mm coaxial MG, a 120 mm autoloaded main gun with improved ammo, and a remote-controlled 30 mm autocannon on the turret roof. No mention yet of a drone-launch capability. The turret sports an unusual number of "catch points."

Apparently, the 120 mm may someday be replaced by a 140 mm gun – under development – which would require a revised turret, likely raising overall weight further.

Comment

Across all three projects we see: more add-ons in the guise of systems integration than genuine innovation. The design philosophy seems to treat the MBT as a self-contained "do-it-all" system – big, costly, and complex – rather than leaning on a clearer division of labor with other systems that could simplify it. The underlying platform is fairly conventional, akin to a bare Christmas tree – then it's festooned with ornaments galore.

DESIGN SKETCHES

This chapter opens with a sketch of a tank destroyer, born out of the first Russian assault on Ukraine's territorial integrity back in 2014. The design concept is both whimsical and serious. On one hand, it's an almost exotic creation achieved through imaginative use of proven technology. On the other, it aims to spark discussion – at a time of growing military threat to Russia's neighbors – about what Western support (beyond infantry weapons) could be offered without inflaming the conflict further. The relatively low complexity of the proposed tank destroyer makes it feasible with a crew of just two.

Following that comes a bundle of designs for a family of heavy armored vehicles. They are envisioned as 'troubleshooters', the 'iron fist', of a defense specialized in the art of holding ground, relying chiefly on light, area-covering infantry cum indirect fire (see APPENDIX). The names of the new designs ridicule the martial tone of current (and Nazi) German usage: herbivores instead of carnivores.

The purpose of both these contributions is to show that, rather than following the established path toward ever-costlier complexity, more robust and practical alternatives can be imagined. The aim is not to propose something radically new, but to explore unconventional ways of harnessing tried-and-tested technology.

Tank Destroyer: A Pragmatic Alternative

First published as “Entzauberung eines Wunderpanzers“ in: *Österreichische Militärische Zeitschrift (Austrian Military Magazine)*, 5/2016

Russian Challenge

Russia’s bid for international status is increasingly underpinned by military means, intended to offset the economic weakness of a country heavily reliant on commodity exports.

This neo-imperialistic show of power is directed above all at nations formerly part of the Soviet Union or within its immediate sphere of influence.

The illegal annexation of Crimea and the infiltration of eastern Ukraine by irregular militias and regular Russian soldiers stand out as prime examples. Fear has spread in many states neighboring Russia, and the West is under growing pressure to offer political and, indeed, military support.

Against the backdrop of Russia’s own weaknesses – and since Ukraine, assisted by the West, has unexpectedly held out – the conflict zone appears to have partially stabilized. Yet it would be an error to discount the possibility that, if conditions are opportune, Russia might resurrect its policy of political pressure and military aggression.

Within Russia’s intimidation-oriented military strategy, the wide ly heralded plan to renew almost the entire active fleet of armored vehicles in its ground forces bears particular significance. Up to 11,000 new vehicles are slated for procurement by the early part of the next decade, replacing older assets.

Aside from various personnel carrier types designed for asym-metrical threats, the bulk of these new vehicles fall into three classes:

- An amphibious wheeled design (8×8) with Western-inspired lines, roughly 20 tonnes,
- an amphibious tracked platform of around 25 tonnes,
- a heavy chassis — foundation for the T-14 main battle tank, T-15 infantry fighting vehicle, and a self-propelled howitzer – each at around 50 tonnes.

All three represent a major leap in complexity, weight, and cost, compared to earlier Soviet products (Russia had offered nothing fundamentally new until recently).

However, the entire endeavor hinges on feasibility of funding. Low global prices for oil and gas are steadily eroding Russia's once-considerable state reserves. Still, global commodity prices could rally in the longer term. President Putin apparently counts on that. Consequently, at least part of these armament plans may still go forward.

Germany's Answer

After the Cold War, the Bundeswehr's active main battle tank inventory had shrunk from about 5,000 to an almost negligible size. In the wake of the Ukraine crisis of 2014, a correction took place: rather than having just 225 Leopard 2 tanks, the force is now scheduled to have 328. (These extra vehicles come from industry stocks and will be upgraded.)

Additionally, starting in 2015, Germany and France jointly em- barked on developing a new combat platform to replace the Leopard 2 (and the French Leclerc) as of 2030.

From the perspective of Russia's neighbors, however, this Ger- man package is anything but sufficient. One might point out that, even after a nearly 50-percent boost, the Bundeswehr's tank fleet still appears minuscule in the context of a renewed East-West confrontation.

It might also be argued that, given heightened tensions, the priority should be on near- to mid-term reinforcement of NATO's ground forces in Europe, and that a modernization outlook for 2030 cannot adequately address current problems.

So what can be done? A strong and readily implementable signal could be to recondition additional Leopard 2 tanks from industry depots and deliver them to states feeling especially threatened, provided these states are capable of incorporating them into their force structure.

The snag here is that such a measure might be read on the symbolic level as a threatening gesture: something that would hardly enhance stability.

Krapke's Initiative

In 1981, Paul-Werner Krapke, "father" of the Leopard 2, tried to dissuade Chancellor Helmut Schmidt, who wanted to sell Leopard 2 tanks to Saudi Arabia, by advocating heavy gun tank destroyers instead. These would share the Leopard 2's chassis and power train but replace the turret with a fixed casemate, making the vehicle simpler and thus cheaper. Krapke suggested that a platform geared to defense rather than offense would convey a calming signal (Hoffmann 1981).

At the same time, the prominent tank expert proposed that the German Army build only one-third of the Leopard 2s it had planned as replacements for the Leopard 1, substituting his favored alternative for the other two-thirds. These simpler vehicles would equip specialized blocking formations (Krapke 1981-1985).

Here, too, Krapke argued that in the interest of security-policy stability, one should reduce offensive potential while reinforcing the defensive. Opponents responded with the familiar reasoning that a mobile defense needs robust options for counter-thrusts. The main battle tank's multifunctionality, they said, makes it the linchpin of a flexible defense and is ultimately more cost-effective than a gun tank destroyer with its more limited tactical possibilities.

Nevertheless, in 1984, no fewer than 1,700(!) heavy-gun tank destroyers made an appearance in the procurement plan – in addition to the ongoing Leopard 2 production, not as a replacement for the Leopard 1 fleet that remained in service. By the latter half of the 1980s, however, the gun-tank destroyer requirement was removed from the purchase list again.

When these vehicles were brought once more into the planning on a large scale – the Bundeswehr had had lighter platforms of this kind – it was hailed as a declaration of defensive resolve, a reflection of then-prevailing political-symbolic fashion: defense without provocation.

The notion was apparently to set up relatively simple blocking formations, generated from infantry-reserves, with the gun tank destroyers as their backbone.

Operating in scouted, engineer-prepared terrain, they would fulfill barrier roles: not purely static, but with somewhat restricted tactical mobility. This arrangement would free true tank formations from narrow defensive tasks and allow them to undertake more wide-ranging operations, though that again stirred up the specter of provocation.

Historical Detour

How did Paul-Werner Krapke, up to 1980, the chief project manager of the Leopard 2 program at the Federal Office for Military Technology and Procurement, arrive at the idea of curbing main battle tank production in favor of a gun tank destroyer? Were strategic security arguments the only factor?

In the latter half of World War II, Krapke worked in Berlin's Army Ordnance Office in charge of the Panzer III and IV programs. Both platforms predated the war. The Panzer III came in two broad configurations: a turreted MBT and a casemate-style assault gun with a short cannon, while the Panzer IV was turret-only, at least initially.

When these turreted tanks could no longer match the heavier Allied vehicles, the plan emerged to produce large batches of the Panzer IV not as tanks but as *Jagdpanzer* (tank destroyers), adopting the Panzer III's casemate concept.

Concurrently, production of the Panzer III turreted version was halted – but continued in the form of assault guns and tank destroyers. By removing the turret, manufacturers reduced the vehicle's weight, enabling heavier frontal armor and a longer, more powerful gun. However, these vehicles became front-heavy, and the long barrel overhanging the front led to complaints (turning radius, barrel hitting the ground).

Nonetheless, the Jagdpanzer, especially the IV, performed admirably, typically fighting from scouted positions or while conducting a staggered retreat.

With this background, it is not surprising that Krapke later advocated a rebirth of the gun tank destroyer. Nor is it surprising that his 1981 design for a heavy Jagdpanzer bore a notable resemblance to what had been envisioned at the wartime Ordnance Office: a Leopard 2 main gun mounted on a heavily armored frontal casemate, with the engine at the rear.

Though he gave the casemate a steeper slope than was used in WWII designs (improving protection and reducing barrel overhang somewhat), some still criticized the front-heaviness. They also felt the barrel was still protruding too much.

Hence there emerged discussions on how to incorporate the Leopard 2's gun into a Jagdpanzer in a completely different way – specifically, on the Marder IFV chassis.

The overarching plan was to remove the two-man turret, moving the driver's seat to the right behind the power pack (commander raised behind it) and using the freed-up space on the left for the gun so that it wouldn't stick out as far. The heavier breech (plus ammunition) would rest in the rear (Bohrmann 1984: 93).

An Alternative Proposal

What follows here is a proposed tank destroyer that adopts the cost-effective approach of using an IFV base but takes an unconventional path with the armament. 'Unconventional' must not mean 'futuristic'.

On the contrary, this is about intelligent combination of established technology – effectively 'sticking out one's tongue' at Russian high-tech aspirations.

Were states bordering Russia, provided they do not insist on full-blown MBTs, to equip part of their armies with such vehicles, it would underscore their determination to resist and enhance their sense of security, all without appearing provocative. In that environment, Moscow might conclude that heavy armor for offensive action yields poor returns.

Design Sketch

We begin with the Marder IFV (original configuration): 28.5 tonnes, hull length 6.8 m, width 3.25 m, hull-top height 1.9 m, ground clearance 0.45 m, engine output 442 kW.

By removing its turret/armaments and installing a lighter engine (while boosting power to 530 kW), the vehicle's weight drops to 24 tonnes. The aim is a tank-destroyer weight of 36.5 tonnes, meaning we have a margin of 12.5 tonnes to re-allocate for:

- wider tracks/reinforced running gear,
- mine protection,
- partial hull extension (in height),
- a lightweight composite add-on armor layer, and
- a "hard-kill" active protection system.

This total also has to cover armament and sighting. The primary weapon is a left-mounted 155 mm light gun (L/25), firing single-piece combustible-case ammunition with a muzzle velocity of 500 m/sec and a rocket boost to 1,000 m/sec.

Each projectile carries 33 bomblets (primarily HEAT, secondarily HE), malleable and with limited terminal guidance (laser marking).

Auto-loading is done without requiring the barrel to align with a fixed angle (no index position), using a revolver magazine behind the breech that holds four rounds and enables a very high rate of fire. The revolver itself is refilled automatically at an index position from a rear magazine holding another 24 shells.

The cannon has only elevation control, simplifying the mantlet design and saving weight. Lateral aiming is accomplished via the vehicle's continuously variable hydrostatic drive.

Secondary weapons, an unmanned rapid-fire light cannon and a machine gun, are mounted on a rotatable sensor mast (1 m high) in the vehicle's center. This mast offers stabilized electro-optics for 360° plus overhead surveillance and is equipped with a laser rangefinder/marker.

Crew: two people – driver/primary gunner plus commander/ secondary gunner – seated slightly staggered to the right behind the engine in an armored cell. The commander's all around view (with optics, not optronics) is largely unimpaired by the sensor mast. Behind the cell lies an escape corridor, parallel to the gun compartment, with a rear hatch

This corridor, measuring about three-fifths of the interior width, can hold three or four infantry as needed, so a tank-destroyer company might have an entire platoon of dismounts. (Those extra troops could also assist the small core crew.)

An Assessment

Tactical mobility is relatively average: no high speeds or aggressive maneuvers into enemy lines are intended. Protection is weaker than that of current main battle tanks.

Yet the tank destroyer should still enjoy decent battlefield survivability: it is notably compact, has a low profile, and follows the typical tank-destroyer tactic of minimizing exposure, fighting from alternate, concealed positions in pre-scouted terrain.

Its real trump card lies in armament: the big-bore gun can take on all kinds of armored vehicles and can punish infantry behind walls. The secondary cannon counters aerial threats, too.

This firepower has the potential to overwhelm the defenses of any MBT, shredding tracks, sensors, communications, defensive suites, optics, etc.: all that makes a tank a fighting machine – thereby hopefully escaping the endlessly expensive race between heavier armor and ever more lethal kinetic rounds.

Unconventional Armored Platforms

First published as "Unconventional Designs" in: *Über Panzer* (*On Tanks*), Berlin: LIT, 2023.n:

Design and Key Features

The designs presented here revolve around a shared platform for heavy armored vehicles. Why opt for a unified solution when the global trend is to develop main battle tanks and infantry fighting vehicles separately?

Only in Israel do a main battle tank and a heavy infantry carrier share the same basic chassis. In Russia, where the plan had been to render an MBT, IFV, and self-propelled howitzer members of one technological family (the Armata program), that effort stalled or was possibly abandoned.

Within an alternative force structure (Grin/Unterseher 1988; SAS 1989), it is assumed that in a defense specialized for holding ground, there remains a need for a relatively small core of heavy forces for counterattack in the context of a networked (web-like) arrangement dominated by light troops supported by precise, responsive indirect fire on medium-weight platforms.

Consequently, the emphasis should be on a rather limited number of vehicles. Given that it is both technically feasible and militarily sound, a family solution is advisable. Compared to distinct single-purpose designs, a unified platform would be significantly more cost-effective (economies of scale).

Such a universal platform should be compact (though not "over-compact" and therefore as trouble-prone as some Soviet-Russian tanks) and give the most favorable silhouette possible. It also makes sense to lighten the vehicle from the usual 60+ tonnes down to around 50 tonnes: trying to retain a higher level of protection through "intelligent design." That reduction mainly benefits operational mobility.

An unconventional solution for drive and running gear is recommended, to enhance both mobility and survivability. Each vehicle would ride on five powered wheel pairs (rubber-tired, run-flat, hydro-pneumatically sprung, with brake steering) plus, in operational areas or off-road, a reinforced rubber track (where recent advances have greatly improved durability under load).

- Off-road: The first and/or last wheel pair can be raised.
- Road travel: The second and fourth can be raised.

When moving long distances on roads, the wheeled mode confers greater operational mobility via extended range and obviates the cumbersome low-loader convoys. The redundancy of both wheels and tracks also boosts overall robustness of the running gear.

Hydro-pneumatic suspension is well proven today. Among its advantages:

1. The hull floor remains free of suspension components (optimized mine protection).
2. .Variable ground clearance is possible.

The engine block is located in the front. It is a compact diesel-based hybrid system providing around 18–19 kW/tonne. Higher power-to-weight ratios bring fewer advantages and more downsides. Short stretches of purely electric drive yield very quiet ("tactical") movement. The concept envisions three variants: a Main Battle Tank, a Tank Destroyer/Direct-Fire Support, and a Heavy Infantry Transporter.

Family Members

Common Characteristics: The base platform measures 7.00 m in hull length, 3.50 m in width (without side skirts), and 0.50 m in average ground clearance. Weight varies: 47-49 tonnes 'bare', 52-54 tonnes when add-on armor is installed.

A Main Battle Tank, nom de guerre "**Giraffe**"

- Crew: 3 personnel in a protected cell behind the engine block.
- Cell layout (triangular floor plan): driver and commander side by side, gunner behind them.
- Turret: The gunner sits beneath a lightly armored overhead

mount that rotates 360°, allowing optical all-around view.

- Main armament: A 120/130 mm cannon with autoloader.
  - Six canisters, each holding four rounds, stored in the rear.
  - The canister at the breech can fire its rounds without returning to an index position (indexing occurs only when canisters are switched).
  - One type of ammo: single-piece KE (APDSFS).
- Secondary armament: coaxial MG plus 16 HE rockets in protected containers on wing-like outriggers of the overhead mount.
- Escape route: a "lock" (airlock-like) parallel to the ammo bunker leads to a rear door.
- Hull-roof height: 2.15 m; total height (sensor mast): 3.25 m.

B Tank Destroyer/Direct Fire Support, nom de guerre "**Camel**"

Crew: 3 personnel in a protected cell at the rear. A rear ramp allows escape. Driver and commander side by side, with unimpeded all-around vision (no reliance on optronics).

Gunner/operator sits in a lowered position between them. Both driver and commander have rotating seats to face either forward or backward; forward and reverse speeds are identical.

Sensor mast: an armored, telescoping unit mid-vehicle, carrying a remotely operated light autocannon plus MG. This mast offers stabilized optronics for 360°/overhead observation.

Main weapon: located in a "sunken turret" (in the hull) behind the engine block but in front of the crew cell. Inspired by the "Borgward" system, 160° traverse, auto-loader of the carousel type under reactive-armor cover. The breech moves upward in a narrow central "hump," letting driver/commander see over it from the rear cell.

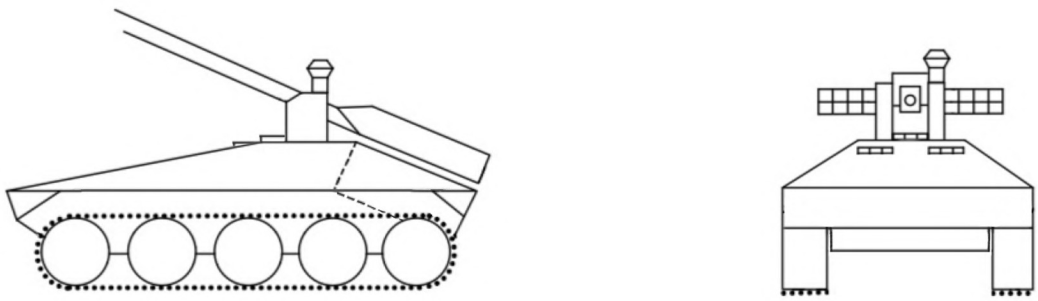
Could be the same 155 mm low-velocity gun from the "Jagdpanzer" concept in this volume or a medium-caliber auto-cannon (e. g., 50 mm Rheinmetall, 60 mm Oto Melara).

Height: hull roof 1.75 m, cell roof 2.25 m, sensor mast 3.05 m.

C Heavy Infantry Transporter, nom de guerre "**Kangaroo**"

Crew: 3 in a protected cell behind the engine block.
Commander and driver side by side on rotating seats (as in variant B) with optical means for all-around vision. Gunner/operator is in a lowered center position. Passenger area: behind them for six infantry, with a rear ramp.Sensor mast with remote- operated autocannon or a light AGL plus MG (optionally 4 ATGMs with a range of 4-5 km). Height: hull roof: 2.00 m, crew cell: 2.45 m, mast: 3.05 m.

A



without launcher | with launcher

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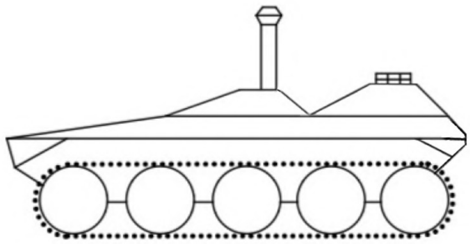
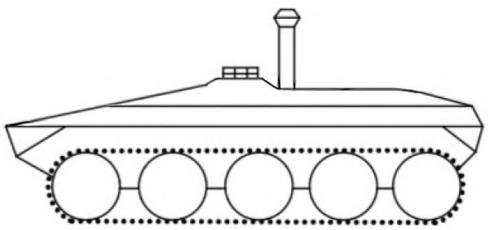


without armament

C



without armament

APPENDIX

The Interaction of spider and web

The following text was first published in a somewhat different form at the end of the debate on conventional military alternatives to NATO's established posture in the 1980s (Grin/Unterseher 1990: 243-262) – and then occasionally again.

The purpose

The purpose of our study has been to translate an argumentation that had previously only been delivered verbally into a formalized calculus: to make systematic considerations – even – clearer and, above all, to bring them closer to that circle of interested experts who are used to mathematical abstraction.

The inspirer of this approach, the Dutchman John Grin, is a physicist and social scientist.

The considerations are based on the proposal of the international Study group on Alternative Security Policy (SAS) for the defense of Central Europe – with the claim to link effective deterrence with the proviso to minimize provoking the other side (SAS 1989).

The perspective: a structural contribution to crisis stability. The development of the SAS model is based on conceptual ideas of earlier authors: for example, those developed, at the beginning of the 1950s by Bogislaw von Bonin (Bonin 1989), as well as the corresponding approach of Horst Afheldt (Afheldt 1976).

Central to this school of thought are area-covering, web-like light structures (based on infantry and indirect fire) which are specialized in the defense: strategically and operationally. To render such a scheme more resistant and flexible, the SAS approach envisages tactically mobile forces that interact with the decentralized light formations.

In the parlance of the study group, the forces intervening within the defensive network operate like “a spider in its web“, which is an allegory introduced by the renowned Dutch physicist Egbert Boeker (Boeker 1986: 62).

The aim here is to provide systematic support for the following statement which is central to the SAS concept:
“The web prepares the ground for the spider forces, among other things, by forcing the attacker to concentrate his troops. Being confronted with such concentrations implies both an advantage and a risk. The advantage is that such massed forces are easy to locate and, because of their high density, provide a rich assembly of lucrative targets. The risk is ... that the concentration of troops against a particular point of the defense brings with it the danger of unacceptably deep penetration.

In the SAS concept, the risk is considerably reduced, while the aforementioned advantage is optimally exploited.“ (Grin/Unterseher 1990: 256; 1988).

Defensive synergy

Basic considerations and definitions

In order to be able to appropriately work out the interrelationships that arise here, it is first necessary to outline a certain part of the doctrine of 'maneuver warfare' as formulated by Richard Simpkin (Simpkin 1985).

In concrete terms, it is about the procedure to defeat freely maneuvering troops of an aggressor aiming at rapid advance. In the context of our model analysis, which is primarily based on experience with mechanized warfare, the close cooperation of relatively static web forces (H), optimized for holding and mobile mass: counter-attack formations/heavy spider forces (M), is of key importance.

The interaction of these functionally different contingents of the defender exposes the attacker (A) to a leverage effect. To generate a leverage effect, three elements are required – as known from physics:

a swinging mass (M), an arm (namely the connection between M and H) and a pivot around which the movement of arm and M takes place. If the leverage is to be increased, the arm must be lengthened. In other words: the mass (M) has to move beyond the center of gravity of A. This results in a 'hammer and anvil' setting.

To make this succeed, the forces with the task of holding (H) must do the following: they have to cover the base of M, to give the lever arm a fixed pivot and to tie down the penetrating forces (A) for a sufficient time.

Although the formations with the holding function (H) have to remain relatively static during the execution of the lever maneuver, they nevertheless are in need of – potential – mobility, because they always have to take the right position which enables them to perform their blocking task, meaning that A cannot bypass them.

Formalized calculus

This tactical concept results, in principle, in some requirements for H and M, which can be expressed as relative speeds of the forces H, M and A (hereafter referred to as VH, VM and VA).

Firstly, it can be deduced from the functional model that H must not lose contact with A: $VH \geq VA$. Secondly, in order to increase the leverage effect appropriately, the mobile element (M) should be able to move at least twice as fast as H: $VM > 2\ VH$. Thirdly, it can be assumed that the lever arm will break if it is overstretched. To exclude this as far as possible, the speed of M must not be too high: $VM < 10\ VH$ is a plausible rule of thumb. This results in the following require- ments for the relative velocities:

$VH \geq VA$
and
$2\ VH < VM < 10\ VH$

Logically, with these two relationships, another one is implied – na- mely $VM > 2\ VA$. This expresses the obvious requirement that the mobile counterattack/spider forces (M) must be sufficiently fast to get beyond the center of gravity of the attacker (A). All these requirements can be met quite easily in the SAS concept:

In the case of a defensive operation dealing with only a relatively small concentration of troops on the attacker's side, the space-covering web is able to play the role of H alone, namely to tie up penetrating forces at least for a limited time.

At the same time, its covering capacity is also sufficient for its own spider elements (M), since these may also be quite small due to the limited size of the attacking forces – and for reasons that remain to be explained.

The spatially bound character of the web forces makes it impossible to correspond to the first relationship ($VH \geq VA$). However, because the web has considerable depth (and cannot be bypassed), it is still able to fulfil the basic requirement for H that contact with the attacker is not lost.

Analogously, the relationship $VM < 10\ VH$ cannot be fulfilled either: because of the basically static character of the web structure. Yet it does not have to be fulfilled at all. The depth of the system prevents the lever arm from breaking. Again and again, new pivots for lever actions are offered in a flexible way.

The requirements for the relative speed of the mobile component (M) are also reduced by the web – for two reasons. Firstly, the quasi-static character of the system means that the relationship $VM > 2\ VH$ becomes trivial. Secondly, because the deceleration function of the web considerably reduces the speed of the attacking troops, it becomes easier to fulfil the derived relation $VM > 2\ VA$.

In other words, due to the virtual omnipresence of the web structure, the mobile counterattack/spider forces (M) can considerably increase their leverage. In doing so, they are able to outmaneuver the intruder with less mobility than would 'normally' be necessary (without the cooperation of spider and web).

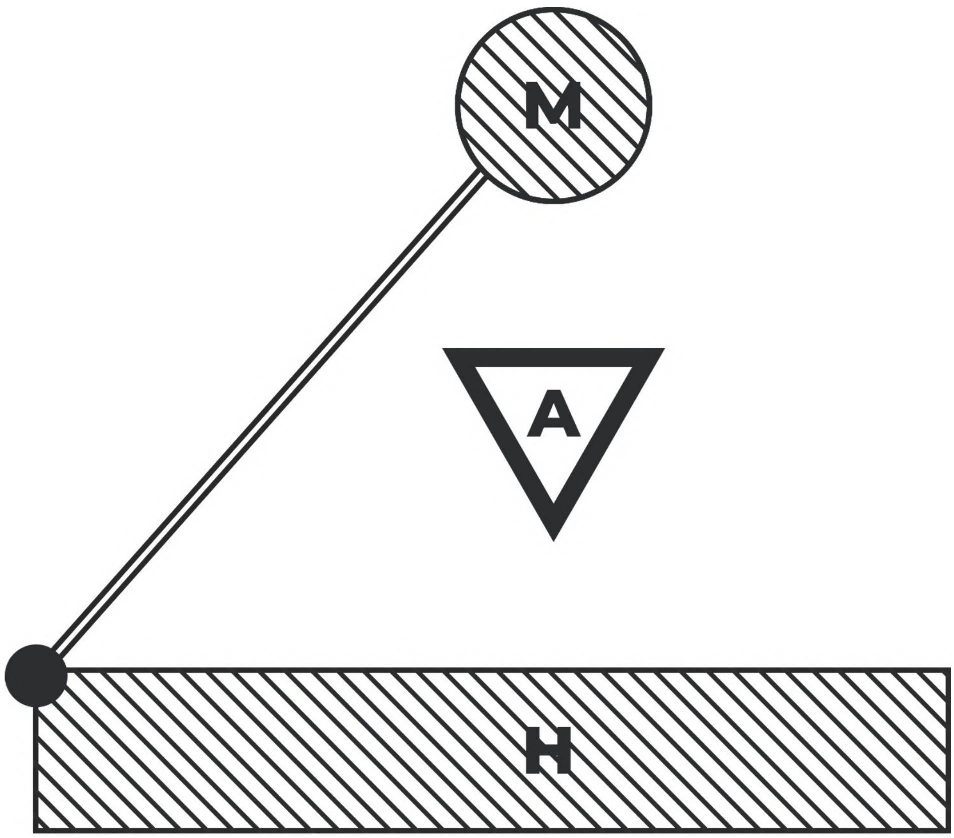
The second case to be discussed here relates to the need to be able to cope defensively with the penetration of larger masses of troops (A“). This means that the web structure has to be reinforced by special defensive spider elements, such as highly mobile infantry, so that a sufficient holding effect can be achieved.

Thus, the forces with an H-function consist of two components: H (web elements) and H" (spider elements). Of course, the mobile forces (M") must also be stronger than in the first scenario.

Essentially, it is a matter of bringing the additional forces with a holding effect (H") and the reinforced mobile elements (M") to the right point at the right time.

The relations developed for our interaction model should there fore also be applicable to VH". Because of the covering function of the web, the relation (VH" ≥ VA") can be easily satisfied, and the relations whose subject are the relative velocities of M" and H" (2 VH" < VM" < 10 VH") are considered trivially satisfied.

It can thus be seen that the spider-in-the-web approach greatly facilitates defensive maneuvers to overcome challenges even by sub stantial concentrations of attacking forces.



Source: R E. Simpkin

Holding without provocation

There is a defensive arrangement that owes its performance to high responsiveness. This is rooted less in "absolute" speed than in a basic structure that is tailored for the coordinated, optimal allocation of forces.

Reactivity – as the ability to bring adequately strong forces to the right place at the right time – minimizes, simply put, the "waste" of cost-intensive mobile potential. This means that the corresponding forces may be smaller in terms of total as well as unit size than in the case of the non-existence of the concept outlined above.

If the mobile forces are faster than average, as is the case in the SAS model due to the greatly reduced logistical burden of the M -forces through web support, although their responsiveness depends less on this than on the function of the system, the – potential – performance of these intervention units would increase further.

This promises an even more substantial reduction of the mobile component in terms of overall scope and unit size. Thus, the military counterpart is offered a minimized structural threat.

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