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Main Battle Tank: obsolescence or renaissance?

Léo PÉRIA-PEIGNÉ

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Executive summary

Since February 2022, Russian and Ukrainian forces combined have lost more than 5,000 battle tanks, a much higher volume than all the European armor combined. Spearhead of the Soviet doctrine from which the two belligerents came, tanks were deployed in large numbers from the first day and proved to be a prime target for UAVs that became more numerous and efficient over the months. The large number of UAV strike videos against tanks has also led a certain number of observers to conclude, once again, that armor is obsolete on a modern battlefield. This approach must, however, be nuanced by a deeper study of the losses and their origin, UAVs rarely being the sole origin of the loss itself, often caused by a combination of factors such as mines, artillery or other anti-tank weapons. Even if its own efficiency has increased since 2022, the UAV itself is still often used to « finish » a disabled and abandoned armored vehicle, to avoid its recovery and recommissioning. Indeed, a significant proportion of tanks considered to be put out of action are recovered and returned to service or reused. Interestingly, the tank duel represents only a fraction of the losses.

To face a more transparent and deadlier battlefield, both sides have led adaptation of their use of the heavy segment, for example, favoring operations in overcast weather, less conducive to drones, or incorporating terrain modifications such as the famous anti-UAV cages – a Russian innovation subsequently adopted by other armies like the IDF. These tactical and technical adaptations have made it possible to reduce the losses of tanks, which are now mainly used for infantry support, just as they did in 1917 when they first appeared on the battlefield. The use of tanks to shoot beyond line of sight is another practice that has become widespread to gain a few kilometers and stay away from an increasingly lethal front line. The few breakthroughs, however, saw the more classic use of armor in a temporary return to mobile warfare. In the long term, changes in the very architecture of the tanks are envisaged by both sides to better fit their needs.

After three decades of contraction of the fleet in service, European forces are back investing in armor, which remains an essential element of combined arms combat. Most armies, including those that had abandoned them a decade earlier, launched programs to acquire new tanks or modernize existing parks. This dynamic mainly benefits the German industry, and the *Leopard* 2 is already the most common modern tank in Europe. The other historical European players in this sector – the United Kingdom, Italy, and France – no longer produce tanks, and non-European actors are coming to challenge the quasi-monopoly of Germany. South Korea and the United States have won a few contracts that offer them solid bridgeheads on a

resurgent continental market. The competition for the next generation of tanks seems to be articulated between the German and South Korean industries, which both have a strong lead.

Strongly considered by the French Army in the early 2000s, abandoning tanks no longer seems relevant, but the alternatives to the ongoing French-German cooperation are limited. In addition to off-the-shelf procurement, leads exist in the Middle East as well as in Europe. A national effort could also lead to the development of an intermediate national solution, helping to upgrade the French land defense industry, which has been able to preserve the necessary core competence but did not put them in use for years. Regardless of the solution chosen, increasing the heavy segment seems essential to support the French ambition to command an army corps within the Atlantic Alliance. Without trying to match the Polish or German plans, which could exceed a thousand tanks in service, France must be more assertive in the ongoing European rearmament dynamic, at the risk of permanently losing ground in a military field that has long been its strong point.

Résumé

Depuis février 2022, les forces russes et ukrainiennes ont perdu plus de 5 000 chars de combat, un volume très supérieur à l'ensemble du parc européen actuel. Fer de lance de la doctrine soviétique dont sont issus les deux belligérants, le char a été déployé en grand nombre et s'est avéré être une cible de choix pour des drones devenus de plus en plus nombreux et efficaces au fil des mois. Le grand nombre de vidéos de frappes de drone contre des chars a d'ailleurs poussé un certain nombre d'observateurs à conclure, une fois de plus, à l'obsolescence de ceux-ci sur un champ de bataille moderne. Cette approche doit être nuancée par une étude plus fine des pertes, les drones n'étant que rarement à l'origine de la perte elle-même causée par la conjugaison de plusieurs facteurs comme les mines, l'artillerie ou d'autres armes antichar. Le drone est plutôt utilisé pour achever un blindé immobilisé et abandonné, pour éviter sa récupération et sa remise en service. De manière intéressante, le duel de chars ne représente qu'une fraction des pertes.

Pour faire face à un champ de bataille plus transparent et plus létal, les deux camps ont adapté leur emploi du segment lourd, favorisant des opérations par temps couvert, moins propice aux drones, ou intégrant des modifications de terrain comme les fameuses cages anti-drone – une innovation russe adoptée ensuite par d'autres armées comme Tsahal. Ces adaptations tactiques et techniques ont permis de réduire les pertes en chars, qui sont surtout utilisés pour l'appui à l'infanterie, à l'image du rôle qui était le leur en 1917 lors de leur première apparition sur le champ de bataille. L'utilisation du char pour réaliser des tirs au-delà de la vue directe est une autre pratique qui s'est généralisée afin de gagner quelques kilomètres et de s'éloigner d'une ligne de front de plus en plus létale. Les quelques percées ont cependant vu l'utilisation plus classique du char dans un retour temporaire à la guerre de mouvement. À plus long terme, des évolutions dans l'architecture même des chars sont envisagées par les deux camps pour correspondre encore davantage à leurs besoins.

Après trois décennies de contraction du parc en service, les armées européennes opèrent un réinvestissement massif autour du char, qui reste un élément indispensable du combat interarmes. La plupart des armées, y compris celles qui l'avaient abandonné une décennie plus tôt, lancent des programmes d'acquisition de nouveaux chars ou de modernisation des parcs existants. Cette dynamique profite notamment à l'industrie allemande, le *Leopard* 2 étant d'ores et déjà le char moderne le plus répandu en Europe. Les autres acteurs européens historiques de ce secteur – Royaume-Uni, Italie et France – ne produisant plus de chars, ce sont des acteurs extra-européens qui viennent contester le quasi-monopole allemand. La Corée du Sud et les

États-Unis ont décroché quelques contrats sur un marché continental renaissant. La compétition pour la prochaine génération de chars semble d'ailleurs devoir s'articuler entre les industries allemandes et sud-coréennes, qui disposent toutes deux d'une solide avance.

De son côté, la France reste pour le moment à l'écart de cette remontée en puissance du segment lourd européen. Le parc national de chars est en cours de modernisation, mais celle-ci reste limitée et ne résout pas les obsolescences les plus critiques, comme la motorisation, tandis que la loi de programmation militaire de 2023 ne prévoit pas d'évolution du nombre de chars en service. La situation est d'autant plus problématique qu'il semble impossible de relancer une production de *Leclerc* stoppée depuis plus de quinze ans, et que son successeur ne devrait pas être disponible dans les forces avant 2045 au mieux. La coopération franco-allemande dans ce domaine reste difficile, tant par le déséquilibre entre les partenaires industriels que par l'écart croissant entre les moyens et les besoins des deux armées. Berlin dispose en effet des atouts financiers et techniques pour développer une solution autonome, une perspective bien moins accessible pour la France.

Sérieusement envisagé au début des années 2000, l'abandon du char par l'armée française ne semble plus d'actualité. Les alternatives à la coopération franco-allemande sont cependant limitées. Outre l'achat sur étagère, des pistes existent au Moyen-Orient comme en Europe, tandis qu'un effort national pourrait permettre de proposer une solution intermédiaire française capable de remettre à niveau l'industrie de défense terrestre française qui a su préserver le cœur de compétence nécessaire. Quelle que soit la solution choisie, la remontée du segment lourd semble indispensable pour soutenir l'ambition française de pouvoir commander un corps d'armée au sein de l'Alliance atlantique à partir de 2030. Sans chercher à égaler les plans polonais ou allemands, qui pourraient dépasser le millier de chars en service, la France doit s'inscrire de manière plus affirmée dans la dynamique de réarmement européenne en cours, sous peine de connaître un déclassement durable.

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Introduction

Early on in Russia's invasion of Ukraine, media outlets broadcast images of the streets of northern Kyiv littered with Russian tank wrecks that had been abandoned following the withdrawal of Moscow's forces. One of the reasons Ukrainian resistances succeeded early in the conflict was the use of unmanned aerial vehicles (UAVs), such as the Turkish-made TB2, as well as lighter systems derived from civilian models. (The latter were particularly useful in anti-tank missions.)[1] Kyiv encouraged this narrative through images and videos from these same UAVs showing the final moments of their attacks on Russian forces. This created an impression that conventional military equipment—tanks, armored vehicles, artillery—was vulnerable to this new weapon that combined modernity and efficiency. Within Ukraine, the UAV (along with the Javelin anti-tank missile) became a popular symbol of Ukrainian resistance to Russian tanks.

UAVs are undeniably useful, but they are not an all-powerful weapon, and they are unlikely to displace more conventional systems. Part of the reason they seem so effective is that only videos of successful attacks are shared. These are actually dwarfed by the number of failures. Even in 2025, destroying a tank almost always requires dozens of UAVs.

Moreover, while a growing number of missions (including strikes, surveillance, radio relays, and jamming) can be carried out by drones, some still require traditional weapons systems, such as tanks. In missions that involve breaking through a front line and exploiting that breakthrough, blocking an axis of advance, or holding a point or area of terrain, UAVs can play only a supportive role; battle tanks, therefore, remain vital in high-intensity combat. On the other hand, tank tactics and architecture must evolve in order to adapt to the proliferation of enemy and friendly UAVs on the battlefield.

Both Ukraine and Russia are working to develop their armored forces to adapt them to battlefield realities, which has generated valuable lessons. While tanks remain vulnerable, they are difficult to replace and represent the best compromise in a demanding and lethal operational environment. Drawing on these lessons from the Ukrainian battlefield, European forces are embarking on an ambitious buildup of their fleets. Tank acquisition and modernization announcements have proliferated since 2022, including from small European countries, reversing the downward trend that had prevailed

1. L. Péria-Peigné, "TB2 Bayraktar: grande stratégie d'un petit drone", *Briefings de l'Ifri*, Ifri, April 17, 2023.

since the end of the Cold War.[2] This buildup is, in turn, revitalizing Europe's tank market, which has changed significantly since the previous generation of systems was launched. New non-European actors such as South Korea are establishing secure footholds in this market, while historical local players are increasingly rare.

France is struggling to keep pace with this continental rearmament effort. Although it has been modernizing its fleet, the size and availability of the national armored force remain insufficient to achieve France's goal of a deployable division by 2027, or even a North Atlantic Treaty Organization (NATO) army corps by 2030. The Franco-German Main Ground Combat System (MGCS), intended as the successor to the Leclerc tank, has encountered serious issues and will not be operational before 2045. This prospect seems distant, as the current fleet ages rapidly, which increases maintenance costs and reduces platform availability. If the MGCS fails, a national alternative is possible, but it would require significant industrial and financial investment, while the military budget increases announced in the 2024–2030 Military Programming Law (Loi de programmation militaire, LPM) have yet to materialize, more than two years after its passage.

As Europe rapidly modernizes its tank fleets, how should we assess the lessons from Ukraine and consider the future of the French armored forces? This analysis first examines the changes the conflict in Ukraine has brought to battle tank employment and architecture (I). As European armed forces rearm, most of the continent's historical producers have disappeared from the industrial landscape, and non-European actors are entering a rapidly expanding market (II). France is faced with a problematic situation: an aging fleet, a struggling replacement program, and a military culture that has gradually turned away from heavy armor (III).

2. S. Siebold, "Germany to Order 105 Leopard Tanks to Equip German Brigade in Lithuania", Reuters, June 20, 2024. See also R. Ruitenberg, "Netherlands Buys 46 Leopard Tanks from KNDS for More Than $1 Billion", *Defense News*, May 15, 2025.

The tank in the war in Ukraine

The conflict in Ukraine has profoundly disrupted armored doctrines that had been established since the beginning of the Cold War. The massive, ongoing use of drones has led many observers to question whether tanks are still relevant. Both Russia and Ukraine, however, have continued to reinvent tank employment rather than abandon it, relying on tanks' particular advantages in terms of mobility, survivability, and firepower. The answer to the destruction of large numbers of tanks by UAVs is not to abandon the tank but to profoundly adapt it, both through technical and tactical innovations and a return to older expertise.

From a war of tankers to a war of drone operators

A tank-centered Soviet legacy

By the end of summer 2025, three and a half years after the Russian invasion began, observers have recorded more than 5,000 tanks destroyed, damaged, or abandoned, including more than 4,100 from the Russian army alone.[3] By comparison, Britain lost 4,400 tanks in four years during the Second World War.[4] During the Yom Kippur War in 1973, more than 2,600 tanks were destroyed in just 20 days. The current conflict's massive tank losses reflect not just the scale of fighting between Kyiv and Moscow, but also the tank's central role in both sides' military models. For both Russia and prewar Ukraine, the tank remains an essential tactical asset, indispensable for modern combined arms combat and present in nearly all front-line formations. The doctrine manuals and operational organizations of both sides, inherited from the Soviet era and the Cold War, emphasize large-scale armored maneuvers that involve significant numbers of armored vehicles operating in concert at all stages of operations.

Beginning in the late 1920s, Soviet military thinking developed a resolutely offensive doctrine in which mechanized armored formations played an increasingly important role. Mechanized corps were designed for direct assault and encirclement to break through enemy lines and exploit that breakthrough.[5] Defensive operations played a limited role, characterized by

3. "Attack on Europe: Documenting Russian Equipment Losses During the Russian Invasion of Ukraine", *Oryx*, February 24, 2022, available at: www.oryxspioenkop.com (accessed August 28, 2025).
4. S. Zaloga, *Armored Champion: The Top Tanks of World War II*, Mechanicsburg: Stackpole Books, 2015.
5. "Soviet Tank Company Tactics", Defence Technical Information Center, May 1976.

rapid counterattacks. Prior to 2022, these all remained prominent features of Russian military doctrine.[6]

The tank is a key element of this doctrine, which views self-propelled artillery and infantry fighting vehicles mainly as complements to tank action. Soviet tank and armored vehicle development reflected this quest to maintain operational momentum at all costs. Rather than setting up cumbersome systems of evacuation and repair, Soviet doctrine favored in-the-field repair, either by cannibalizing or replacing damaged vehicles. This led the Soviets to mass-produce armored vehicles on common chassis or with interchangeable parts that could be stored for long periods.[7] These same vehicle stocks enable both belligerents to endure heavy losses while returning increasingly older armored vehicles to service. This approach has enabled Russia to maintain its front-line effort thus far, but it appears to be reaching its limits, as more and more Russian storage bases appear to have been emptied of recoverable machines. (Thanks to a growing number of commercial space imaging services, independent actors can continuously monitor this dynamic.)[8]

Faced with the overwhelming numbers of Soviet tanks, NATO doctrine and matériel adapted to prepare to face armored vehicle numbers several times greater than those of the Atlantic Alliance.[9] In France, the Tiger helicopter and Leclerc tank, both developed starting in the 1970s, made the anti-tank mission central to a defense-in-depth strategy against a numerically superior adversary. The Leclerc could engage four or five enemy tanks.[10] Despite changes beginning in the 1990s, the anti-tank mission remains an important approach for many European armed forces.

Russian and Ukrainian doctrines draw heavily on their shared Soviet heritage, with tanks retaining a key role in both armed forces and a presence in most ground formations.[11] Russia attempted to emulate American network-centric doctrines, but the 2008 Serdyukov reform achieved mixed results and failed to break with the Soviet material and conceptual legacy. Following the occupation of Crimea in 2014, Ukraine more openly integrated NATO practices and techniques as it sought to join the Alliance.[12] After 2014, the annexation of Crimea and the war in the Donbas hybridized Ukrainian

6. Joint Grouping of Forces, "Recommendations for Countering an Enemy Operating as Tank and Mechanized Columns (Hostile)", [Рекомендации по борьбе с противником, действующим в составе танковых и механизированных колонн], captured from the enemy, Library of the Territorial Defense Forces, Rostov-on-Don, 2023.
7. J. H. Irvine, "Soviet Weapon-System Acquisition", Naval Weapons Center, September 1991.
8. Tweet from the account @Jonpy99 on August 13, 2025, on the state of reserve base No. 6018, available at: x.com/Jonpy99.
9. M. Allen, "Military Helicopter Doctrines of the Major Powers 1945-1992: Making Decisions About Air-Land Warfare", Westport, 1993.
10. M. Chassillan, *Char Leclerc, de la guerre froide aux conflits de demain*, Paris: Sofia Éditions, 2024.
11. "Temporary Combat Statute of Mechanized and Tank Troops of the Ground Forces of the Armed Forces of Ukraine—Part III (PLATOON, DEPARTMENT, CREW)—2016-2018", Command of the Ukrainian Forces—Academy of Ground Forces, SBP 3-(01,02,04).58(59).
12. V. Tourret, "Drones en guerre: la confrontation russe et ukrainienne", *Vortex*, No. 7, 2025.

doctrine while incorporating valuable field experience. However, both sides' force structures remain heavily influenced by the Soviet past and, at the start of the conflict, involved very large numbers of tanks.

In line with their doctrine, the Russian Armed Forces deployed substantial mechanized resources against Ukraine on February 24, 2022. In the north and especially the south, armored forces attacked Ukrainian forces that were either overwhelmed or spread too thinly across such a broad front. Similar operations in the east against lines fortified since 2014 met with limited success. A few days after the full-scale invasion began, however, the Russian armored offensive stalled and met stiff resistance from Ukrainian forces. Ukraine conducted major armored counterattacks in the south, where the terrain was more favorable than in the north near Kyiv, where the terrain is wooded and difficult. Blocked in early March outside Mykolaiv, Russian armored forces retreated under Ukrainian mechanized counterattacks, which broke several encirclements. After marching sometimes more than a hundred kilometers in a few days, the scattered, uncoordinated Russian forces retreated to areas less favorable to armored vehicles in April 2022.[13]

Mechanized units proved vital for Ukraine in defending several important locations, such as Chernihiv, a city of 300,000 in northern Ukraine, which was surrounded and overwhelmed by Russian forces in the early days of the conflict. Used flexibly across the entire defensive perimeter, the few tanks in Chernihiv provided its defenders with essential firepower, particularly indirect fire, to repel Russian assaults during three months of encirclement.[14]

The heavy tank losses of the conflict's first weeks were thus primarily since the tanks were present at higher rates in engaged units and were used extensively in both offensive and defensive combat between the two armies, for which tanks remained the primary weapon of war.

Explaining the losses: beyond the numbers

The thousands of tanks lost, combined with widespread UAV use, have led many observers to conclude that tanks are now obsolete in modern warfare.[15] Versions of this argument have been made repeatedly over the past century, but have never proven true: The widespread use of shaped charges in the 1950s, anti-tank guided missiles in the 1960s, and the emphasis on air superiority in the 1980s and 1990s all prompted observers to declare the tank "dead" because of its heightened vulnerability to other weapons. After more

13. M. Zabrodskyi et al., "Preliminary Lessons in Conventional Warfighting from Russia's Invasion of Ukraine: February-July 2022", *Special Resources*, Royal United Services Institute, November 30, 2022.
14. W. Chung, "War in Ukraine Volume 5: Main Battle Tanks of Russia & Ukraine, 2014-2023", *Europe@War*, No. 36, 2023.
15. P. Payson O'Brien, "War Will Never Be This Bulky Again", *The Atlantic*, May 26, 2022.

than a century of operational use, however, the tank's relevance has been maintained and developed, and, indeed, a detailed analysis of Ukrainian tank losses challenges the claim that the tank is becoming obsolete.

In addition to the very high concentration of tanks within the forces on both sides, there are several possible explanations for the high number of losses. Despite a decade of extensive reform, Russian ground forces suffered from critical weaknesses that led to significant losses. At the tactical level, observers have pointed to poor soldier preparation, a factor linked to the Russian command's apparent confidence that Ukraine would rapidly collapse and that extensive preparation was therefore not essential.[16] The forces engaged in northern Ukraine in particular were equipped only for a quick and easy operation: They had very limited supplies (ammunition, fuel, rations). Prolonged Ukrainian resistance and harsh weather conditions in February-March 2022 thus put Russian forces in a difficult position; notably, they were forced to abandon many vehicles that had run out of fuel. The Russian forces' lack of operational preparedness, sometimes coupled with a total lack of information about the purpose of their mission and their destination, further increased the vulnerability of Russian combined arms battalions.[17] Observers also questioned the composition of these battalions, highlighting a glaring lack of infantry and an outsized proportion of tanks and artillery, which limited their capacity for action, particularly in urban areas.[18] Foreign observers and the Russian command have also pointed to poorly trained crews and the rigidity of the Russian command and control system.[19]

Furthermore, the rapid advance of Russian forces in the north and south disrupted already fragile joint coordination that was further hampered by faulty communications equipment.[20] Advancing faster than their infantry and artillery support, their logistics echelons, and even their air defense, Russian armored spearheads found themselves exposed to a Ukrainian defense that had regrouped after a few days of rapid but disorderly Russian advances. The abandonment of a large number of damaged or broken-down vehicles in the first weeks of the conflict can be explained by the inability to evacuate them, the necessary support structures having been left far behind. The early success of tactical UAVs, such as the TB2, can also be explained by

16. D. Minic, "What Does the Russian Army Think About Its War in Ukraine? Criticisms, Recommendations, Adaptations", *Russie.Eurasie.Reports*, No. 44, Ifri, September 2023.
17. Ibid.
18. P. Baev, "Russia's War in Ukraine: Misleading Doctrine, Misguided Strategy", *Russie.NEI.Reports*, No. 40, Ifri, October 2022.
19. L. Bansept, "Le retour de la haute intensité en Ukraine: Quels enseignements pour les forces terrestres?", *Focus stratégique*, No. 111, Ifri, July 2022. See also D. Minic, "What Does the Russian Army Think About Its War in Ukraine?", op. cit.
20. S. Cranny-Evans and T. Withington, "Russian Comms in Ukraine: A World of Hertz", Royal United Services Institute, March 9, 2022.

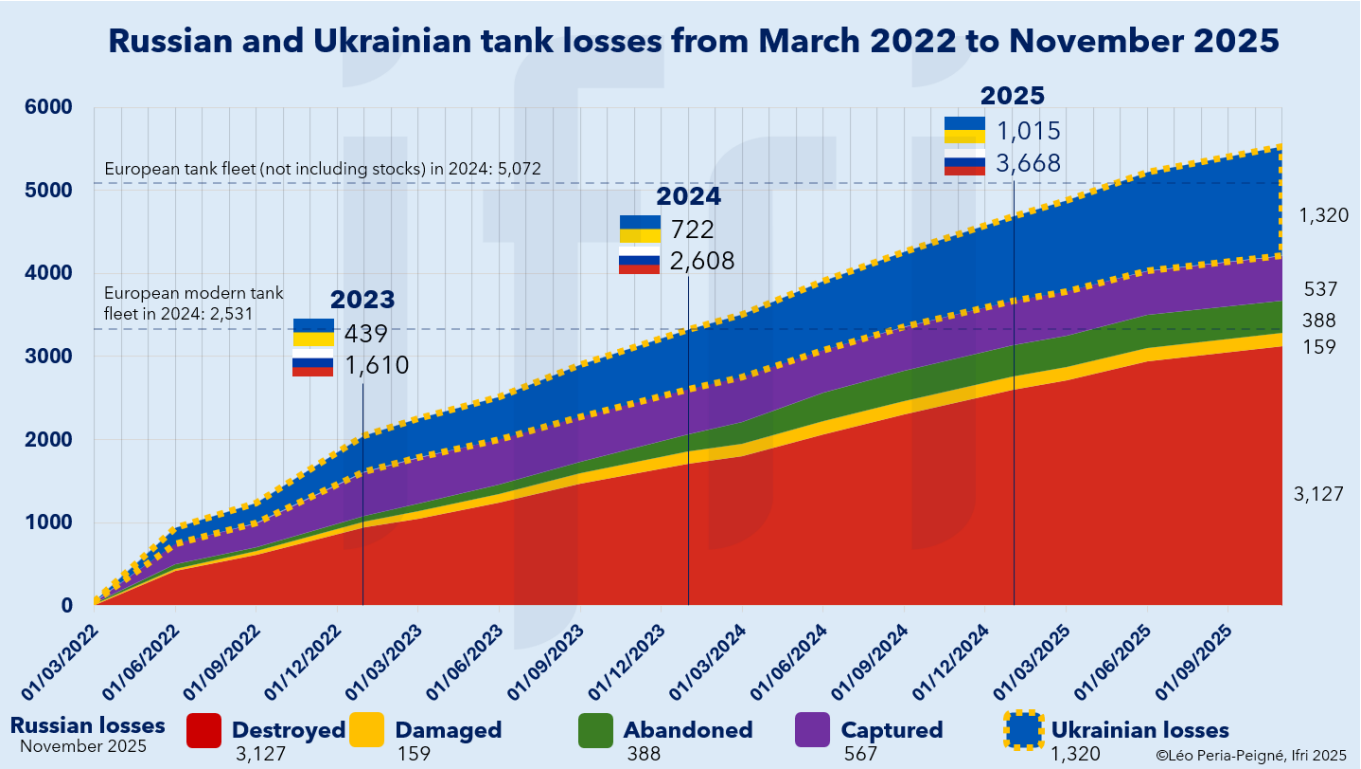
the late deployment of an air defense bubble. Once it was in place, this type of UAV quickly disappeared from the battlefield.[21]

In general, Russia's strategic retreat in April 2022 allowed its joint forces to reorganize and limited vehicle losses. The greatest losses after April 2022 usually occurred during multiple unsuccessful assaults on fortified enemy lines. These assaults, systematically supported by tanks, revealed persistent problems of tactical coordination between combat arms during at least the first two years of the conflict.[22] Assault tactics were then adapted to changes in the terrain, involving lighter and more mobile forces on motorcycles, quad bikes, or civilian vehicles. Tanks were still used in most large-scale assaults, however, usually in a mine clearance or support role.[23] Russian tank losses have declined over the course of the conflict, reflecting the fact that tanks were not only being used less but were also becoming less readily available as Soviet stocks were depleted. Finally, the increased transparency of the battlefield provided by UAVs limited the possibility of concentrating armored forces. Instead, Russia favored sporadic assaults involving a smaller number of vehicles.[24]

Finally, the loss figures themselves deserve scrutiny. The most cited data comes from the open-source research account Oryxspioenkop, which has been active since the first hours of the conflict and whose methodology counts losses based on verified visual evidence. According to this tally, by mid-August 2025, 4,084 Russian tanks[25] and 1,246 Ukrainian tanks[26] had been destroyed, damaged, abandoned, or captured. As this method is based solely on visually verifiable losses, the actual figures could be much higher. Conversely, observers who use an even more conservative methodology, such as WarSpotting, report 3,559 Russian tanks destroyed by the same date, which is still considerable. The proliferation of UAVs and the videos they transmit makes it possible to count losses more accurately than in previous wars, which can easily create an impression of maximum efficiency.

21. Péria-Peigné, "TB2 Bayraktar: grande stratégie d'un petit drone", op. cit.
22. L. P. Orlenko, "Assault Companies for Ground Forces", *News of the Russian Academy of Rocket and Artillery Sciences*, Vol. 83, No. 3, 2014.
23. J. Watling and N. Reynolds, "Meatgrinder: Russian Tactics in the Second Year of Its Invasion of Ukraine", *Special Resources*, Royal United Services Institute, May 19, 2023.
24. P. Néron-Bancel and G. Garnier, "'De l'autre côté de la colline': Atouts et fausses promesses de la transparence du champ de bataille", *Focus stratégique*, No. 118, Ifri, May 2024. See also V. Tourret, "Design, Destroy, Dominate: The Mass Drone Warfare as a Potential Military Revolution", *Ifri Papers*, Ifri, June 5, 2025.
25. "Attack on Europe: Documenting Russian Equipment Losses During the Russian Invasion of Ukraine", op. cit.
26. Ibid.

Figure I-1: Russian and Ukrainian tank losses from March 2022 to November 2025



Source: Oryxskioenpok.

However, a word of caution is likewise in order regarding this approach. Most videos of tanks destroyed by UAVs are only the culmination of longer tactical sequences in which the UAV's role varies. During the first two years of the conflict, a large proportion of tanks and armored vehicles were merely "finished off" by UAVs to render them unusable by the enemy. These UAVs were more "scavengers" than "hunters". In fact, a significant proportion of tanks and armored vehicles considered lost by observers were recovered and subsequently repaired and returned to the front or reused for spare parts. The interviews conducted as part of this study did not provide reliable data, but most of the respondents estimated that one-third to one-half of damaged tanks were recovered and reused in one way or another. Tanks are more resistant than lighter platforms and are therefore easier to repair when damaged.[27]

A significant proportion of the tanks considered destroyed by UAVs had in fact been abandoned by their crews after being immobilized by mines, artillery fire, or internal technical problems. Thus, while the proportion of tanks considered destroyed by UAVs has steadily increased over the years, reaching 50% in 2025, UAVs are rarely entirely responsible for eliminating tanks.[28] By comparison, Ukrainian data from 2014 already showed that tank-

27. Interviews conducted with European and Ukrainian military and civilian actors, spring-summer 2025.
28. Ibid.

on-tank combat accounted for only 15% of losses, compared with 45% due to artillery, 17% due to enemy infantry, and 13% due to mines. A similar distribution was observed in early 2022, before UAVs began to play an increasingly significant role.[29]

The destruction of one tank by another tank has been and remains an exception, accounting for perhaps 5% of losses during the conflict in Ukraine. Despite the number of tanks deployed, direct tank encounters remain rare; other, more common weapons play a more important role in anti-tank missions. Anti-tank missiles, such as the Javelin, are particularly important, but their effectiveness has been declining because Russian crews have found a number of ways to counter them. Cages or coatings that limit infrared radiation are now common, significantly reducing the usefulness of modern anti-tank missiles by disrupting their target lock-on. Apart from UAVs, tanks, and specialized missiles, most tank losses at the start of the conflict were due to mines and conventional artillery, used intensively and often in combination: mines immobilize, artillery destroys. UAVs have been integrated into these combinations to increase their effectiveness. Their widespread use has produced spectacular results and first-rate video footage to prove it. Nevertheless, destroying a tank with UAVs alone requires a large number of them—more than 50 in some documented cases, particularly when facing "turtle tanks", which are completely covered with various protective structures.[30] It is the tank's ability to evolve that has allowed it to continually adapt to the drone threat with some success, whereas lighter and less capable platforms, such as infantry fighting vehicles, suffer even greater losses. A Ukrainian soldier interviewed for this study stated that while tanks may be obsolete because they are vulnerable to UAVs, infantrymen are just as vulnerable, if not more so.[31]

An alternative approach to obsolescence focuses on usefulness and suitability for specific missions rather than vulnerability alone. As long as the tank performs its missions better than any other system, it remains relevant on a battlefield that is highly lethal in any case. One observation that emerges from the interviews is the tank's continuing importance in the ongoing conflict. More mobile and better protected, it remains the most surefire—or least risky—means of carrying out several critical missions in both offensive and defensive operations, even though it is less advanced than other available armored platforms. Conversely, tanks may be considered obsolete when these missions can be carried out more effectively by simpler, less expensive, or more readily available systems, such as future ground robots. The UAVs developed in Ukraine over the past four years can fulfill many missions, but on their own, they cannot combine the mobility, survivability, and firepower

29. "Évolution de l'arme blindée durant la guerre en Ukraine en 2023", Cellule RETEX de l'école de cavalerie, February 20, 2024.
30. "Everything We Know About Russian Turtle Tanks in Ukraine", *Army Recognition*, April 26, 2024.
31. Interviews conducted with European and Ukrainian military and civilian actors, spring-summer 2025.

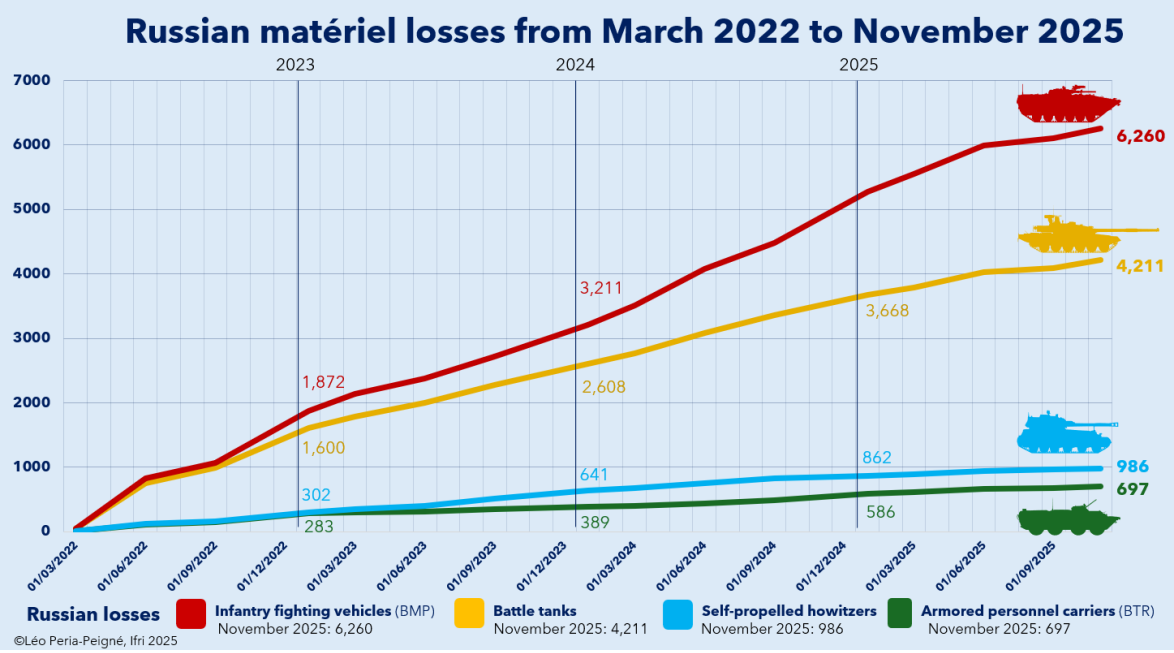
needed to carry out breakthrough, exploitation, or hardpoint reduction missions, which tanks commonly perform.[32]

The offensives carried out by both sides thus continue to rely heavily on armored units used in combined arms combat with increasing numbers of UAVs. The Ukrainian offensive in Kursk in summer 2024 combined UAV capabilities, electronic warfare, engineering, and ultimately tanks to exploit the breakthrough. The efforts by both belligerents to maintain and increase their tank fleets underscore the importance of these platforms. Ukraine has reportedly recovered more than 500 Russian tanks abandoned by their crews, including a dozen latest-generation T-90Ms.[33] Half of these have reportedly been returned to service and sent to the front, with the rest serving as a source of spare parts. Some tanks have reportedly changed sides several times in three years of war.[34]

Kyiv also continues to request tanks from its Western supporters. The delivery of 49 Australian M1 Abrams tanks in July 2025 is the latest example, and the flow of Leopard 1 tanks refurbished in Germany has not abated. As of fall 2025, however, the number of armored vehicles available to Ukrainian forces appears to be declining at an alarming rate.[35] For its part, Russia has focused on increasing its production of new tanks while bringing a growing number of stored tanks back into service.[36] While these stocks appear to have exhausted most of their potential, they have been indispensable in sustaining Russia's war effort thus far, and there was no major inflection in the rate of matériel losses before summer 2025. This dip could signify either the depletion of stocks or a Russian attempt to build up a significant reserve force for future offensives. (Mechanized assaults involving up to 20 vehicles did in fact resume in October 2025.)

32. R. Lee, "The Tank Is Not Obsolete, and Other Observations About the Future of Combat", *War on the Rocks*, September 6, 2022.
33. "Attack on Europe: Documenting Russian Equipment Losses During the Russian Invasion of Ukraine", op. cit.
34. Interviews conducted with European and Ukrainian military and civilian actors, spring-summer 2025.
35. D. Malyasov, "Ukrainian Tank Units Face Shortage of Combat-Ready Vehicles", *Defence Blog*, October 27, 2025.
36. "Attack on Europe: Documenting Russian Equipment Losses During the Russian Invasion of Ukraine", op. cit.

Figure I-2: Estimated Russian *matériel* losses from March 2022 to November 2025

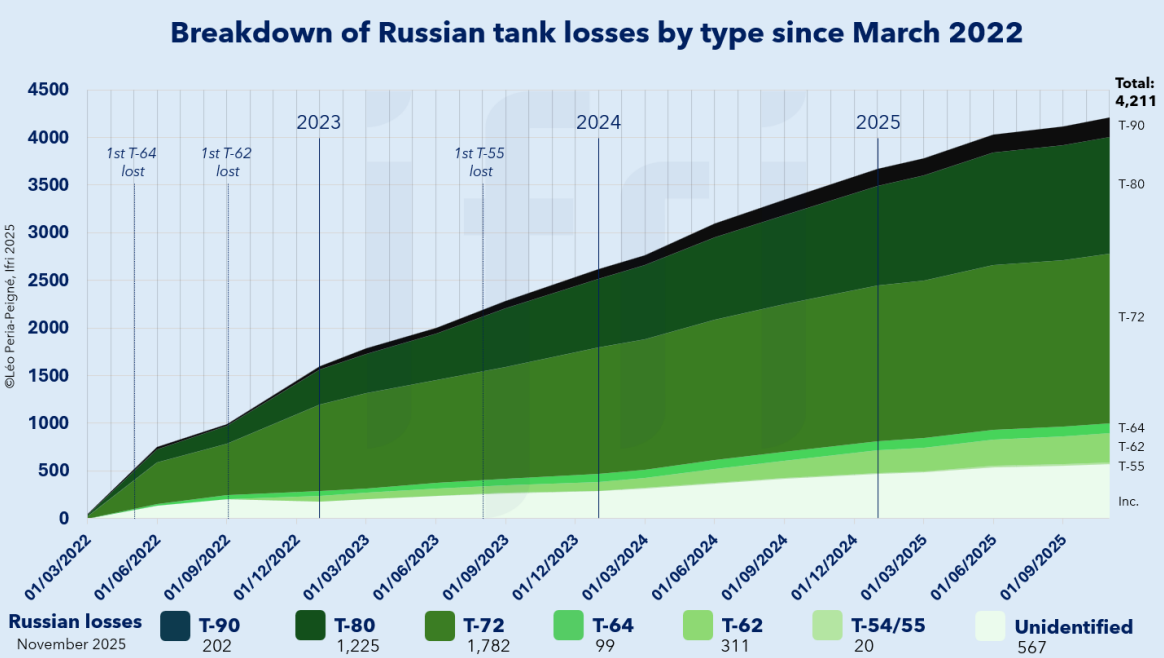


Source: Oryxspioenkop.

The analysis of Russian tank losses also provides insight into the degree of reliance on Soviet-era stocks. The Russian order of battle in 2021 consists mainly of 1,500 to 2,000 active T-72s—which entered service in 1973—400 to 500 T-80s—which entered service in 1976—and a core group of around 100 T-90s, in service since 1992. Most of the platforms are old but have undergone substantial improvements and modernization, the most advanced being the T-90M, delivered beginning in spring 2020. 800 modernized T-62s, from 1961, are also kept in active reserve in case of mobilization. Produced and developed in Soviet Ukraine, the T-64s played only a minor role in this organization and were mainly used to equip the separatist forces in the Donbas. The T-54 and T-55, which entered service in the 1950s, were, in most cases, no longer counted in the Russian order of battle, including in stock accounting.[37]

37. P. Gros and V. Tourret, "Guerre en Ukraine: Analyse militaire et perspectives", *Recherches & Documents*, No. 4, Fondation pour la recherche stratégique, 2023.

Figure I-3: Breakdown of Russian tank losses by type since March 2022



Source: Oryxspioenkop.

The first losses of T-62s, in fall 2022, indicate that the Russian army activated emergency reserves to compensate for its tank losses. A year later, the first losses of T-55s reflect a deterioration in the situation. The fact that these tanks were used as casemates or ersatz artillery reveals a more defensive Russian posture. Satellite imagery shows an acceleration in the depletion of Russian storage bases, with increasingly old and dilapidated platforms being taken out of storage to be refurbished and sent to the front.[38] Among the more modern platforms, around 10 T-90S tanks have been destroyed since January 2023, indicating that tanks produced for export have also been brought into service by the Russian army.[39]

New uses, new relevance of the tank

By introducing new weapons and tactics, the conflict in Ukraine has forced the belligerents to adapt their platforms and methods to their needs and capabilities. Tanks are no exception to this logic of adaptation, and the conflict has produced many innovations that must be considered in developing the next generation of tanks and tank crews.

38. Tweet from the account @Jonpy99 on November 6, 2025, on Russian tank production and renovation, available at: x.com/Jonpy99.
39. Tweet from the account @PolymarketIntel on January 4, 2023, on the first confirmed loss of a T-90S, available at: x.com/PolymarketIntel.

Innovation, adaptation, improvisation

Ukrainian practice

By 2014, the Ukrainian army had realized that it would be difficult, if not impossible, for it to apply the Soviet doctrine of mechanized combat in large units. The lack of training and coordination between different branches of the military, of leadership, and of available platforms or even basic tactical communications equipment made it impossible to carry out complex maneuvers. The initial successes against pro-Russian separatists were followed by significant setbacks against better-equipped Russian troops. Faced with the stalemate in the Donbas conflict, Ukraine took advantage of American, British, and Canadian support in attempting to assimilate elements of NATO doctrine. The results of this development have been mixed. Ukraine's lack of resources and air superiority has prevented it from effectively applying the new methods, but some have noted a positive influence on the training of Ukrainian crews.[40]

That said, Ukraine has used the extensive firsthand experience it gained between 2014 and 2022 to develop new practices that it has since generalized. One of the major lessons it has learned is to use tank guns for indirect fire, complementing and sometimes replacing artillery suffering from chronic ammunition shortages. This functionality, built into Soviet-era tanks, has enabled Ukraine to develop alternative expertise combining indirect firepower and high mobility in the immediate vicinity of the front. The practice of indirect fire or firing beyond direct sight was integrated into crew training and led to the development of specific ballistics calculators such as the Verba and Armor in 2016. These enable a trained and equipped crew to quickly fire up to 12 kilometers beyond direct sight. Despite not being very accurate, this technique has become indispensable for both offensive and defensive operations, particularly after these calculators were integrated into artillery command software, such as Kropyva and, after 2022, Delta. A tank squadron can now deliver a substantial explosive barrage on a fixed position or an enemy formation from a distance before quickly changing position.

The integration of observation drones began in 2015 and became widespread after the Russian invasion. From 2023 onward, the proliferation of loitering munitions, such as the Lancet, forced less-protected self-propelled howitzers to move away from the front line, further increasing the importance of the tank's indirect fire capability.[41] In particular, this capability enabled the rapid and effective reinforcement of encircled areas, such as Chernihiv, for interdiction and defense missions, providing a more durable and mobile platform than the available howitzers while still offering satisfactory firepower. It was then used not only in counteroffensives, but

40. W. Chung, "War in Ukraine Volume 5: Main Battle Tanks of Russia & Ukraine, 2014-2023", op. cit.
41. Interviews conducted with European and Ukrainian military and civilian actors, spring-summer 2025.

also in ambushes, a tactic used widely at the beginning of the conflict against overly extended Russian lines.[42]

The tank has also proved indispensable for mine clearance missions, because most other platforms are too fragile to carry the necessary modules, and specialized platforms are too rare. The stabilization of the front around fortified lines also resulted in the tank once again being used in an assault-gun and infantry fire-support role to reduce points of resistance. (The German Sturmgeschütz III and the Soviet SU-100 were used in similar capacities in the Second World War.) Once the fortified line was breached, the tank resumed its main offensive function, with many platforms, including Western ones, having been injected into the breach obtained around Kursk in August 2024.

This diverse use of the tank by the Ukrainian army has fueled criticism of modern Western platforms delivered since the end of 2022, such as the Leopard 2, the Challenger 2, and the M1A2 Abrams. Ukrainian crews appreciate the survivability of these platforms, which is far superior to that of Soviet models, but regret the fact that they are overspecialized for anti-tank combat: In particular, they lack more versatile explosive ammunition. The 30-odd American Abrams tanks were reportedly delivered by Washington with exclusively anti-tank ammunition.[43] The crux of the criticism is that tank duels remain an exception in the conflict in Ukraine and that more common weapons can deal with enemy tanks. A modern anti-tank shell, however, is of limited use outside its intended scope: It is excessive against a moderately armored vehicle and entirely useless against infantry. Tank duels, meanwhile, remain rare and account for less than 5% of tank losses in 2024.[44] Furthermore, most Western 120 mm shells are fin-stabilized, which optimizes their flight performance in direct fire but degrades their performance in indirect fire.[45]

Russian practice

In response to the losses, it suffered in the early days of the war, the Russian army has also adapted not only the use of its tanks, but also the platforms themselves. The rapid increase in the number of enemy UAVs and the delivery of large quantities of Western anti-tank missiles have led to a series of field modifications and experiments, some of which remain in place today. Russia has managed to greatly reduce the effectiveness of Javelin and other infrared-guided missiles by applying a special coating on the hottest parts of the armor and better dispersing exhaust fumes, which effectively limits radiation. Conducting operations at the beginning and end of the day, when the sun is on the horizon, has also helped deceive the guidance mode of these

42. Ibid.
43. Ibid.
44. "Évolution de l'arme blindée durant la guerre en Ukraine en 2023". Cellule RETEX de l'école de cavalerie, 20 février 2024.
45. Interviews conducted with European and Ukrainian military and civilian actors, spring-summer 2025.

missiles by forcing them to lock onto the sun, a heat source more visible than armored vehicles.[46]

The use of cages and, later, nets limited the effectiveness of UAVs and, to a lesser extent, anti-tank missiles at an early stage. This innovation was reportedly inspired by the 2020 Nagorno-Karabakh conflict, which was closely studied by the Russian army.[47] Ridiculed at the beginning of the conflict, these "cope cages" nevertheless proved so useful that they were adopted on both sides of the front line and even abroad (the Israeli army has used them in Gaza).

From April 2024 onward, the front saw the installation of spectacular variations of these cages that encompass the entire tank to allow it to cover the maximum possible distance during assaults on Ukrainian positions. The few such Russian turtle tanks that were captured were mostly older models, such as T-62s, in poor condition. The most valuable parts had been removed, and their guns were rarely operational. These damaged tanks were not worth sending far to the rear for repair, so they were converted into makeshift troop transports with improvised protection against UAVs.[48] Despite their cluttered appearance, they can be particularly resistant: More than 50 UAVs may be needed to immobilize or destroy them when more suitable weapons are unavailable. More sophisticated solutions also emerged beginning in 2025: The space gained by removing the turret has allowed tanks to be converted into genuine troop transport vehicles.[49] These jury-rigged solutions, however, do not appear to have been pursued beyond the stage of local experimentation. (Note that the Israeli army also commonly removes the turret for this purpose, both from its own tanks, such as the Merkava-derived Namer, and from captured tanks such as the Achzarit, a modified Syrian T-55 chassis.)

The development of small jammers has involved numerous attempts and prototypes, such as the Volnorez, deployed in fall 2023.[50] The rapid adaptation of Ukrainian UAVs, however, limits the relevance of these systems, which cover only a small part of the electromagnetic spectrum. (UAVs operate across an increasing number of frequencies.) Jammer models are therefore rapidly evolving to cover an ever-wider range of frequencies, but they are struggling to provide lasting protection. Fiber-optic drones, against which jammers are powerless, began appearing in large numbers in early 2025 and have only multiplied since: They already account for 15% to

46. J. Watling and N. Reynolds, "Meatgrinder: Russian Tactics in the Second Year of Its Invasion of Ukraine" op. cit.
47. P. Makowiec, "New Vision of the Land Battle: Russian Lessons Learned – Nagorno Karabakh", *Defence24*, December 29, 2021.
48. "Ukraine Captures First Turtle Tank Along with the Crew", *Defense Express*, June 17, 2024, available at: https://en.defence-ua.com.
49. D. Axe, "Russia Is So Scared of Ukrainian Drones, It's Stripping the Turrets Off Tanks", *Euromaidan Press*, September 25, 2025.
50. D. Hambling, "Russians Complain About Their Overpriced Useless Drone Jammers", *Forbes*, February 22, 2024.

20% of UAVs on the front line. These UAVs are a prime example of how quickly the drone threat can evolve and the need for conventional systems to adapt fast.

These various improvisations show that while UAVs have become a major threat to armored vehicles, this threat can be reduced by adopting appropriate practices and improvements. Indeed, only tanks have the size and adaptability required to install them.

Russian armored units also underwent a major combined arms reorganization in April 2022 to address their shortcomings in dismounted infantry and increase their effectiveness in assaults on fortified lines, which remain highly lethal. The number of tanks deployed per assault has also declined over the years because of both a lack of available platforms and internal reorganizations. They have been partially replaced by more agile and vulnerable vehicles, such as motorcycles, since mobility itself is a form of protection on a battlefield that has become more transparent. Russian assaults involving more than a handful of tanks were common between 2022 and 2023 but have since become the exception. The quality of tank crews also appears to have deteriorated with the loss of senior officers in 2022, reaching a low point around the end of 2023. Given the pace of replacement, this has been difficult to remedy.[51] This dynamic has been exacerbated by the creation or reinforcement of numerous reserve brigades, equipped with tanks drawn from increasingly old stocks. While T-55s remain rare, with fewer than 30 confirmed losses, the T-62 has become a common sight on the front. Initially distributed to the forces of the separatist republics of Donetsk and Luhansk, all Russian front-line forces are now equipped with these tanks for assault missions or as a substitute for artillery with a range of 12 kilometers.[52] One T-55 was even loaded with explosives and remotely guided toward Ukrainian lines to be used as a "suicide vehicle". (It was destroyed before it reached its target.)[53]

Given that Russia theoretically has a large number of T-55s in storage, the small number deployed raises questions. The answer may be related to the age and condition of these tanks, some of which have been in storage for over 50 years, and the difficulty of returning them to service when slightly more modern platforms, such as the T-62, along with their munitions, are also available in large quantities. Both models require a crew of four operators, unlike more recent models, such as the T-72 and T-80, which have also been removed from storage bases in large quantities and sent to factories for upgrading. Western sanctions have also had a significant impact by limiting Russia's ability to import the components needed for these

51. Interviews conducted with European and Ukrainian military and civilian actors, spring-summer 2025.
52. Tweet from the account @AndreiBtvt on September 3, 2025, available at: x.com/AndreiBtvt.
53. "Russians Creating Makeshift Suicide Tank Based on Khrushchev-Time T-54/T-55 Vehicles to Burn Them in Ukraine", *Defense Express*, June 26, 2023, available at: https://defence-ua.com.

upgrades, particularly in the areas of communications, optics, and night-vision devices.[54]

The T-90M is the most modern Russian tank and the only model still produced by the Russian industry. Production of the T-90M has been increased significantly and is expected to reach between 200 and 300 units per year. A share of the production in 2022, 2023, and 2024, however, consisted of more basic pre-production T-90A tanks that were upgraded.[55] Further increasing the production of new tanks would demand considerable investment, which, despite substantial imports of Chinese substitutes, has been impeded in particular by Western sanctions on machine tools. All other tanks leaving Russian factories are vehicles taken from storage bases or repaired after being damaged at the front. Russian industry, therefore, "produces" only a limited number of new heavy armored vehicles.

Finally, the Russian Armed Forces have also developed the use of tanks for indirect fire, a tactic already used in Chechnya but to a lesser extent than on the Ukrainian side because of the latter's lack of conventional artillery. Older platforms, such as the T-62, seem to be preferred for these missions. The use of gun-fired missiles, such as the Invar-M, has also become widespread. (The Russian army has large stocks of these missiles, but used them relatively infrequently before the start of the conflict.)[56]

Toward the next generation of tanks

Platform architecture

Field experience from Ukraine offers a wealth of information on the evolution of the tank as a platform. The plans that both sides are considering for the future of their armored forces should therefore be studied carefully.

For most of the Western platforms transferred to Ukraine, the war there is often their only experience of high-intensity combat between evenly matched opponents. This trial by fire reveals their qualities and shortcomings in the field, all of which must be considered in the context of the development of successor systems. The Leopard 2, Challenger 2, and Abrams are generally perceived by Ukrainian forces as better protected, more maneuverable, and better armed than their Soviet counterparts. The architecture of these tanks, particularly the placement of ammunition in the turret, reduces the catastrophic detonations that are more common in Soviet models. The accuracy and durability of the guns are well known, and while their weight (over 70 metric tons) imposes certain constraints, the crews appreciate the extra protection.[57]

54. G. Aleksandrov, "The Barren Barrels", *Novaya Gazeta Europe*, November 2, 2022.
55. Conflict Intelligence Team, "How Many T-90M Tanks Does Russia Produce?", *CIT Research*, June 19, 2025, available at: https://notes.citeam.org.
56. W. Chung, "War in Ukraine Volume 5: Main Battle Tanks of Russia & Ukraine, 2014-2023", op. cit.
57. Interviews conducted with European and Ukrainian military and civilian actors, spring-summer 2025.

However, these advantages come at the price of far greater complexity, which, because of the lack of suitable infrastructure, makes field repairs almost impossible. This is compounded by the very small number (rarely more than 50) of tanks delivered, which has obliged the Ukrainian forces to spread their training efforts across a number of unfamiliar and complex platforms. Even behind the lines, it remains difficult to maintain these machines: Not only is the supply of spare parts unreliable, but the documentation needed for advanced maintenance is also rarely provided by the relevant manufacturers, who are worried about protecting their intellectual property. As noted above, the overspecialization of Western platforms for the anti-tank mission is also proving problematic. The tail fins on modern 120 mm shells improve their performance in direct fire but make their trajectory less predictable, making them less accurate and less useful. On the other hand, the older Leopard 1, more than 100 of which have been delivered, is quite popular: It is easy to understand and maintain and can be easily modified in the field (with modules, reactive armor, etc.). Its 105 mm gun, supplied with high-explosive shells and not just anti-tank shells, is also appreciated for its accuracy in direct fire and its ability to conduct adequate indirect fire.[58]

A considerable amount of discussion is taking place in Russia about the future of the tank, its architecture, and its use. Russian military thinkers, far from considering the abandonment of the tank, are instead entertaining at times extreme concepts. The T-14 Armata, unveiled in 2015, which emphasized crew protection, was a radical departure from the Russian tank architecture of the past. It was probably too complex and costly, especially for a Russian industry under sanctions, and does not appear to have entered production a decade later. National production lines appear to be focused on refurbishing older tanks for front-line needs. The resumption of new T-80 production, also under consideration, is regularly discussed.[59]

Russian planners are even considering moving away from the versatile "main battle tank" concept in favor of more specialized versions, such as an assault gun equipped with specialized short- and medium-range weaponry and heavy passive and active protection for assaulting fortified lines. In late July 2025, a series of videos was made public that showed tests of a new armored vehicle based on the T-72 chassis and equipped with a shortened gun, presumably intended for support missions.[60] According to a team of researchers from the Omsk Armored Vehicle Engineering Institute, this platform could be complemented by another, more versatile platform equipped with a 152 mm gun capable of direct and indirect fire as needed. Outside of major offensive operations, the challenge would be to improve the range of the weaponry through indirect fire and the use of guided

58. Ibid.
59. L. Lagneau, "La Russie envisage de relancer la production du char T-80, conçu durant la période soviétique", *Zone Militaire*, September 11, 2023.
60. Tweet from the account @Volke_ on July 27, 2025, available at: x.com/Volke.

ammunition or missiles in order to remain at a distance from a front line saturated with UAVs.[61]

In the field of system architecture, some observers believe that armored protection has been maximized and that any further gains in survivability from additional armor are not worth the added weight and reduced mobility. Equalizing the armor across the entire vehicle, however, is being considered; doing so would erase the distinction between the heavily armored glacis plate and the other sides of the tank. The tank roof itself could have the same armor thickness as the glacis plate to provide greater protection against aerial threats, such as UAVs. Other solutions to increase protection need to be explored, such as more intensive and automated use of multispectral smoke grenades, which can blind cameras and thermal sights. The use of fully automated active protection that can autonomously handle threats at very short range is also being considered, including against peripheral threats such as enemy infantry. This represents a significant evolution from current active protection systems such as Trophy, which is designed to intercept incoming projectiles.[62]

The quest to better assess the tactical situation is a recurring theme in Russian and Ukrainian thinking. Information superiority remains an objective in its own right because it enables a high degree of automation in responses to detected threats. Detecting the enemy first remains one of the best guarantees of success and survival. The integration of tethered UAVs connected to the tank that can be used as "periscopes" for the crew has already been tested, particularly to speed up indirect fire.[63]

With threats multiplying, it is becoming ever more vital to automate threat detection and neutralization within a radius of one to two kilometers. Nevertheless, Russia continues to view robotization and automation with reluctance. Russian industry is considered too immature to produce a "war-ready" robotic system. Experiments with small Uran-type robotic tanks in Syria have disappointed,[64] and they have not been deployed in Ukraine despite officially entering service in 2019 and the announcement, in 2021, of the creation of a fully robotic unit. Reducing the crew to fewer than three members is also viewed negatively: Any increase in platform autonomy to compensate for the reduction in crew size would require larger and better-qualified maintenance teams, a major obstacle for Russia's already struggling military human resources. Other innovations, such as hybrid engines, have

61. P. A. Prozorov et al., "Trends in the Main Properties of National Tanks", Armament and Military Equipment, Omsk Armored Vehicle Engineering Institute, No. 3, 2024.
62. A. Lesin, "Chars du futur", *Pensée Militaire*, No. 9, 2023.
63. Interviews conducted with European and Ukrainian military and civilian actors, spring-summer 2025.
64. "Strong Failures of Russian Uran-9 Unmanned Ground Vehicle in Syria", *Army Recognition*, July 10, 2018.

also been shelved for the next decade because Russian industry lacks the requisite capabilities.[65]

Evolution of use

Just as the architecture of tanks is expected to evolve, Ukrainian battlefield experience must also inform their use in the future. The importance of combined arms coordination—a common refrain in most modern conflicts—has been emphasized repeatedly since February 2022. Tanks are an asset only if they are integrated into maneuvers that involve other elements; these must, moreover, increasingly incorporate UAVs both as a threat and as a force multiplier. Until they can perform the same missions, UAVs will not be a replacement for tanks. Like mines in their day, however, UAVs complicate the use of tanks by increasing battlefield transparency. (Complete transparency, however, is not possible.) Jamming, terrain conditions, and weather can all be taken advantage of to pursue maneuvers, including armored maneuvers, but they also make them more complex.[66] Given that the target time of UAVs has been reduced to under 10 minutes in clear weather, maneuvers must further limit static periods. The tactical situation in Ukraine, centered on a war of position that UAV use has made more transparent, should not be the sole reference point for theorizing tank use. A return to a war of movement, as seen in Kursk, remains possible and presents a range of opportunities for more ambitious armored maneuvers.

Indirect fire is another method of limiting the UAV threat by moving tanks away from the front line and from a drone-ridden no man's land. The threat cannot be eliminated, but gaining a few kilometers does reduce it, since most of the most common UAVs have a range of less than five kilometers. This capability, which was done away with entirely on the latest generation of Western tanks, is now considered indispensable by the Ukrainian forces. According to some interviews, a vehicle loses much of its operational usefulness when armed with a large-caliber gun that cannot deliver satisfactory indirect fire.[67]

The rapid development of fiber-optic drones further complicates the situation. They cannot be jammed, so they must be identified, intercepted, and destroyed in flight to prevent unacceptable losses.[68] Anti-UAV modules that combine guns and radar (and sometimes short-range missiles) are likely to become essential for even the smallest units. The success in Ukraine of German Gepard anti-aircraft tanks, which were originally designed to combat Soviet helicopters and attack aircraft, is one example of the return of

65. L. Lagneau, "Le ministère russe de la Défense annonce la création d'une unité entièrement robotisée", *Zone Militaire*, April 12, 2021.
66. P. Néron-Bancel, "'De l'autre côté de la colline' Atouts et fausses promesses de la transparence du champ de Bataille", *Focus stratégique*, n° 118, Ifri, May 2024.
67. Interviews conducted with European and Ukrainian military and civilian actors, spring-summer 2025.
68. J. Watling and J. Bronk, "Protecting the Force from Uncrewed Aerial Systems", *Occasional Papers*, Royal United Services Institute, October 15, 2024.

systems that had been considered obsolete since the 2000s and which were withdrawn en masse from Western fleets. The €6-8 billion that the German Army is expected to invest in 2025 to purchase 500 Skyranger anti-UAV turrets is therefore not just a rational investment, but a necessary one.[69] Placed on tracked escort platforms, these modules could provide denser last-line anti-UAV protection for an armored squadron while being versatile enough to provide support against ground targets. The use of such systems to protect command posts and even civilian infrastructure increasingly appears vital as well.

The conflict in Ukraine has foregrounded the tank's adaptability and its continuing relevance for various missions in spite of its vulnerability. Practices, on the other hand, have changed profoundly. Cold War doctrines have been invalidated, and the belligerents have returned to tactics reminiscent of 1917, when tanks were first employed as assault artillery and infantry support. Brief periods of mobile warfare have also seen the more traditional use of tanks as a tool for exploiting a breakthrough, a mission that remains essential. Anti-tank missions have proved rare; these are preferably conducted by other means, with UAVs playing an increasingly important role. The ever-present drone threat is also leading to significant changes in tank usage, with the widespread use of indirect fire to increase range and survivability being the most notable. All these developments are being closely monitored by Western armies, which have undergone a radical shift in recent years and are reinvesting heavily in a capability that, since the 1990s, they had often neglected or even abandoned for want of demand.

69. "Rheinmetall Expects €6-8 Billion Bundeswehr Order for Skyranger Air Defence Systems by Year-End", *Defence Industry Europe*, August 9, 2025, available at: https://defence-industry.eu.

Massive European reinvestment

After three decades of hesitation, underinvestment, and even abandonment by some European armies, such as those of the Netherlands and Belgium, the conflict in Ukraine has led to massive military reinvestment on the continent, with heavy armor among the main beneficiaries. Modernization programs that had long been in the works have been launched at a rapid pace, and European tank fleets are growing at rates not seen since the 1970s. Whether this trend will continue remains to be seen, but the dynamics of the European battle tank market are changing significantly as a result of both Germany's desire for dominance and of aggressive competition from non-European suppliers.

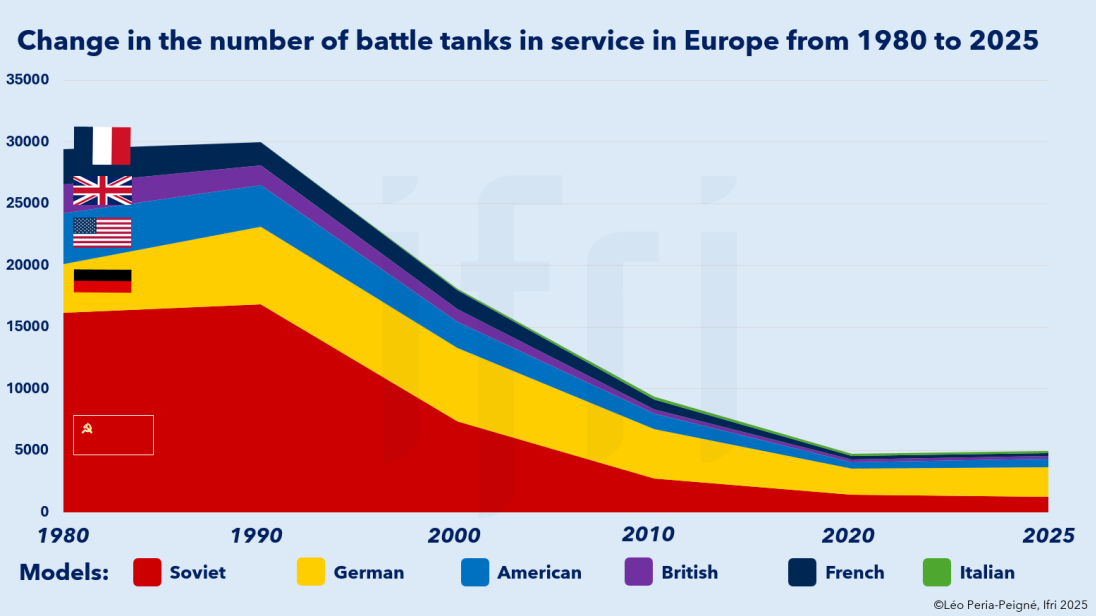
A European fleet in continuous decline since 1990

A fragmented and aging fleet

The end of the Cold War led to a massive reduction in the number of tanks in Europe. Having grown steadily on both sides of the Iron Curtain since the 1960s, the European tank fleet peaked at nearly 30,000 units in the late 1980s, before falling to just under 5,000 by the end of the 2010s. This trend was reinforced by the withdrawal of Soviet forces from Central and Eastern Europe. The Treaty on Conventional Armed Forces in Europe (1990) confirmed a significant voluntary reduction in the number of tanks in Europe. The tanks withdrawn from service supplied a thriving surplus market—a trend that greatly benefited the Leopard 2—while new programs lowered their acquisition targets. The design phase of the French Leclerc, launched in 1978, was completed in 1990, just as the initial target of 1,400 units was reduced to 400. This significant cut was only very partially offset by a 1993 deal to export 400 additional units to the United Arab Emirates, and it resulted in an increase of more than 20% in the unit price, which had initially been projected to cover the development costs over a larger number of tanks.[70]

70. "Projet de loi de finances pour 2005: Exposé d'ensemble et dépenses en capital", French Senate, November 25, 2004, available at: www.senat.fr.

Figure II-1: Change in the number of battle tanks in Europe between 1980 and 2025 by country of production



Source: Military Balance, IISS.

The composition of the European fleet is also undergoing profound changes. The proportion of Soviet-designed tanks in the continent's fleet has fallen from 55% in 1990 to 25% in 2024. This decline is expected to continue as a result of massive transfers to Ukraine and the replacement of these tanks by platforms from other sources. German suppliers in particular are benefiting from this shift: The share of Leopard 1 and 2 tanks in the European fleet has climbed from around 10% in 1980 to nearly 50% in 2024.

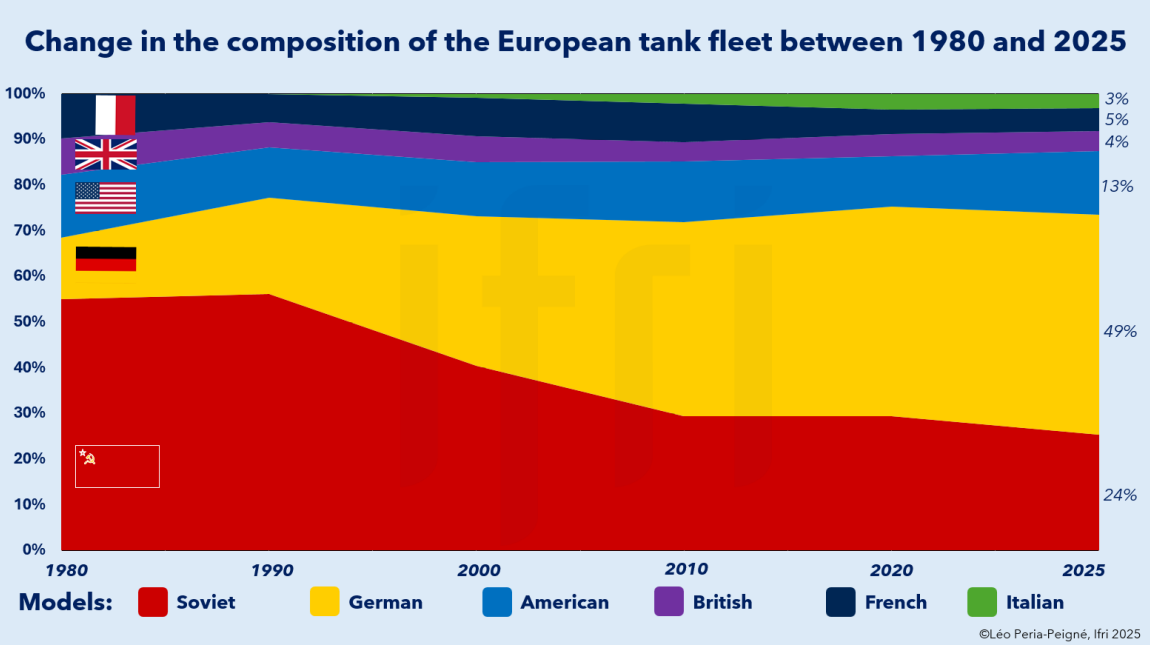
The high availability of surplus vehicles, continuous modernization, adaptation to customer requirements, and availability of spare parts have all helped establish a dominant "Leopard club" on the continent. The proportion of French- and British-designed tanks, on the other hand, has steadily declined. The Leclerc and Challenger 2 have failed to replicate the commercial success of their predecessors, such as the AMX-30 and Centurion. The fact that a significant and constant proportion of American platforms has been maintained must be qualified. Until Poland's acquisition of some 360 M1-Abrams tanks, American tanks were represented in European inventories only by obsolete platforms from the previous generation and were usually relegated to long-term storage or used as targets during exercises.

In addition, shrinking defense budgets and the rarity of actual European battle tank deployments—amid a rise in overseas stabilization operations—led to a loss of interest in these platforms among many of the continent's armies, particularly in Western Europe. Some have made the radical decision to abandon this capability entirely, deeming it too costly given its limited utility. Accordingly, the Netherlands eliminated its battle tanks in 2011, and Belgium

followed suit in 2014. Across the Atlantic, Canada prepared to take similar action in the early 2000s by transforming its army into a light, expeditionary force, only to urgently reverse that decision to meet the demands of the conflict in Afghanistan.

For nations that chose to retain but reduce these capabilities, the development of new versions has been slower and focused on emerging asymmetric conflicts. In 2004, France developed an Urban Action Kit (AZUR) for the Leclerc, while Germany produced a similar upgrade in 2006 with the Leopard 2 PSO (Peace Support Operations), adapted for urban combat. These kits usually include optimized armor, a secondary weapon system with a wide range of elevation for engaging targets positioned high up, and enhanced active protection. Although most of these configurations have not seen active service, the objective at the time was to adapt platforms designed for high-intensity warfare to other types of combat.

Figure II-2: Change in the origin of combat tank fleets in Europe between 1980 and 2025 in percentage terms



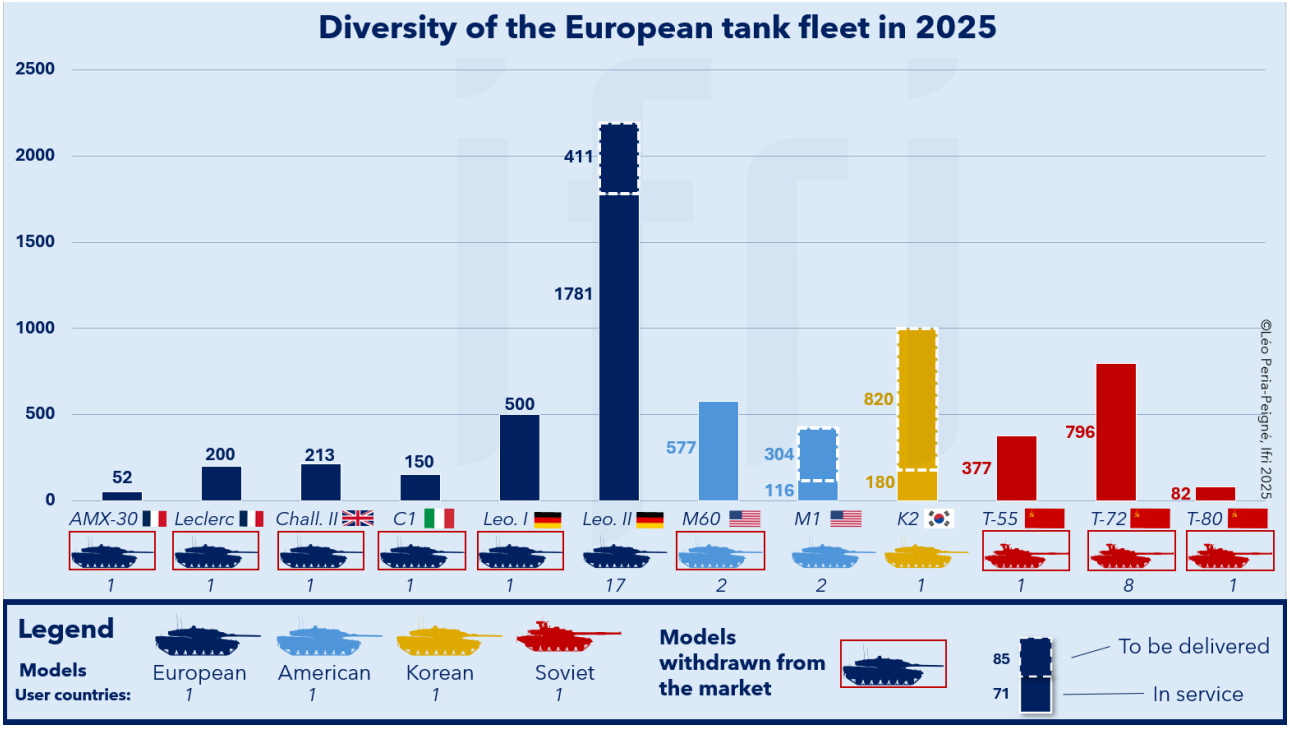
Source: Military Balance, IISS.

However, certain exaggerated claims have found their way into official documents and must be challenged. A 2013 study by the consulting firm McKinsey & Company, cited by the Munich Security Conference (MSC), suggested that European armies operated 14 different tank models, along with 19 infantry fighting vehicles and 15 self-propelled artillery models.[71] Frequently cited in the media, these figures also appear in subsequent MSC documents, particularly a 2016 report that presented even higher figures:

71. "The Future of European Defence: Tackling the Productivity Challenge", McKinsey & Company, 2013, p. 14, available at: www.mckinsey.com.

17 tank models, 20 infantry fighting vehicles, and 27 self-propelled artillery models—an unaccounted-for increase. This data is often used to support the unfavorable comparison with the American model, which is presented as being based on only one or two models.[72]

Figure II-3: Diversity of the European tank fleet in 2025



Source: Military Balance.

This data must be significantly qualified to reflect reality. The only credible explanation for such excessive figures is that McKinsey aggregated not only different tank models but also their variants, provided the variants possessed a different name. The Swedish Leopard 2, known as the Stridsvagn 122, and the PT-91 (the Polish version of the Soviet T-72) appear to have been counted as separate models, a trend further amplified by the 2016 figures. A more balanced assessment of the situation is therefore necessary. Furthermore, these 17 models are treated as equivalent, with no distinction made between generations or their proportion within the European fleet.

Figure II-3 provides a more nuanced overview of the fleet's status in 2024. While 12 tank models coexist in European inventories, they do not all hold the same significance. Some Cold War platforms, such as the AMX-30 and the T-80, are present in fewer than a hundred units, and are in varying states of readiness. The German Leopard 1 and American M48 tanks, developed in the 1960s, represent a more substantial volume but are primarily long-term stocks, particularly in Greece, where their operational relevance is very limited

72. "More European, More Connected and More Capable: Building the European Armed Forces of the Future", Munich Security Conference, 2017, p. 13, available at: https://securityconference.org.

due to a lack of modernization. They are expected to be phased out in the medium term. The fleets of Soviet platforms—the T-55, T-72, and T-80 and their many derivatives—are steadily dwindling because of transfers to Ukraine and replacements. Although more modern, the trio of indigenous tanks—the Leclerc, the Challenger 2, and the Ariete—are no longer in production, and their numbers will inevitably decline over time. In reality, the future of the European fleet appears to be consolidating around the only three platforms currently in production: the Leopard 2, from Germany; the M1 Abrams, from the United States; and the K2, from South Korea.

Table II-1: The state of the European tank fleet

Type of tank	Origin	Year put into service	Number in fleet in 2024	Status
AMX-30	France	1966	<50	Short-term replacement
Leclerc	France	1993	200	Medium-term replacement/Modernization
Challenger 2	United Kingdom	1998	213	Medium-term replacement/Partial modernization
C1	Italy	1995	150	Medium-term replacement/Partial modernization
Leopard 1	Germany	1965	500 (in storage)	In long-term storage
Leopard 2	Germany	1979	>2,000	In production/Modernization
M48/M60	United States	1953	>500	In long-term storage
M1 Abrams	United States	1981	>200	In production
K2	South Korea	2014	>150	In production
T-55	USSR	1958	>350	Short-term replacement
T-72/PT-91	USSR	1973	>780	Replacement/Modernization
T-80	USSR	1976	<100	Short-term replacement

Source: Military Balance 2024, interviews.

Active since the end of the Cold War, the market for surplus heavy armored vehicles appears to be shrinking in the face of massive European reinvestment in defense. This shift currently favors a market for new vehicles dominated by German suppliers, even as various non-European options are emerging.

Toward a German monopoly on European production?

Three decades after the end of the Cold War, the European tank landscape has changed profoundly. Products from Germany's defense industrial and technological base (DITB) now occupy a dominant position and are poised to

remain the primary force in this sector for at least another decade or two. This situation is the result of three factors: the inability of other historical European producers to maintain the necessary industrial competencies, insufficient investment in capabilities deemed obsolete, and a lack of exports. At the turn of the twenty-first century, however, the European market featured four modern platforms developed on the continent: the British Challenger 2, the Italian C1 Ariete, the French Leclerc, and the German Leopard 2. Twenty years later, this range of options has severely contracted. The United Kingdom and Italy can no longer be considered independent players in the field of tank production, while France's capabilities in this area are uncertain.

The United Kingdom and Italy: historical players now on the sidelines

The United Kingdom was long a major European player in this segment. British industry produced several highly regarded battle tank models, such as the Centurion, which entered service in 1945, and the Chieftain, which entered service in 1966. More than 2,000 of these tanks were produced and exported to more than 10 countries. However, this momentum stalled with the Challenger 1: only 420 units were produced, and it was exported only to Jordan. Furthermore, studies to develop or acquire a successor began in 1986, just three years after the Challenger 1 entered service.

The Challenger 2 epitomizes this decline in British tank design. Ordered in 1991 and delivered through 2002, just 38 units were exported (to Oman). From the outset, the Challenger 2 was an outlier, as British design choices clashed with NATO standards, particularly regarding armament: The decision to use a 120 mm rifled gun made it incompatible with contemporary Western platforms, which use a similar caliber but a smoothbore gun. Operations in Iraq led to substantial improvements in armor, though at the cost of increasing the vehicle's weight to nearly 75 metric tons in combat weight, which is problematic for a platform already considered underpowered. This represents the only significant upgrade to a vehicle with a shrinking fleet. Of the 407 units delivered, only 227 remained in service in 2022, in line with British capability plans established in the 2010 *Strategic Defence and Security Review*.[73]

Ultimately, only 148 units will be upgraded to the Challenger 3 configuration announced in 2021.[74] This development confirms the success of German industry in the heavy armor sector, as Rheinmetall, in partnership with BAE Systems, is leading this major modernization program. With a budget of €1.85 billion, the CR3 program also confirms the "standardization"

73. "Securing Britain in an Age of Uncertainty: The Strategic Defence and Security Review", Ministry of Defence of the United Kingdom, 2010, available at: https://assets.publishing.service.gov.uk.
74. A. Chuter, "Britain Awards $1 Billion Contract to Upgrade Challenger 2 Tanks", *Defense News*, May 7, 2021.

of British armored vehicles, as the original gun is being replaced by a smoothbore model—similar to that of the Leopard 2—housed in a redesigned turret. Other improvements are expected to include active protection, sensors, and engines. While the total number of upgraded vehicles could be increased, if necessary, British independence in tank design appears compromised, and the Challenger 3 is not expected to be replaced for several decades.[75]

The Italian context is very different. After the Second World War, Italy stopped developing its own tanks and opted instead to procure American and German models such as the M48 and the Leopard 1. However, the requirement to replace these fleets presented an opportunity to develop a domestic solution. An ambitious program launched in 1984 consolidated several major players in the Italian DITB, including IVECO for the engine and OTO Breda for the armament. The C1 Ariete entered service in 1995, but production ended in 2002, after only 200 units, due to a lack of export orders. While it shares architectural similarities with the Challenger 2 and Leopard 2, its design is almost entirely Italian. Though considered modern in the early 1990s, the Ariete suffers from low ammunition capacity and insufficient power. These deficiencies were exacerbated by the addition of supplemental armor after 2004 to meet the requirements of operations in Iraq.

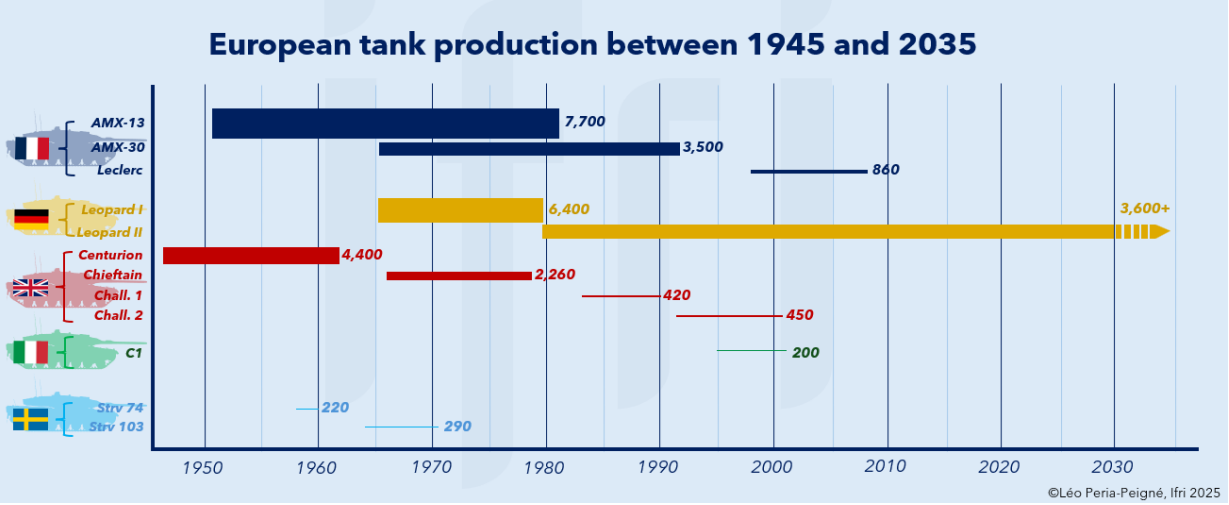
Although envisioned as early as 2005, the modernization of the C1 was repeatedly postponed due to budgetary constraints and was not launched until 2022. Valued at nearly €850 million, this contract with the Italian DITB covers a comprehensive upgrade of the vehicle—particularly its engine and optics—with initial deliveries scheduled for mid-2025. However, only 125 vehicles are expected to be upgraded to the C2 configuration, with an option for additional units, as Italy seeks long-term solutions for its armored fleet.[76]

KNDS Deutschland's Leopard 2A8 has been seriously considered as a replacement for the C1 since the early 2020s. However, negotiations ended abruptly in June 2024, following a disagreement over the extensive integration of Italian components into the German platform. This failure paved the way for Rheinmetall, which proved more accommodating on this issue. In early 2025, Italy announced a comprehensive modernization of its armored forces, extending beyond main battle tanks. The Italian Army is expected to acquire, in close cooperation with Rheinmetall, 132 tanks and 248 support variants based on the KF51 chassis, as well as 1,000 tracked infantry fighting vehicles based on another Rheinmetall product, the KF41 (which Hungary has already ordered and is currently manufacturing). The entire program, including significant industrial offsets and extensive adaptation of the vehicles for Italian requirements, is projected to cost nearly $16 billion over more than a decade.[77]

75. Y. Boivin, "Le Challenger 3 dévoilé", Blablachar, January 24, 2024.
76. Y. Boivin, "Modernisation italienne", Blablachar, November 10, 2023.
77. Y. Boivin, "Como se dice segment de decision in italiano?", Blablachar, February 4, 2025.

Announced in October 2024, a joint venture between Leonardo and Rheinmetall will execute 60% of production in Italy. Leonardo will integrate its proprietary 120 mm gun on 82 of the 132 future tanks, while the remainder will be equipped with the German 120 mm gun. Backed by a robust order book, this new German-Italian entity could become a major player in the European tank market in the coming years—a prospect that has raised concerns among established competitors such as KNDS. Furthermore, these announcements coincide with Italy's rapid and ambitious rearmament across the land, air, and naval domains, which could substantially increase Rome's influence in European military affairs. Finally, the failure of KNDS Deutschland and the success of Rheinmetall confirm the latter's dominant position in the European land sector, reinforcing the trend established by the British case.

Figure II-4: European tank production numbers since 1945



Source: Military Balance, IISS.

Germany's success

With London and Rome choosing to join forces with Berlin, the number of independent players in the European tank market has fallen from four to two. The French case will be examined below, but the success of German industry is well established. The Leopard 1 and 2 already account for a considerable proportion of the European fleet in service, a trend that will be further reinforced in the short and medium term by the gradual withdrawal of Soviet platforms and the modernization of arsenals.

Germany's success in this area results from numerous factors, but a few salient points deserve to be mentioned.

- **An already large customer base**—the Leopard 1's success having paved the way for its successor—gave Germany an advantage that France failed to replicate when switching from the AMX-30 to the Leclerc. In addition, the creation of user communities, genuine Leopard 1 and 2 "clubs", allows pooled feedback over time, facilitating

the establishment of new standards. The development of the Leopard 2A7 is largely based on the Canadian experience in Afghanistan.

- **Incremental improvement.** The continuous incremental improvement of German tanks by Krauss-Maffei Wegmann (KMW) and Rheinmetall has maintained the fleet at a high performance level for a platform over 40 years old. This approach has prevented significant obsolescence, unlike the Leclerc, Ariete, and Challenger, which have received only limited upgrades. Consequently, throughout the progression of the standard from Leopard 2A1 to 2A8, dozens of adapted variants have been developed and produced.
- **Commercial adaptation.** This adaptability extends to the export market, with nearly every customer procuring a "national" variant of the Leopard 2. As a result, approximately 40 national configurations across various standards coexist in service, with differences ranging from the simple integration of domestic subsystems to extensive architectural redesigns. This tailored configuration applies to both newly manufactured and surplus vehicles: For example, Canadian Leopard 2s acquired from the Netherlands underwent modifications designated as Leopard 2A4CAN and 2A6CAN.
- **Uninterrupted production.** Export success is a decisive factor in the platform's longevity because active production lines facilitate upgrades, adaptations, and obsolescence management. This also allows for rapid adjustment of production rates in response to shifting demand—particularly during crises like the war in Ukraine, which drive procurement. Conversely, resuming production of French, British, and Italian indigenous models less than a decade after line closures would be impossible, or would require such significant investment that developing or acquiring a new platform would be faster or more cost-effective. Over the long term, production volume also generates significant economies of scale, creating a virtuous cycle.
- **Capitalizing on storage and surplus equipment.** While the market for new tanks collapsed following the Cold War, the German DITB adapted by developing capabilities for long-term storage and maintenance. Because delivering existing, refurbished units is faster than manufacturing new ones, these stocks enabled effective participation in the surplus market, which became highly active in the 1990s due to Western force reductions. This culture of stockpiling and upgrading, cultivated over 30 years, allowed the German DITB to respond rapidly to Ukrainian requirements by supplying dozens of Leopard 1 and 2 tanks from various European donors within just a few months.

- **Constant political and military support.** Unlike other European armies, the German military never considered abandoning the tank, as it remains a source of national pride and a profitable industrial and fiscal asset for the government. The platform has consistently benefited from the necessary funding and investment for development and improvement, particularly because Rheinmetall and KMW enjoy strong parliamentary support due to the high volume of skilled jobs they provide across the country.[78]

Figure II-5: The Leopard club in Europe in 2025

Source: Military Balance 2024.

While these factors are not unique to the German DITB, they help explain the commercial success of German tanks over at least the past 30 years. This success has enabled KNDS Deutschland and Rheinmetall to be the main beneficiaries of massive European reinvestment in heavy armor.

Toward a renewed focus on heavy armor in Europe

Modernization and expansion of the European fleet

While the observation that tanks are "dead" in Ukraine has resonated with public opinion, European armies clearly do not share this view and have begun reinvesting heavily in this segment. The transfer of a large number of

78. Interviews conducted with European and Ukrainian military and civilian actors, spring-summer 2025.

Soviet-era tanks to Ukraine has opened up a yawning capability gap in Europe, while the trend toward European rearmament generates ample opportunities for the purchase or modernization of existing fleets. The table below lists the main acquisition and modernization announcements made since the start of the conflict in Ukraine.

Table II-2: Major modernization and tank acquisition programs in Europe

Country concerned	Date	Objective
Austria	2023	Modernization to Leo. 2A7 standard
Czech Republic	2023	Planned acquisition of 61 Leo. 2A7s (+16 option)
Czech Republic	2023	Delivery of 42 Leo. 2A4s under the Ringtausch program
Denmark	2023	Modernization of the Leo. 2A7N?
Germany	2023-2024	123 Leo. 2A8s ordered
Netherlands	2024	Acquisition of 46 Leo. 2A8s
Norway	2023	Acquisition of 54 Leo. 2A8s
Slovenia	2022	Receipt of 15 Leo. 2A4s under the Ringtausch program
Sweden	2025	Acquisition of 44 Leo. 2A8s
Sweden	2023	Modernization of fleet
Lithuania	2023	Acquisition of 44 Leo. 2A8s
Croatia	2024	Planned acquisition of x Leo. 2A8s
Spain	2025	Acquisition of Leo. 2A8s
Italy	2025	Acquisition of 200+ MBTs
Romania	2023	Acquisition of 54 M1A2 Abrams
Poland	2023/2024	Acquisition of 366 M1A1 and M1A2 Abrams
Poland	2022	Acquisition of 180 K2s (820 additional tanks optional)

Sources: Media, interviews.

Some of the contracts listed in the table above also involve significant industrial offsets. The acquisition of 54 Leopard 2A8 tanks, for example, includes producing 37 of the 54 vehicles in Norway and opening a dedicated industrial site for the maintenance of the Scandinavian Leopard 2 fleets.[79]

The table above covers only programs finalized or committed to in concrete terms. However, other announcements and prospects should be mentioned to illustrate the scale of the changes to come. Berlin's

79. W. Geiger, "Norwegen baut Produktionsstätte für Kampfpanzer *Leopard* 2 auf", *Hartpunkt*, June 11, 2024.

announcement in 2023 that it would acquire 123 Leopard 2A8 tanks may be only the prelude to a more ambitious plan. In early July 2025, Bloomberg reported that Berlin was preparing to invest up to €25 billion to acquire capabilities aligned with the NATO capability plans decided a month earlier. The aim would be to equip the German Army with 1,000 modern tanks and nearly 2,500 armored vehicles by 2035. If realized, this plan would enable Germany to field seven new armored and mechanized brigades, bringing Berlin to an inventory level similar to that envisioned by Poland for its own forces.[80] Although much more modest in its ambitions than its northern neighbor, Austria is also moving toward acquiring around 60 Leopard 2A8s to modernize its armored corps, after deciding, in 2023, to upgrade its existing fleet of 58 Leopard 2A4s to the 2A7 standard.[81]

Another major operator of the Leopard 2, Spain is gradually modernizing its land forces through the Fuerza 35 program. After a prolonged period of silence regarding its tank fleet, Madrid also appears to be moving toward acquiring an as-yet-unknown number of Leopard 2A8s to replace the 80 Leopard 2A4s, 30 of which have been transferred or pledged to Ukraine. Madrid also has more than 200 Leopard 2Es, acquired in the early 2000s.[82]

Other actors seem hesitant to invest in their heavy armored vehicle fleets. The condition of Canada's fleet raises questions about its short-term viability: Fewer than 20% of the vehicles appear to be in working order. After operations in Afghanistan, the Canadian fleet did not receive the necessary maintenance, which explains its current condition.[83] Greece, whose official tank inventory reportedly exceeds 500 units—primarily obsolete M60s and Leopard 1s in storage—is also expected to announce a substantial plan to modernize its aging platforms and acquire new heavy armor. Although rumors circulated in 2023 regarding the acquisition of Leopard 2A7s, there is no indication that this has materialized.[84] Switzerland, another long-standing Leopard operator, has announced no significant investments beyond a limited modernization of the 134 units currently in service. However, a group of officers has criticized the lack of resources available to sustain the existing fleet, which has already been depleted by sales on the surplus market.[85]

80. M. Nienaber, "Germany Prepares €25 Billion Tank Order to Boost NATO Forces", *Bloomberg*, July 4, 2025.
81. G. Heiming, "Austria Is Modernizing the Leopard 2A4 Main Battle Tank and the Ulan Infantry Fighting Vehicle", *Europäische Sicherheit & Technik*, February 24, 2023.
82. "El Ejército de Tierra prevé reemplazar su flota de carros Leopard 2A4 por la versión 2A8, la más moderna", *Infodefensa*, January 24, 2025.
83. A. Zivo, "How Canada Sabotaged its Own Fleet of Tanks", *National Post*, January 25, 2023.
84. P. Felstead, "Hellenic Defence Procurement Poised to Embark on New Modernisation Plan", *European Security & Defense*, April 28, 2025.
85. D. Ballmer, "Malgré un budget en hausse, les officiers de l'Armée exigent des milliards en plus!", *Blick*, May 9, 2025.

In addition to developing an indigenous tank, Turkey is working to modernize its large armor fleet and is relying on domestic solutions, even for obsolete vehicles. Beyond local upgrades, some of the 1,000 Turkish M60s (acquired from the United States in the 1990s but produced in the 1960s) could receive a locally designed modernized or even unmanned turret, which would significantly enhance their combat potential. Turkey's 355 Leopard 1s could also receive an extensive modernization package. In general, Turkish industry is highly active in upgrading legacy armored vehicles, offering costs and lead times with which other players in this sector (such as John Cockerill Defense, which also offers an unmanned turret) struggle to compete.[86]

New actors in a rapidly growing European market

By the summer of 2025, it has become clear that the German tank sector is the primary beneficiary of the surge in investment that has come after three decades of decline. The Leopard 2 and its various iterations are and will remain the most prevalent modern tank in European armies for several decades. Meanwhile, KMW is developing the Leopard 3 with Rheinmetall (which already fields the KF51), ensuring that succession planning appears secure. However, non-European actors are seeking to expand their presence in Europe to capitalize on the current market dynamics.

An American comeback?

While the American M60 accounted for a significant proportion of European armored fleets during the Cold War, its successor, the M1 Abrams, has not been as successful. Although contemporary with the Leopard 2, it failed to gain ground against effective German export strategies. Not only were the export variants of the M1 considered inferior, particularly in terms of armor, but they also came with high acquisition costs and complex maintenance. The end of the Cold War also made a large number of Leopard 2 tanks available on the surplus market, an asset the United States failed to capitalize on despite having large stocks intended for export. The American failure can also be explained by uncompetitive industrial offset packages: Washington limited offsets to orders larger than the ones European armies were placing in the 1990s. Egypt alone obtained significant industrial offsets by ordering more than 1,300 Abrams tanks.

However, the purchase of 366 M1A1 and M1A2 Abrams tanks by Poland and 54 surplus M1A2s by Romania between 2020 and 2024 is changing the landscape by introducing a new model to the European market. The Polish order responds to an urgent need to backfill its fleet after the transfer of several hundred Soviet-era tanks to Ukraine. Warsaw capitalized on a

86. K. Azman, "ROKETSAN'dan M60A3 ve T-72 tankları için MZK kulesi", *Defence Turk.net*, January 27, 2023.

competitive offer by purchasing 116 M1A1s decommissioned by the US Marine Corps, all delivered between June 2023 and June 2024. A further 250 M1A2s were then ordered in the most modern configuration. Romania's acquisition is part of a long-term recapitalization of its fleet of 300 T-55s, designed in the 1950s and modernized locally. The exact cost to Romania is undisclosed, but the US Foreign Military Sale approval published in November 2023 cited a sum of €2.37 billion—more than €40 million per vehicle, including maintenance and training. A second tender was launched in the fall of 2025 to complete this replacement, with Bucharest seeking to acquire 216 additional units and 76 support vehicles, most to be produced domestically. This competition will likely pit the Korean K2—which can generate more offsets—against the Leopard 2, made more affordable through European financing mechanisms.

South Korea and Turkey: ambitious new entrants

The recent emergence of the South Korean defense industry in Poland also represents an attractive opportunity for other European customers. In 2022, Warsaw signed a framework agreement for the acquisition of 1,000 K2 Black Panther tanks developed by Hyundai Rotem. An initial batch of 180 units will be delivered between 2022 and 2026, with the majority of subsequent batches to be manufactured in Poland. Poland has also acquired self-propelled howitzers and rocket launchers from Seoul, giving the Korean DITB a firm foothold in Europe from which to offer its products to partners seeking an alternative to Berlin and Washington.

While both the American and Korean DITBs offer modern tanks, Turkey could be the next candidate to enter this booming market. Having pursued autonomy for more than 50 years, Ankara is now taking the final steps toward its goal, with projects for a heavy tank, combat aircraft, and a national submarine. Designated the T1 Altay, the Turkish tank began development in 2007 and has since experienced its share of difficulties, including a change of prime contractor, financing problems, and an embargo on German-made powertrain components. However, the progress made in recent years appears substantial, supported by significant Qatari funding and valuable South Korean technical assistance, particularly in engine development. The first three production models are expected to be delivered in 2025, with a production target of 250 units, while Qatar has also announced its intention to order around 100 units, although this has yet to be confirmed. Depending on its operational performance and its price, the Altay could become a market competitor within a decade and offer an attractive alternative to the German and American models. Turkey will have to shift from being an offset recipient to the more sensitive position of offset provider to match competing offers from countries more accustomed to these mechanisms.

Future platforms

The short-term revitalization of European tank fleets will center on a trio of platforms: the Leopard 2, M1A2 Abrams, and K2 Black Panther. This will result in a consolidation of the European fleet around these three models and their domestic variants, supplemented by a decreasing number of legacy systems. In the longer term, next-generation tank programs from various actors will become increasingly important and create new competitive dynamics.

The Abrams X: a step forward but not a successor

The American situation is unique, as the current Abrams has no formal successor, limiting Washington's ability to offer anything other than further upgrades to its existing tank. Replacement of the Abrams has been considered several times since the 1990s without reaching a satisfactory conclusion. The Future Combat Systems program, launched in 2003, aimed to develop a family of vehicles based on a standardized tracked chassis with a strong emphasis on unmanned capabilities, but was canceled in 2009 due to escalating costs and uncertainty about its technological feasibility.

With more than 10,000 Abrams tanks produced for an army with efficient maintenance, storage, and preservation infrastructure, it has always been possible to delay addressing the issue of replacing the vehicle without causing costs to skyrocket. Successive upgrades have also allowed adaptation to new types of conflict, although the weight of the latest versions is considered too heavy for use on certain civilian infrastructure, particularly bridges. The latest known versions are expected to weigh 68 metric tons, which has led their manufacturer, General Dynamics Land Systems, to focus its development efforts on making the vehicle lighter while maintaining its performance. The Abrams X, unveiled in 2022, is the result of this approach: It weighs less than 60 metric tons and comes with several significant improvements over the original vehicle. However, it is only a demonstrator, and a replacement program is not expected to materialize before 2040, which limits the United States' ability to offer a long-term option to its customers.[87]

From the K2 to the K3: a generation in 15 years

By contrast, the Korean commercial proposal based on the K2 includes concrete prospects for the K3 (currently in development), for which Hyundai Rotem has announced completed armament and armor development. A model of the K3 has already been presented at various trade shows, such as D24 in Warsaw in 2025. It offers South Korea's DITB (already dynamic in the field of tanks) a significant commercial advantage: Having entered service in 2014, the K2 succeeds the K1, which entered service in 1985, and is itself expected to be replaced by the K3 by 2040.

87. H. Kass, "AbramsX: The U.S Army's Next Big Tank Nightmare?", *National Interest*, August 30, 2024.

The Korean DITB, which was essentially nonexistent in the early 1970s, has developed three generations of battle tanks with increasing confidence and speed. While 30 years separate the K1 and the K2, the K3 is set to come roughly 15 years after the K2. The K3 also benefits from ambitious technological developments: It combines active protection, a silent hydrogen engine, and new-generation armor. Its manufacturer, Hyundai, is actively seeking a first customer to participate in the development of its future tank, particularly in the Middle East.[88]

In addition, the Korean DITB can rely on the national army's conscription stocks to shorten delivery times while offering generous offsets. Combined with the K3's prospects, these advantages could prove decisive in a European market characterized by urgency, fear of American disengagement, and the need to maintain high performance against an adversary capable of mobilizing large forces. (These last two strategic dimensions also happen to correspond to the situation in South Korea.)

Panther and Leopard 3: alternatives for Germany?

Faced with these new competitive prospects, the German DITB is preparing to offer two distinct alternatives.

Unveiled at Eurosatory 2022, the KF51 Panther has been developed by Rheinmetall using its own funds since at least 2018. Based on the Leopard 2A4 chassis, it features a new turret that can accommodate the 130 mm gun, which has been under development since 2015. By balancing active protection and armor, the KF51's weight is expected to remain below 60 metric tons, similar to that of the Abrams X. Unlike the Abrams X, however, the Panther is not just a technology demonstrator but the cornerstone of Rheinmetall's future commercial strategy in Europe, which is targeted specifically at Leopard 2 operators. In 2022, the company's CEO estimated that around 1,000 new tanks would likely be ordered across Europe by 2030 and that the KF51 could capture half of this market.

Less than a year after its unveiling, Hungary, already an operator of the Leopard 2A7, expressed interest in the program and announced an investment of nearly €300 million to complete the Panther's development and establish a domestic production line. However, Budapest has not yet made a firm purchase commitment, although it is considering one.[89] The proposed Hungarian Panther would retain the Leopard 2A7's 120 mm main gun while being integrated onto a proprietary Rheinmetall chassis, not one derived from the Leopard 2A4. This development is significant, as it marks a break with the usual division of labor within the German DITB. Historically, KMW (now KNDS Deutschland) has been responsible for the hull and mobility, while

88. Interviews conducted with European and Ukrainian military and civilian actors, spring-summer 2025.
89. M. Murphy and R. Tyborski, "Ungarn soll den neuen Kampfpanzer Panther bekommen", *Handelsblatt*, September 29, 2023.

Rheinmetall has handled the turret and armament. Rheinmetall's development of an independent mobility solution indicates a major shift in the internal power dynamics of the German DITB. The previously mentioned Italian contract has further bolstered the credibility of Rheinmetall's alternative platform.

Rheinmetall is a particularly ambitious and aggressive player in the European land systems market. Capitalizing on lessons learned from the conflict in Ukraine, it has invested in particular in air defense artillery. The 2022 unveiling of the Panther also generated significant discourse, as the platform represents a serious competitor to the ongoing MGCS program, in which Rheinmetall is a contentious partner. With significantly higher revenue than KNDS France and Deutschland combined, Rheinmetall possesses unique investment and acquisition capabilities in the European land sector. Exploiting the breakdown in negotiations between KNDS and Italy, Rheinmetall secured a second, highly ambitious contract for the KF51 at the expense of its German competitor. Leveraging greater technological and financial latitude, the Düsseldorf-based company is positioning itself as a dominant force in the European market.

KNDS Deutschland, however, has not remained idle. With the MGCS not expected to be available until 2040 at the earliest and not entering service until 2045, the German Army has expressed its desire for an intermediate tank to bridge the gap between the Leopard 2A7/8 and its eventual successor. Consequently, the BAAINBw—the German procurement agency—announced the development of technological "building blocks", focusing on firepower, mobility, and survivability, to be integrated into a future Leopard 2 variant designated Leopard 2AX or Leopard 3. Requirements include a new main gun (likely Rheinmetall's 130 mm) housed in a redesigned turret, a new engine developed by Liebherr, and enhanced protection systems led by Hensoldt and KNDS Deutschland. Currently, Germany has no plans to acquire the KF51; therefore, the future German fleet is expected to comprise a mix of Leopard 2A8s (ordered in 2024), Leopard 3s, and ultimately the MGCS.[90]

Launched well after the KF51 and more akin to a thorough overhaul of the Leopard 2 than a new tank, the Leopard 3 is not expected to be available on the market before the end of the decade.

MARTE and FMBTech

The flurry of tank investment has not escaped the attention of European institutions such as the European Defense Fund (EDF), which launched a call for projects titled Future Main Battle Tank. This resulted in the selection of two separate projects:

- Led by Rheinmetall and KNDS Deutschland (partners in the MARTE ARGE GbR joint venture), the MARTE (Main ARmoured Tank of Europe)

90. T. Newdick, "Germany Kicks Off Work on Leopard 3 Main Battle Tank", *TWZ*, February 7, 2025.

project was launched in December 2024 for two years. With a €20 million budget from the EDF, it brings together around 50 partners from 11 different countries (Germany, Belgium, Spain, Estonia, Finland, Greece, Italy, the Netherlands, Norway, Romania, and Sweden). In addition to the German duo, Leonardo, Indra, and Saab are key members. The stated objective is to study and design a new tank model to address current and future threats. However, the project's small budget and the wide range of partners will make it difficult to achieve this goal. The project is better understood as one that will help ongoing projects—notably the KF51, the Leopard 3, and perhaps the MGCS—to develop building blocks and components.[91]

- The other project, led by Thales, is called FMBTech and was launched in April 2025 for 36 months. With a budget comparable to MARTE's, it involves 26 entities from 16 different countries (France, Germany, Belgium, Finland, Norway, Italy, Greece, Spain, Slovakia, Poland, Ireland, the Czech Republic, Cyprus, Estonia, and Sweden). Its goal is to develop technological building blocks deployable on existing tanks and their successors, with a stated focus on AI and integrated systems in the fields of protection and command and control.[92]

Both programs have small budgets that must be shared among dozens of partners. MARTE and FMBTech are presented as complementary to existing national or cooperation programs rather than as a fully fledged European alternative. Their main purpose is to promote the creation of a European ecosystem of players in a future value chain dedicated to upcoming tanks. Despite their small budgets, these projects also signal the growing involvement of European institutions in the field of defense and armaments.

91. "MARTE, Main ARmoured Tank of Europe", European Commission, 2024, available at: https://defence-industry-space.ec.europa.eu.
92. "FMBTech: Technologies for Existing and Future MBTs", European Commission, 2024, available at: https://defence-industry-space.ec.europa.eu.

Prospects for the French tank fleet

Relative to Europe as a whole, which is reinvesting in heavy armor, France is an exception. While European armies have invested more in their tanks since 2020 than in the two decades prior, French tank capabilities are degrading, even as the country continues to spend money maintaining its heavy armor. The Leclerc tank is not expected to be replaced before 2045, a horizon that may be too far off for a French fleet that is already in trouble. France is struggling to develop the Leclerc's successor, and conservation measures may not be enough to sustain the fleet until it can. Proposals to procure an intermediate platform, meanwhile, have come up against budgetary constraints.

A problematic intermediate period

The Leclerc fleet in end-of-life care

France—the country that, in 1917, pioneered the concept of the modern tank—theoretically has an operational fleet of 200 Leclerc tanks, along with another 200 that have been in storage since the late 2000s. Leclerc tanks in service must be upgraded to the XLR standard by 2035. The Leclerc, as the star of France's Bastille Day military parades, is easily recognizable to the French public. It enjoys a positive reputation and indeed is often described as "the best tank in the world". The Leclerc earned that reputation with a technical and tactical performance that surpassed the platforms of its time, but it has since suffered from a lack of investment and the peace dividend. Its short commercial career ended too soon for it to benefit from the recent revival of the European market.

Designed to engage two or three Soviet equivalents simultaneously, the Leclerc was developed from the outset to outperform contemporary adversaries while holding its own against their eventual successors. Like most of its French predecessors, such as the AMX-13 and AMX-30, it features excellent engine performance, reflecting a doctrine that views mobility as a protective factor in itself. In particular, it was designed to maintain a superior power-to-weight ratio by limiting the vehicle's size (and therefore its weight) and equipping it with a high-output engine. The Hyperbar system, supplied with air by a turbomachine, enables very high acceleration and excellent responsiveness even at low speeds. The Leclerc also introduced other innovations since adopted or imitated on other platforms, such as the

autoloader in the turret bustle and the stabilized sighting system, which enables firing on the move against moving targets.[93]

The Leclerc was perhaps meant to be the most modern tank of the Cold War era. However, it entered service after that conflict ended, during a period of massive fleet and budget reductions when operations relied on lighter, more mobile components. Intended to equip the entire French Army, the initial 1989 order for 1,500 units was reduced throughout the 1990s, resulting in only 406 tanks delivered by 2008. To this figure should be added 388 units for the United Arab Emirates, the sole export contract in a short and unsuccessful commercial career. As the unit price of the UAE Leclerc was calculated before the French procurement target was reduced, the tank was sold at an undervalued price, leading to significant losses for GIAT Industries (later Nexter, now KNDS France), which reportedly lost more than €1.3 billion on the deal.[94]

Although deliveries concluded in 2008, the French Army never actually had 406 Leclerc tanks in its active inventory. The first batches delivered were quickly sidelined due to significant manufacturing defects, with a small number converted into recovery vehicles. Additionally, the end of deliveries coincided with significant budget cuts and force reductions under the General Review of Public Policies (Révision générale des politiques publiques, RGPP) initiated by President Nicolas Sarkozy to address the 2008 financial crisis. Consequently, nearly 150 additional units were placed in long-term storage by the end of the 2000s to reduce maintenance costs. Some of these stored tanks were offered for export in 2008, but no buyers were found, reflecting France's desire to draw down its fleet as much as possible.[95]

Further savings were achieved by reducing spare parts and maintenance equipment procurement to a bare minimum, which increasingly compromised the fleet's readiness. The decision was made to cannibalize stored tanks for spare parts rather than purchase new ones. While rational given the context of economic austerity, this decision had two major consequences:

- The rapid deterioration of vehicles stored in the management fleet—cannibalized to support the active fleet—made returning them to service impossible. It took several months to reactivate approximately 20 units when the 5th Dragoon Regiment was reestablished in 2016, even though the tanks, which were intended only for target practice, did not need to be fully operational.[96]

93. M. Chassillan, *Char Leclerc. Char Leclerc, de la guerre froide aux conflits de demain,* op. cit.
94. "Rapport d'information sur la situation de GIAT Industries", French National Assembly, National Defense and Armed Forces Committee, December 2002, available at: www.assemblee-nationale.fr.
95. J. Guisnel, "La France veut vendre le tiers de ses chars Leclerc", *Le Point*, April 28, 2008.
96. L. Péria-Peigné, "Military Stockpiles: A Life-Insurance Policy in a High-Intensity Conflict?", *Focus stratégique*, No. 113, Ifri, December 2022.

- The shutdown of the production line for some of the Leclerc's parts, particularly the turbine for its engine, is essential for the vehicle to achieve its theoretical performance. According to certain interviews, the last turbine was reportedly taken from the Leclerc held at the Saumur Museum of Armored Vehicles between 2022 and 2024, a symptom of a parts shortage that has become problematic.[97]

This is now one of the major limitations of the Leclerc fleet, as production of the turbomachinery essential to its propulsion was halted in the early 2010s because of a failure to anticipate obsolescence and future demand. With the cannibalization of stored vehicles consuming the limited stock, this supply source appears to have dried up around 2019. The resulting parts shortage has since led to a major reduction in fleet usage, with crew training falling below 80 hours per year in 2023, compared to the standard target of 115 hours. Technical availability is the best indicator of the Leclerc fleet's condition, but unfortunately, it has not been publicly available since 2020 because the Ministry of the Armed Forces considered it classified information.[98] However, it was 55% in 2013, meaning just over half of the French fleet was actually operational at that time.[99] It remained at 54% in 2019, the last year for which figures are available.[100] It likely plummeted between 2020 and 2024 because of parts shortages, before gradually recovering for reasons explored below.[101]

A fleet of modern tanks with 55% availability is not unusual, given that tanks are among the most maintenance-intensive and complex land systems. Availability rates rarely exceed two-thirds in peacetime for most armies. For comparison, the availability of German Leopard 2 tanks in 2020 was only 47%, even though tanks play a central role in the German Army.[102] However, differences in accounting methods can lead to significant discrepancies in the absence of a standardized methodology. In the United States, the availability of Abrams tanks is estimated at around 80%, which can be explained by the fact that, relative to European forces, US forces have much larger budgets and support structures and allocate more technicians per vehicle.[103]

97. Interviews conducted with European and Ukrainian military and civilian actors, spring-summer 2025.
98. "Question écrite au gouvernement n° 35467", French National Assembly, January 21, 2021, available at: www.assemblee-nationale.fr.
99. "Le maintien en condition opérationnelle des matériels militaires: Des efforts à poursuivre", Cour des Comptes, September 2014, available at: www.vie-publique.fr.
100. "Question écrite au gouvernement n° 25691", French National Assembly, January 7, 2020, available at: https://assemblee-nationale.fr.
101. Interviews conducted with European and Ukrainian military and civilian actors, spring-summer 2025.
102. É. Tenenbaum and L. Péria-Peigné, "*Zeitenwende*: The Bundeswehr's Paradigm Shift", *Focus stratégique*, No. 116, Ifri, September 2023.
103. G. Williams, "The Army's M1 Tank: Has It Lived Up To Expectations?", Project on Government Oversight, January 1, 1990.

However, the total availability of the Leclerc fleet appears to have fallen sharply since 2020. Part of the fleet's unavailability is temporary and necessary; these tanks have been held at the manufacturer's facilities to receive the XLR upgrade. The rest of the fleet, meanwhile, has been affected by a growing parts shortage, reducing technical availability to its lowest point between 2020 and 2022, largely due to the lack of turbomachinery. This predictable shortage has led to a gradual deterioration in how the vehicles are used to preserve each platform's operational potential, particularly their engines. Safran has committed to producing an alternative as a temporary solution, with the French Air and Space Force's aeronautical maintenance service (SIMMAE) set to take over by 2026, by producing its own turbomachinery. The goal of returning to 115 hours of annual training per crew, as stated in the annexed report to the 2023 Military Programming Law, may therefore be achievable.[104] Platform availability appears to be increasing but remains very limited, with estimates in this study placing it between 25 and 35% in 2025. Although difficult to estimate, this investment places a considerable burden on the armed forces' maintenance budget, especially since it represents stopgap maintenance for an ageing and already costly capability rather than genuine investment.

The engines alone account for half to two-thirds of the maintenance cost of the Leclerc fleet, which represents more than €120 million of the €992 million budget allocated for maintaining the French Army's land equipment in operational condition.[105] The latest available figures show a maintenance cost for the Leclerc fleet equivalent to that of the AMX-10 RC—a simpler vehicle, but one much more heavily utilized in operations—despite a similar number of vehicles.[106] In 2006, even before the final deliveries were made, the heavy tank fleet already accounted for nearly 20% of the Army's scheduled equipment maintenance resources, which has prompted much internal criticism. This problematic situation led to the launch of a fleet management reform in 2008, known as the Fleet Employment and Management Policy (Politique d'emploi et de gestion des parcs, PEGP).[107]

While the Leclerc fleet is being upgraded to the XLR standard, the propulsion issue remains unresolved and weighs heavily on the platform's future. After several difficult years, Safran has launched production of suitable turbomachines, while the Aeronautical Industrial Service (Service Industriel de l'Aéronautique, SIAé), which possesses the necessary expertise, will launch its own in-house production line around 2026. This entire operation should allow for a gradual restoration of availability, but

104. "Rapport annexé à la Loi de programmation militaire 2024-2030", Légifrance, October 14, 2025, available at: www.legifrance.gouv.fr.
105. "L'organisation budgétaire de la Mission *Défense*", Cour des Comptes, May 2025, available at: www.ccomptes.fr.
106. "Question écrite au gouvernement n° 25691" Assemblée nationale, 7 janvier 2020.
107. J.-T. Verna, "La Politique d'emploi et de gestion des parcs (PEGP) de l'Armée de terre, retour sur une politique publique innovante", *Revue de Défense nationale*, No. 791, 2016.

represents a very significant investment merely to return to a baseline status. An alternative option—re-engining the fleet with a power plant similar to that of the Leopard 2 and the Emirati Leclerc—could generate substantial savings while providing a sustainable capability increase. An internal study by the land forces estimated the cost of re-engining at €1.5 billion—a considerable sum, yet one that would generate savings over a decade, given that the Leclerc fleet will not be replaced before 2045 under current projections.[108] This solution, attractive in absolute terms, would necessitate abandoning the investments made in domestic turbomachinery production. Furthermore, the expected return on investment, which extends beyond the timeframe and budget of the current Military Programming Law, has struggled to gain traction. Other, less orthodox solutions exist, such as developing a hybrid engine to address the continuous increase in power consumption of onboard electronic equipment. Such a solution is being studied by the French DITB but has not yet reached full maturity or passed the required NATO tests, which include driving several hundred kilometers consecutively.[109]

After several years of severe difficulty, the French Leclerc fleet is being stabilized at great expense, while modernization to the XLR configuration continues. This modernization brings welcome capabilities, such as a new remote weapon station, a new fire control system, and integration of the SCORPION information and communication system. A new sight developed by Safran will also be added starting in 2028. Other improvements, such as an anti-IED jammer and reinforced ventral armor plating (which obstructs the lower escape hatch), are the result of lessons learned in Afghanistan.[110] Although the Leclerc was not deployed to Afghanistan, these improvements have attracted criticism for being outdated, as they are based on feedback from counterinsurgency operations far removed from the lessons of the conflict in Ukraine, such as drone warfare.[111]

Other improvements in the XLR standard, such as the remote weapon station, represent simple upgrades or the addition of features conceived in the 1990s during the tank's development but omitted for budgetary reasons. (The Emirati Leclerc tanks already possess these features.) Furthermore, not all vehicles may receive every component of this new configuration, as the number of turrets acquired is lower than the number of platforms planned.[112]

Ultimately, the major question is whether the Leclerc fleet, even upgraded to the XLR standard, can endure for another two decades, since the MGCS, as currently envisioned, is not expected to enter active service before 2045 at the earliest.

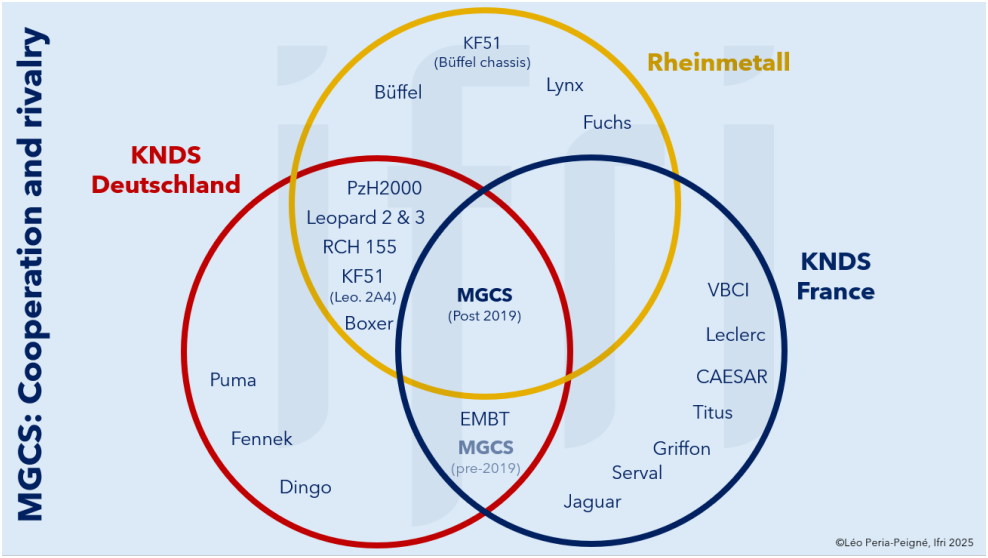
108. Interviews conducted with European and Ukrainian military and civilian actors, spring-summer 2025.
109. Ibid.
110. L. Lagneau, "L'armée de Terre détaille les capacités apportées par l'intelligence artificielle au char Leclerc XLR", *Zone Militaire*, April 20, 2025.
111. Interviews conducted with European and Ukrainian military and civilian actors, spring-summer 2025.
112. M. Chassillan, *Char Leclerc, de la guerre froide aux conflits de demain,* op. cit.

A distant and uncertain MGCS

The condition of the Leclerc fleet is particularly concerning given that the development of its successor faces significant challenges. Launched in 2017 alongside the Future Combat Air System (FCAS), the MGCS represents the third Franco-German attempt to field a joint tank, following failures during the early development of the AMX-30 and the Leclerc. Designed to replace the Leclerc and Leopard 2 by 2035-2040, the project relied on a binational holding company established in 2014, uniting Nexter (armament and turrets) and KMW (mobility and chassis). This logical division of labor was disrupted in 2019, when the German Bundestag conditioned budget approval on Rheinmetall's integration into the program.[113]

Expanding from two to three partners meant rethinking the division of labor to maintain a 50/50 Franco-German split—a difficult equation to solve. More critically, this shift generated significant tension between French and German actors, as well as among the German firms themselves. Not only is Rheinmetall a direct competitor to KNDS France in sectors such as ammunition and 155 mm artillery, but it is also a cumbersome and aggressive partner for KNDS Deutschland, with whom it collaborates on platforms such as the PzH 2000, the Puma, and the Boxer.

Figure III-1: Cooperation and rivalry in the MGCS program



Sources: Websites of relevant firms.

The stormy relationship between the family trust controlling KNDS Deutschland and Rheinmetall is well documented; Rheinmetall has repeatedly signaled its intent to acquire KNDS Deutschland.[114] Furthermore, Rheinmetall's entry into the MGCS—backed by 20,000 employees and over

113. Interviews conducted with European and Ukrainian military and civilian actors, spring-summer 2025.

114. "Rheinmetall will mit Krauss-Maffei Wegmann fusionieren", *Bundeswehr Journal*, November 27, 2018

€6 billion in 2019 revenue—brought a true industry giant into play against a Franco-German conglomerate with fewer than 10,000 employees and €3 billion in revenue. Within the MGCS program, Rheinmetall and KNDS France are at loggerheads, particularly over the issue of the main armament. Rheinmetall is advocating for its 130 mm gun, already integrated into the KF51, while KNDS France is seeking to leverage its 140 mm ASCALON, which it promotes as more powerful and scalable. This standoff remains unresolved, though Berlin and Paris agreed in 2024 to allow multiple MGCS configurations, each capable of mounting either weapon system.[115]

These frictions, compounded by disputes over the industrial workshare for a vehicle that remains ill-defined, have pushed deadlines from 2035 to 2040, suggesting that deliveries will likely not begin until 2045 at the earliest. Eight years after the project's launch, even the baseline configuration has not been formally decided. The French concept envisions an "MGCS ambition" as a "system of systems", linking a gun platform with one or two support and command vehicles capable of deploying anti-UAV, electronic warfare, and missile capabilities within a SCORPION-style information network. One or more of these platforms would be automated, acting as a "loyal wingman" to the manned platform. This vision must also be flexible enough to satisfy both French and German doctrine.

The partners' visions may diverge further because their timelines do not align. France faces an increasingly urgent need to replace the Leclerc for the reasons previously mentioned or, at a minimum, to acquire an intermediate solution. Conversely, Berlin is not under pressure to obtain an MGCS. The Leopard 2 benefits from active production lines, a robust order book, and continuous upgrades that keep it operationally relevant; the 2A8 variant is comparable to modern tanks such as the K2. Furthermore, the development of the Leopard 3 and, to a lesser extent, the KF51 further reduces the need for a next-generation tank.

Finally, industrial expertise and resources present a major challenge for France. Having not developed a tracked platform since the 1990s—the Leclerc being, de facto, the last—KNDS France retains limited expertise in this domain, with most remaining know-how relating to armament and turrets. While these skills can be acquired or regained, doing so requires financial and human capital currently lacking in both the French Ministry of the Armed Forces and the French DITB. Berlin possesses all the necessary expertise through the established KNDS Deutschland–Rheinmetall duo, while the massive growth in its military budgets allows it to forgo French input and develop a fully German MGCS unilaterally. The partnership is therefore deeply imbalanced and heavily disadvantages France, even as the

115. L. Lagneau, "Canon de 130 ou de 140 mm? Finalement, le futur char franco-allemand pourrait donner lieu à deux versions", *Zone Militaire*, April 25, 2024.

need to replace its heavy armor intensifies, foreshadowing difficult choices in the coming years.

The misalignment of French and German requirements and timelines previously caused the failure of the joint tank project launched in 1979. While France needed to replace the AMX-30, Germany had already fielded the initial versions of the Leopard 2 and saw no need to invest in a duplicate capability. Consequently, Paris developed the Leclerc while Berlin successfully continued the Leopard 2 lineage. Nearly half a century later, the situation is similar: France needs a replacement for the Leclerc, while Germany continues to produce and enhance the Leopard 2 while simultaneously developing its successor.[116]

The choices facing the armored cavalry

The temptation to abandon tanks

One solution sometimes proposed within the French Army is to renounce the tank capability entirely. This concept dates back to at least the early 1990s and was implemented by several Western armies, such as Canada and the Benelux nations. The end of the Cold War and of the Soviet threat made maintaining large fleets of heavy armor seem unnecessary, a realization that extended to other "high-intensity" capabilities such as multiple launch rocket systems. Rapid budget cuts after 1990 favored the retirement of costly, rarely deployed capabilities as multinational stability operations became the norm. During such operations, the presence of tanks was often viewed as not only superfluous but potentially counterproductive. Following the imagery of the 1989 Tiananmen Square crackdown, the tank's negative optics often outweighed its potential tactical utility.

In France, the professionalization of the armed forces (armored regiments had predominantly been manned by conscripts), combined with the significant cost overruns and delays of the Leclerc program, lent credence to the idea of abandoning the heavy segment in the late 1990s. The early phases of the SCORPION program in the 2000s illustrated this trend. Before standardizing on the wheeled Griffon–Serval–Jaguar trio, the initial SCORPION concept included a medium tracked segment based on a 30- to 40-ton multipurpose platform capable of various missions. One variant was designed to mount a 120 mm gun, in a configuration similar to the current CV90120.[117] Less than two years after the final Leclerc delivery, internal documents from 2010 explicitly stated a medium-term objective to replace the tank fleet with this platform—which was more modern, lighter, and, crucially, less expensive and easier to deploy—despite the tanks being

116. M. Chassillan, *Char Leclerc, de la guerre froide aux conflits de demain,* op. cit.
117. Y. Boivin, "BAE Systems expose le CV90120 MkIV à Bratislava", Blablachar, May 15, 2024.

effectively new.[118] Meanwhile, the implementation of post-2008 austerity measures led to a substantial reduction in the active tank inventory, with attempts made to sell vehicles placed in reserve. Although the idea of a tracked SCORPION segment was abandoned in 2013 in favor of an all-wheeled force, and the Leclerc fleet was retained, the funding allocated to its maintenance and its perceived limited operational utility continued to spark heated debate.

The profound reorganization of the European strategic balance after 2022 has provided ammunition for both supporters and opponents of abandoning heavy armor. While opponents warn of a potential decline in France's standing given the rearmament of European nations, supporters argue that France will never match the conventional deterrence efforts of Poland and Germany, which are acquiring hundreds of modern armored vehicles. In a spirit of subsidiarity and comparative advantage, they argue that France should focus on areas where its contribution is more significant, such as nuclear deterrence or expeditionary deployments in non-European theaters. This approach relies on a division of labor: The Alliance's eastern flank is held by European allies, while France, capitalizing on its experience and size, secures the southern flank, where tanks are deemed to have no role.

However, the assumption that tanks are useless on the southern flank or in external operations generally requires serious scrutiny, as the Canadian example demonstrates. In the 1990s, the Canadian Army underwent a massive reduction in resources and personnel, planning to abandon its main battle tanks before the end of the decade. Ottawa sought to develop a light, expeditionary army model, perceived as better suited to Canadian foreign policy and current needs—an approach similar to France's. However, this strategy collided with the reality of Afghanistan. Canadian forces entered the theater with an 8x8 infantry fighting vehicle armed with a 25 mm gun. This platform quickly proved not only insufficiently protected and under-gunned, but also unable to operate off-road and therefore vulnerable. Faced with mounting losses, the Canadian Army urgently recalled Leopard 1 tanks that were being withdrawn from service to deploy them in Afghanistan, where their protection, firepower, and all-terrain mobility made them indispensable.[119] The Canadian Army subsequently renewed its fleet by purchasing Dutch Leopard 2 tanks and adapting them to its requirements, resulting in the 2A7 standard. Denmark, among others, followed the Canadian example in Afghanistan.[120] Although the US Army did not deploy tanks in Afghanistan, the M1A2 Abrams tanks deployed in Iraq performed essential support and escort functions that no other vehicle could

118. Interviews conducted with European and Ukrainian military and civilian actors, spring-summer 2025.
119. H. M. Anthony, "Close Combat Vehicle and Leopard 2 Main Battle Tank: Back in the Heavyweight Fight", Master's thesis, Canadian Forces College, 2012.
120. D. Johnson and J. Gordon IV, "Observations on Recent Trends in Armored Forces", *Occasional Papers*, Rand Corporation, 2010, available at: www.rand.org.

accomplish, a conclusion shared by the British Army regarding its Challenger 2 tanks.[121]

The deployment of tanks in these asymmetric operations (similar to French overseas operations) has shown that these vehicles, far from being unsuitable, remain important, as the mere presence of armored forces tended to reduce risks, allied losses, and even collateral damage.[122]

Alternatives to the MGCS yet to be made a reality

Currently, the complete abandonment of French tank capabilities no longer appears to be under consideration. The Chief of Staff of the French Army has noted that the tank remains an asset, but that armored combat must be "reinvented", free from "doctrinal constraints or parochialism".[123] However, in the face of the aging Leclerc fleet and the uncertainties surrounding the MGCS, alternatives are limited.

The acquisition of an intermediate platform to bridge the gap between the currently declining fleet and undefined future systems is a frequently mentioned solution to maintain satisfactory armored capabilities in the short term and to provide flexibility for future planning.

Off-the-shelf procurement

The simplest and most immediate solution would be the off-the-shelf purchase of one of the three platforms available on the European market. The Leopard 2 or 3 is the most frequently cited alternative. However, the substantial volume of orders placed with the German DITB over the past three years makes any delivery before 2030 unrealistic, particularly for a small order volume that would likely receive low priority. The scope of industrial offsets would also depend on the quantity ordered, as the German tank production chain is already deeply integrated across Europe. While acquiring surplus Leopard 2s would offer faster delivery, the market is significantly more limited than it was a few years ago, as many operators are choosing to upgrade their fleets rather than divest them. Furthermore, acquiring earlier-standard Leopard 2s would represent a significant regression in tactical performance.

Purchased in large numbers by Poland, the Korean K2 represents a potential alternative to the Leopard 2, while adhering to the Franco-Polish partnership established by the Nancy Treaty in May 2025. A Korean order could also be initiated and executed within a relatively short time frame, with initial deliveries drawn from the Republic of Korea Army stocks. The first

121. J. Gordon IV and B. R. Pirnie, "'Everybody Wanted Tanks': Heavy Forces in Operation Iraqi Freedom", *Joint Force Quarterly*, No. 39, 2005.
122. D. Johnson and J. Gordon IV, "Observations on Recent Trends in Armored Forces", op. cit.
123. L. Lagneau, "Le chef d'état-major de l'armée de Terre appelle l'arme blindée-cavalerie à se réinventer", *Zone Militaire*, April 27, 2025.

batch of 180 units ordered by Warsaw was delivered in just three years. However, the scale of offsets already granted to Warsaw could limit significant industrial participation for France if the order volume remains between 150 and 200 units. The momentum generated by the K3 program would offer the advantage of long-term prospects for Franco-Polish-Korean development. It would be ironic, though not entirely unfounded, if the K2, which is heavily inspired by the Leclerc in certain aspects, were to replace it.

The acquisition of American tanks appears unlikely given the current state of transatlantic relations. Moreover, a tank 12 metric tons heavier than the Leclerc would be difficult to integrate into French doctrinal and logistical frameworks, even setting aside the "parochialism" mentioned by the Chief of Staff of the French Army.[124] This option can therefore be ruled out.

Domestic development

Alternatives to importation are limited and entail significant uncertainties. Technological capability is a major concern: Given that the French DITB has not developed a heavy tracked platform in over 30 years, does it still have the requisite technological skills and know-how?

The numerous interviews conducted for this study did not provide a definitive answer. Some interviewees believe that the national industry's expertise in this domain has been deeply eroded as a result of a lack of demand and that maintenance operations have primarily preserved expertise in armament and turrets. Others contend that, although unused for several decades, the necessary skills remain present within the industry, though specific areas require more attention than others—particularly propulsion, which "still needs to be taught".[125] An internal study conducted by the French DITB in 2023 estimated that developing and fielding a modern transitional tank—without seeking radical technological breakthroughs—would require at least a decade. While this timeline is significant, it remains sustainable given the condition of the fleet and the two-decade wait for the MGCS.[126] Since KNDS France retains the Leclerc's design and manufacturing data, the path forward would be far less arduous than starting development from scratch.

The Italian example shows that resuming the development of a system as complex as a main battle tank after decades of inactivity is more a political choice than a technical feat. However, consistent investment within a long-term strategy is essential to maintain existing competencies and restore the viability of the most fragile areas, which, in the French case, have lain dormant for 30 years. South Korea's DITB mastered the most complex technological components only by adopting a long-term strategy and partnering with advanced actors, including France. Similarly, Turkey has

124. Ibid.
125. "Rapport d'activité 2024", Groupement des industries françaises de défense et de sécurité terrestres et aéroterrestres (GICAT), 2024, available at: https://gicat.com.
126. Interviews conducted with European and Ukrainian military and civilian actors, spring-summer 2025.

collaborated with South Korea to accelerate the development of a domestic engine currently under study. Given that French industry has, to varying degrees, maintained most of the necessary skills, it should be able to develop an intermediate tank to compensate for the aging Leclerc fleet, buying the time and resources to develop the next generation more deliberately.

A domestic solution that surmounts these technological and financial hurdles could be tailored to French doctrinal and capability requirements, whereas an off-the-shelf purchase would require French forces to adapt to a platform often designed primarily for the export market. Conversely, although exports are less critical for a transitional tank, a platform optimized solely for French specifications risks commercial failure, as potential customers may favor less specialized solutions.

Although designing a complete transitional tank may be viewed as unlikely given France's resources, the national industry does possess intermediate solutions such as the EMBT (Enhanced Main Battle Tank). Unveiled at Eurosatory 2022 by KNDS, this platform is an evolution of the 2018 European Main Battle Tank, which combined a Leopard 2A7 chassis with a modified Leclerc turret—symbolizing the union between Krauss-Maffei Wegmann (KNDS Deutschland) and Nexter (KNDS France). The new EMBT features a comprehensively redesigned turret developed by KNDS France, capable of mounting a 120 mm or 140 mm ASCALON gun, and an onboard electronics suite similar to that of the French Jaguar. The hull remains similar to the Leopard 2A7 but incorporates a new engine and a redesigned architecture that integrates a fourth crew member alongside the driver. Such a solution would offer advantages in schedule and cost: the project is mature and could enter production before 2030.

A future iteration of the EMBT could combine the chassis and engine developed for the Leopard 3 program with a French turret and armament. New capabilities, such as anti-UAV systems or the deployment of loitering munitions, could be integrated without major architectural constraints, particularly through the use of an unmanned turret. The result would be an intermediate platform leveraging the logistical benefits of the "Leopard club" while preserving French industrial expertise in turret design. However, this illustrates France's loss of sovereignty in powertrain technology, while the reliance on a German chassis could encumber certain export opportunities in the event of a veto by Berlin.

Combining lessons learned from the conflict in Ukraine, French requirements, and the current configuration of France's DITB allows for the conceptualization of a platform distinct from the MGCS ambition. Developing a state-of-the-art intermediate tank would facilitate the recovery of the skills necessary for the next generation while providing a modern and affordable transitional platform for French forces. Despite the limitations of such a theoretical exercise, several characteristics of such a platform can be outlined.

- ***Mobility***

A combat weight between 45 and 55 metric tons would enhance tactical, operational, and strategic mobility, while reducing the need for specialized logistical enablers (recovery vehicles, railcars, and heavy equipment transporters), thereby limiting additional costs. Although difficult to achieve, a weight of 35 metric tons would allow the use of rubber tracks, which are lighter and quieter. Finally, limiting the weight would allow for the faster development of a less powerful engine and facilitate hybridization to anticipate the increased electrical power demands of future subsystems. A hybrid engine of this type is currently under study by the French DITB. Operational feedback from Ukraine highlights the link between mobility and protection, but above all, the critical importance of a high reverse speed for evasive maneuvers—a recurring weakness of recent Russian models like the T-90, which cannot exceed 10 km/h in reverse.

In addition to improved fuel efficiency, a hybrid powertrain would enable the vehicle to maintain electrical power generation while stationary ("silent watch"), whereas most current tanks must run their main engines to power onboard systems, creating a significant thermal and acoustic signature.

Despite the absence of a specialized tank engine manufacturer, the French DITB has solid expertise in other automotive technologies and would have a competitive advantage in developing a state-of-the-art engine that balances performance with maintainability (which Ukrainian maintenance personnel have criticized Western platforms as lacking). The Korean and Turkish industries have long struggled to develop reliable transmissions, whereas Renk France can supply a sovereign module.

- ***Armament***

The initial objective should be to use a standard 120 mm gun to ensure NATO interoperability, as Rheinmetall's difficulties in marketing its 130 mm gun demonstrate the challenge of introducing new calibers to Alliance armies. The turret must be designed so that it can be replaced, if necessary, with a non-standard solution such as the 120 or 140 mm ASCALON, the latter possessing a similar system weight. Since the 120 mm ASCALON is compatible with standard 120 mm ammunition, the loss of interoperability would be more limited than with the 140 mm, which represents a true break with NATO allies. The platform would thus trade interoperability for upgrade potential, because the standard 120 mm gun has effectively reached the physical limits of its development.

However, the primary function of the main gun should not be defined solely by the anti-tank role, which can be fulfilled by other integrated weapons, missiles, or UAVs. Instead, it must be capable of a wide variety of missions, particularly infantry support and indirect fire, in order to assist or replace

conventional artillery. This requires rethinking some modern ammunition types to ensure satisfactory ballistic performance in the indirect fire role.

The turret must be designed to allow significant elevation angles, with indirect targeting aided by very simple ballistic calculators derived from Ukrainian software. Indirect fire capabilities must extend the tank's effective range to between 12 and 15 kilometers, allowing it to operate at a standoff distance from a front line potentially saturated with drones and highly lethal to armored vehicles. This indirect fire capability should not be monopolized by scarce and expensive high-end munitions such as POLYNEGE but should allow for saturation fire using standard high-explosive shells. Although initially designed to defeat future Russian tanks, the 140 mm gun is nonetheless capable of effective indirect fire, with its larger caliber offering sufficient volume for components designed for 155 mm artillery shells. However, ammunition cost remains a constraint. While present on the AMX-30, this capability was abandoned on the Leclerc and is available only in a degraded mode by disconnecting the autoloader from the breech, which reduces the rate of fire significantly, effectively to manual levels.[127]

Because such a weapon would necessitate a reduction in stowed ammunition due to volume constraints, a powerful secondary weapon is required to engage targets that do not warrant the main gun. Mounting a coaxial 20 mm gun (similar to the configuration of the AMX-30) or a 30 mm turret would ensure better complementarity of onboard weapons for dealing with lightly armored and far more prevalent targets.

- ***Protection***

Both Russian and Ukrainian forces recognize the limitations of layering passive protection, camouflage, reactive armor, and hard-kill systems. The proliferation of loitering munitions calls for a redistribution of armor mass, reducing the frontal glacis—optimized for rare tank-on-tank engagements—in favor of the roof and flanks. The use of reactive armor, such as the Ukrainian Nizh or Russian ERA, represents a partial but relevant alternative, and France possesses experience in this field from the BRENUS kit fitted to the AMX-30B2.[128] Active protection systems are another option; while costly, they are becoming essential for survivability. KNDS France and Thales possess at least theoretical expertise in this domain.

Improvements in acoustic stealth through hybrid propulsion must be accompanied by significant efforts in thermal and radar signature reduction to reduce the effectiveness of anti-tank missiles that use thermal or millimeter-wave guidance.[129]

127. C. Dorbaire, "Artillerie spéciale et combat indirect: Illusion ou opportunité tactique innovante", *Culture Militaire*, 2022.
128. N. Gain, "De nouveaux blindages réactifs en développement chez Nexter Arrowtech", *Forces Operations Blog*, August 10, 2022.
129. Interviews conducted with European and Ukrainian military and civilian actors, spring-summer 2025.

Figure III-2: French level of mastery of the technological components necessary for the development of an intermediate solution

Sources: Interviews; M. Chassillan, Char Leclerc, de la guerre froide aux conflits de demain*, op. cit.*

- ***Environment***

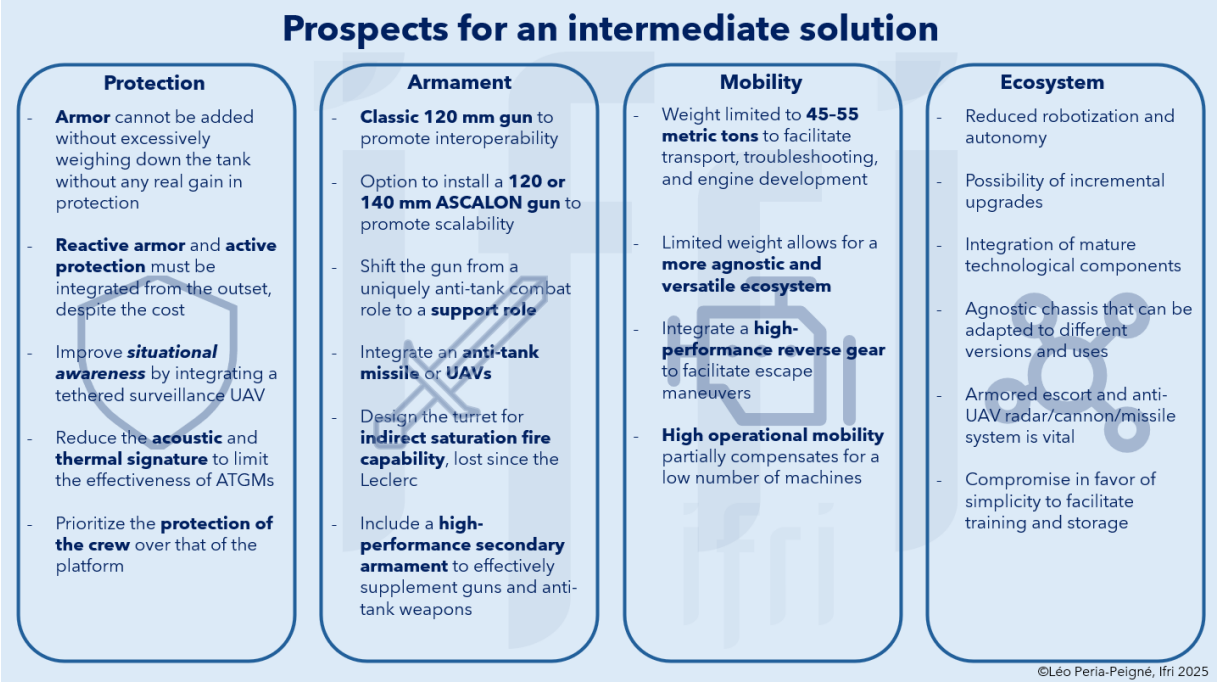
To meet deadlines and budgets, the development of an intermediate tank must limit the use of robotization and autonomy, as these technologies are not yet sufficiently mature for front-line land platforms. However, the future integration of these technologies must be considered from the outset to preserve volume and electrical generation capacity. Initially, automation must be restricted to applications that are reliable and immediately useful to the crew. For example, integrating a tethered UAV (connected via electric cable and fiber optics) could provide the tank with a virtual "periscope" to improve the crew's situational awareness. This system could also support long-range and indirect fire without requiring significant development or increasing the crew's training and cognitive load. In the longer term, the integration of robotic capabilities or the platform's integration into a "system of systems" such as the MGCS should be achievable incrementally.

Developing a tracked platform—the first in France since the Leclerc—would also be an opportunity to go beyond the tank itself and design a versatile chassis suitable for a family of armored vehicles, similar to the approach taken with the AMX-13 and AMX-30. This concept was considered for the Leclerc but, for want of funding, was not adopted.[130] In particular, operating without an escort vehicle capable of providing close anti-UAV protection for tanks will be difficult. Consequently, several chassis could be

130. M. Chassillan, *Char Leclerc, de la guerre froide aux conflits de demain,* op. cit.

converted into armored infantry vehicles armed with a turret combining a medium-caliber gun (with airburst ammunition), radar, or short-range air defense (SHORAD) missiles, similar to the Rheinmetall Skyranger 30. Such a system could provide essential close protection as well as significant direct fire support against infantry and most vehicles. In August 2025, the German company FFG unveiled a prototype support vehicle based on a modified Leopard 1 chassis, equipped with weapons suitable for air defense missions as well as fire support against ground targets.[131]

Figure III-3: An intermediate solution to the obsolescence of the Leclerc



Overall, the platform must strike a balance between adequate performance (speed, range, protection) and relative simplicity. This simplicity would enable units to perform more maintenance in the field—a major lesson learned from the conflict in Ukraine. For France, it also facilitates the training of personnel, including non-professionals, as part of the reserve force buildup. A simple platform also allows for extended storage, and stockpiles, despite their cost, have proven to be a critical asset since the start of the war in Ukraine.[132] This is also a benefit for potential exports, as having stocks in good condition (or capable of rapid reactivation) allows for very competitive delivery times.

131. L. Lagneau, "L'allemand FFG développe un char dédié à la lutte antiaérienne et à l'appui-feu à partir du Leopard 1", *Zone Militaire*, August 25, 2025.
132. L. Péria-Peigné, "Stocks militaires, une assurance-vie en haute intensité ?", *Focus stratégique*, No. 113, Ifri, December 2022.

Although still theoretical, this modest profile outlines the main features of a potential national transition tank capable of meeting the specific requirements of French practice and feedback from the Ukrainian battlefield.

Alternative forms of cooperation?

In addition to the technological hurdles, the development of a national tank faces funding constraints. The budget increases started by the 2023 Military Programming Law reduce this constraint but do not eliminate it. Cooperation is an imperfect solution but one that is difficult to avoid in France's current situation. An interesting alternative to the MGCS would have been cooperation between France, the United Kingdom, and Italy, as all three had similar and complementary needs, financial resources, and technological capabilities. However, recent announcements and the British and Italian decision to adopt a German solution make this unlikely. The 2021 Franco-Greek strategic partnership and the close relations between the two national DITBs could have provided a framework for cooperation (including Cyprus), but these relations focus mainly on the naval and air domains, with German industry already having a strong presence in the land sector.

An oft-mentioned alternative to the MGCS is close cooperation with the United Arab Emirates.[133] The UAE is the only export customer for the Leclerc tank (which it has deployed in Yemen) and has maintained a security partnership with France since the late 2000s, including the presence of 800 French military personnel on the ground. The modernization of the Leclerc could thus be carried out in conjunction with the Emirati army.[134] Excellent bilateral relations, long-standing military cooperation, a common tank to be replaced within a similar timeframe, and significant financial resources all argue in favor of an Emirati option. This would also open up significant future export opportunities, particularly in Egypt, a major ally of the UAE.

However, such a radical alternative would come with uncertainties and potential controversy. The UAE would provide the funding that France currently lacks, but this would not resolve the technological difficulties. Despite a proactive policy to develop its DITB, which is starting to yield visible results, Abu Dhabi lacks the technological expertise to complement France's capabilities. Furthermore, starting from scratch with a new partner could significantly delay the commissioning date, likely to around 2050. Such a project would increase the risk of a capability gap for the Leclerc fleet, which will face obsolescence before 2035.

133. F. Wolf, "Pour sauver l'industrie française du char de combat, les Émirats arabes unis et l'Égypte pourraient être l'alternative à privilégier pour Paris!", Meta-Defense.fr, April 17, 2025.
134. L. Lagneau, "La France veut établir une coopération avec les Émirats arabes unis pour moderniser le char Leclerc", *Zone Militaire*, September 19, 2023.

The positioning of the UAE (and Gulf countries in general) has also changed significantly since the late 1990s, when offset requirements were limited. Emirati financing would now require high industrial and technological returns and, potentially, a workshare arrangement that would be to the detriment of French industry. Finally, turning once again to the Middle East would be difficult to reconcile with France's increasingly vocal rhetoric regarding a return to Europe. Choosing a non-European partner for a major system and potentially breaking the complex but strategically rational cooperation between France and Germany would send a negative message to the continent at a time when Paris is emphasizing the need to support the European DITB.

Furthermore, although the UAE and Egypt are major customers of the French DITB, they are also diversifying their suppliers and turning increasingly to Russia. Abu Dhabi is a key customer for the Pantsir air defense system, while much of Egypt's ground equipment is of Soviet or Russian origin.[135] The UAE's power politics involve seeking a greater balance between global powers by applying the concept of "hedging", to gain autonomy by playing influences against each other. Abu Dhabi, for example, abstained from voting on the UN resolution of February 25, 2022, condemning the Russian invasion.[136] The UAE had previously signed a cooperation agreement with Moscow and appears to have considered developing a joint fighter jet.[137] The friction between Berlin and Paris, which is mostly industrial, should therefore not lead to favoring a partner whose overall strategic interests may be much further removed from those of France than Germany's are.

While cooperation is essential, Europe presents few options. A few stand out, however. By 2035, Poland is expected to possess the largest tank fleet in Europe, with more than 1,500 modern vehicles, including Abrams, Leopard 2PL, and K2PL tanks. Warsaw also wants to develop its DITB capabilities in this area and has negotiated significant industrial offsets with South Korea, although this appears to be generating more and more friction. While France and Poland recently signed the Nancy Treaty to renew and deepen relations, military cooperation between the two countries suffers from a lack of common platforms and projects. Proposing a joint tank development project would make sense, especially since relations between Warsaw and Berlin are strained when it comes to arms issues. Poland possesses considerable civil and military industrial potential, and the growth of its military budget to 5% of GDP by 2027 provides sufficient funding to contribute significantly to the project. This is particularly relevant given that Poland's medium-term replacement needs are several times greater than the potential French order. Having been refused entry into the MGCS twice,

135. "UAE Buys Russia's Kornet, Pantsir Missile Systems", *TASS*, February 17, 2019.
136. R. Chaker, "La guerre d'Ukraine vue du monde arabe", *Le Rubicon*, April 2, 2025.
137. "Next-Generation Fighter Jet Deal Signed by Russia and UAE", *Middle East Eye*, February 21, 2017.

Warsaw turned to a more conciliatory Korean partner, ready to open the doors to the future K3.[138] Building a Franco-Polish partnership around a future tank platform would allow Polish interests to refocus on a project anchored on the continent, aligning with the "European pivot" promoted by France since 2022. However, the strong Korean presence established since 2022 would be an obvious obstacle to such a rapprochement.

Signed in 2008, the strategic partnership between France and Romania could offer another relevant framework for cooperation on an intermediate tank.[139] The deployment of French troops to the country as part of NATO's forward posture has reactivated and greatly improved a long-stagnant relationship. Although Bucharest has acquired around 50 Abrams tanks, the Romanian army still needs to replace nearly 250 T-55s and appears to be seeking a less expensive solution. Romania has an aging but solid industrial base and limited but growing financial resources. A partnership based on a project less ambitious than the current MGCS but better aligned with the financial and technological resources of both partners could be a relevant compromise. This would also open up export opportunities in the Balkans: For example, Bulgaria has chosen to modernize its T-72s but will need to replace them in the medium term.[140] The German and American industries present in the country are competitors, but entering such a partnership would consolidate France's presence on the Alliance's eastern flank, consistent with the strategy implemented five years ago.

Table III-1: Summary of the main French options

Solution	Option	Advantage	Disadvantage
Cooperation	Germany	European integration	Significant imbalance between partners Different timetable
	United Arab Emirates	Historical partnership Similar timetable and needs	High offset requirements Strategically non-aligned partner
	Poland	Renewed partnership French strategy on the eastern flank	Non-European third party (South Korea)
	Romania	French strategy on the eastern flank	Limited financial and technological resources
Off-the-shelf procurement	Leopard 2	European integration Integration for the next generation	Delivery after 2030
	M1A2 Abrams	Fast delivery	Significant cost Deteriorating EU–US relations

138. L. Lagneau, "La Pologne intéressée par une participation au programme franco-allemand de char du futur", *Zone Militaire*, January 30, 2019.
139. "Romania - Joint Press Release - Fifteenth Anniversary of the Signature of the Joint Declaration on the Strategic Partnership between France and Romania", French Ministry for Europe and Foreign Affairs, February 5, 2023, available at: www.diplomatie.gouv.fr.
140. "Bulgarian Modernization of T-72 Tanks and Crew Training Being Carried Out", *Army Recognition*, September 27, 2022.

	K2 Black Panther	Fast delivery	Limited offsets
National solution	Shared intermediate solution (EMBT)	Fast delivery Limited costs	Export restrictions due to the use of German components
	National intermediate solution	Revitalize the French sector Supplement the Leclerc until the MGCS	Strong competition Medium term only
	New generation	Regain autonomy in the long term	Significant cost Technological gap

A capability essential to French strategic ambitions

There are few alternatives to Franco-German cooperation, and France's limited resources restrict the possibility of national development. However, these difficulties should not overshadow the growing importance of the issue, including at the strategic level. After several decades of inaction, the substantial expansion of European main battle tank fleets is a trend that France must also embrace in order to maintain its position as a major European power, even if it means prioritizing consistency over quantity.

The 2023 Military Programming Law establishes a French force structure of 200 upgraded tanks served by three main regiments, with a view to maintaining a comprehensive army model that ensures credibility.[141] Considered inadequate and insufficient even before 2022, this force structure risks losing credibility as European fleets are replenished and modernized, including by partners whose primary strategic focus is on the southern flank, such as Italy. This lack of depth, combined with technical availability below 50%, is a significant vulnerability in France's strategic plans to field a "war-ready" division by 2027. This division, comprising 19,000 troops and 7,000 vehicles, is intended to fulfill France's role as a "framework nation" within NATO.[142] The reduction in the size of French armored regiments from 80 to 54 tanks each, decided in 2009,[143] theoretically makes it possible to meet this objective but offers no credible possibility of rotation, let alone regeneration in the event of losses. This problem of depth is further exacerbated by a highly degraded operational environment, with the Army lacking the recovery vehicles, heavy equipment transporters, and engineering equipment essential for high-intensity armored operations.

141. "Rapport annexé à la Loi de programmation militaire 2024-2030", op. cit.
142. "Les quatre piliers de la transformation de l'armée de Terre", French Ministry of the Armed Forces, June 19, 2024, available at: www.defense.gouv.fr.
143. J.-D. Merchet, "Des chars Leclerc en solde?", *Libération*, April 28, 2008.

At the European level, France intends to command a NATO army corps comprising at least one foreign division in addition to the French division.[144] This ambition is already limited by the weakness, or even absence, of certain corps-level organic assets, which are essential capabilities for a maneuver of this scale: deep strike, electronic warfare, and medical support. Maintaining a pre-2022 French force structure, symbolized by a fleet of 200 tanks, is a clear obstacle to this ambition in a context of massive buildup among Europe's main armies. If most European armies capable of providing a division to this army corps undertake to increase their military capabilities—of which the number of tanks is a major indicator—their ambitions in terms of command will likely follow a similar trend. Ultimately, if Italy, Germany, or Poland have front-line conventional combat capabilities far superior to those of France, the latter's legitimacy to command will be diminished.

Faced with this prospect, one reflex might be to focus on a series of capabilities that France masters more easily: deep strike, air combat, and air support. While pragmatic, this choice would nevertheless risk confining France to a support and backup role that would further distance it from the command functions it intends to perform. Furthermore, some of these capabilities are currently only at the project or program stage, particularly in the area of deep strike, and will not be fully operational for at least a decade. Others, such as nuclear deterrence, remain entirely theoretical for European partners and are difficult to integrate into France's partnership offering.

Without envisioning a significant increase in the number of units or military personnel, and with all the theoretical limitations associated with this kind of thought exercise, the following volume would make it possible to match ambitions and resources, whether the platforms are national or foreign: 300 tank platforms, including 200 in units to return to a regimental allocation of equal numbers of tanks and crews, with the remainder allocated to training and war stocks; 150 anti-UAV platforms for escort and protection; 40 platforms dedicated to assault breaching and combat engineering; and 30 recovery platforms capable of recovering damaged units under fire.

The ultimate goal would be to field at least two compact but modern armored brigades, with all the necessary support assets, capable of integrating as the spearhead of an allied force. This would support French command ambitions on the continent.

As the cornerstone of France's European strategy, the army corps cannot function without a renewed and expanded armored force. While it is not a question of matching the volumes planned by Germany and Poland, a larger French fleet of tanks and artillery is one of the strategic markers capable of supporting France's ambition for European leadership and command on a continent that is rearming. If France sticks to a pre-2022 force structure

144. G. Garnier, "Le corps d'armée, nouvel étalon de puissance pour les forces terrestres", *Briefings de l'Ifri*, Ifri, April 29, 2025.

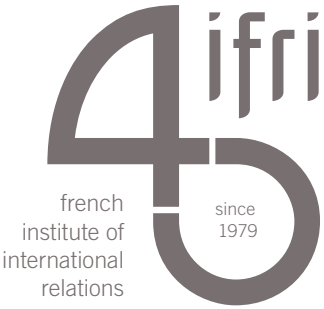
when all of its European partners are revising their own, it risks being downgraded, especially given that the military has historically been considered one of France's major assets on the continent.

Conclusion

The conflict in Ukraine has had multiple consequences for the strategic and capability balances inherited from the Cold War. The massive reinvestment by European armies in their tank fleets and the gradual reinvention of the tank's role and architecture are striking symptoms of this shift. While the proliferation of UAVs has revealed the tank's vulnerabilities, it has not shown the tank to be obsolescent: Currently, no other system can take over the wide variety of missions that tanks perform. The efforts of Kyiv and Moscow to maintain large numbers of tanks in their forces underscore the platform's importance in a modern army in a high-intensity conflict.

Meanwhile, away from the front lines, the European tank fleet is growing at a rate not seen since before the end of the Cold War and the rapid fleet drawdowns that followed. Most European armies are reinvesting in their armored forces, and some that had abandoned them are returning to the capability. However, the European tank market confirms the success of the German model, with Berlin remaining the continent's sole tank designer and manufacturer to date, as the United Kingdom, Italy, and France have failed to maintain their production capabilities. This monopoly is being challenged, however, by American and South Korean offerings, with Seoul establishing a European bridgehead in Poland. Furthermore, after 10 years of development, the Turkish offering is now reaching maturity and could compete in a rapidly expanding market. The next generation of tanks also seems to be following this trend of reduced supply sources, with Germany and South Korea preparing successors to their best sellers.

The French situation raises specific concerns. While the Leclerc fleet has modernized, it is aging and may not last until it is replaced by the MGCS. Nearly a decade after its launch, the MGCS project has yet to move beyond the planning stages, and the tripartite cooperation between KNDS France, KNDS Deutschland, and Rheinmetall has been plagued by problems. The gap between French and German requirements and timetables further exacerbates these issues: Germany does not need France to develop a national project, whereas France would face technological and financial hurdles if it were to pursue one on its own. While not impossible, developing a domestic solution or engaging an alternative partner would require France to make difficult political choices. France cannot do without a revitalized heavy-armor capability to support its ambitions to command an army corps within NATO.



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