TANKS IN THE RUSSO-UKRAINIAN WAR

Anton Paier

Abstract. The Russo-Ukrainian war, after the initial Russian advance following the invasion in February 2022, has turned into a stalemate characterised by grinding trench and urban warfare which in some instances has been compared to WWI. Despite the relative absence of fluid operations by massed mechanised formations, armoured vehicles and tanks in particular have been intensely employed by both opponents, resulting in heavy losses. When properly used in combination with other arms, tanks have been a key factor on the battlefield. During the first year of hostilities the Russian army often suffered from a tactical mishandling of their armoured units, leading to disproportionate losses of tanks and other AFVs compared to their opponent. The great majority of the tanks employed in Ukraine so far are upgraded late Cold War models, even if deliveries by NATO countries have introduced modern Western models into the Ukrainian arsenal. The aim of this article is to give a summary of the key characteristics of the main MBTs employed in Ukraine and to provide a brief analysis of their role and impact.

Keywords: Main Battle Tank, tanks in contemporary warfare, Russo-Ukrainian War

1. Introduction

Since its appearance on the battlefield in 1916, the demise of the tank has been periodically announced by military observers and pundits. It has been claimed on various occasions that the development of anti-tank weapons and other technologies had made the tank too vulnerable or redundant. These claims have been disproved every time, and it is not surprising that the same is true regarding the ongoing Ukrainian conflict. Early in the war it was predicted that light anti-tank missiles (like the well-known *Javelin*) and drones would relegate the tank to the role of costly and vulnerable 'white elephants'. Yet, over one year later, the tank retains a key role in the military operations of both contenders, and the emphasis from the media and military experts on the deliveries of Western MBTs (Main Battle Tanks) from several NATO countries to Ukraine seems to confirm this fact[1].

[1] **Freedberg, S. J. Jr**. 2023. What is a 'main battle tank,' and how will Ukraine use them? – Breaking Defense, 12 January. https://breakingdefense.com/2023/01/what-is-a-main-battle-

But what is a tank? It is not the features traditionally associated with this iconic weapon like threads, guns and armour plates that define it. In a nutshell, a tank is a land weapon system that combines firepower, protection and mobility. With the advent of future technologies it is possible that some of the 'traditional' characteristics of the tank will change or disappear, but as long as land warfare exists the need for firepower, protection and mobility on the battlefield will not go away. Thus the tank, in one form or another, will probably remain an important feature in future conventional wars. Of course tanks are just one of the components of modern mechanised units which include command and engineering vehicles, IFVs, APCs, SP artillery and anti-aircraft weapon systems, and a plethora of other support vehicles and equipment. This is a fact often overlooked by the media when discussing the problem of tank deliveries to Ukraine from friendly countries; this process is much more complex than just the transfer of a few vehicles.

Tanks have been employed intensively by both sides, even if not in massed formations reminiscent of *Desert Storm*. The Russian aggression in Ukraine has proven that tanks still play an important role on battlefields and this will be a factor in future military conflicts. This remains true despite a perception of apparent tank vulnerability due to the significant losses suffered by Russian armoured forces during combat operations. It has been estimated that, until July 2023, Russia had lost 4,278 tanks since starting the invasion of Ukraine in February 2022. This is according to the General Staff of Ukraine's Armed Forces and, of course, this can only be an approximation. Accordingly, an estimated 8,000 armoured personnel vehicles were lost.[2] The International Institute of Strategic Studies estimated in February 2023 that Russia had lost about 40 percent of its pre-war tank stocks, including the newest platform T-90M '*Proryv*'. In this context, it is necessary to highlight that the losses were due not only to the tanks as such but mainly to a lack of appropriate tactics in their use, e.g. without any support from infantry, thus denying the value of the tank as a combat platform.[3] The important factor was the total

tank-and-how-will-ukraine-use-them/ (15.03.2023); **Zamora, K.; Ozug, M.; Kelly, M. L**. 2023. Even after a century, tanks still play a major role in war. – NPR, 28 January. https://www.npr.org/2023/01/28/1152056139/tanks-ukraine-russia-germany-us-leopard-abrams-war-putin-history-wwi-wwii (15.03.2023).

[2] **Cook**, **E**. 2023. Russia Loses 16 Tanks, 13 APVs in a Day: Ukraine. – Newsweek, 10 August. https://www.newsweek.com/russia-tank-losses-armored-personnel-vehicles-ukraine-1818869 (12.08.2023).

[3] See: **Cummings, E**. 2022. Is this the end of the tank? – The Telegraph, 14 March. https://www.telegraph.co.uk/news/2022/03/14/end-tank/ (12.08.2023).

underestimation of Ukrainian armed forces and a desire to achieve a quick victory. This has been a significant mistake often presented by many videos showing the annihilation of Russian tanks, used effectively by the Ukrainian strategic communication staff. Many tanks were just abandoned by poorly trained and unmotivated crews, sometimes leaving the impression that the problem was in the tanks as combat platforms rather than in their wrong employment, poor leadership and unqualified contract soldiers (*kontraktniki*), factors further enhanced by corruption among Russian military ranks at all levels. Such estimates led to early assessments about the diminishing role of armour based on recognising too enthusiastically the success of using antitank missiles, drones, mines and artillery with precision-guided shells. Nevertheless, it was a premature and too overemphasised assessment. As was accurately presented in one of the commentaries, "Russia's heavy tank losses can be explained by employment mistakes, poor planning and preparation, insufficient infantry support, and Ukrainian artillery."[4] The war has continued to cause the evolution of the perception of tanks as combat platforms based on their employment by both armed forces. In contrast to the Russian armed forces, Ukraine has been quite proficient and inventive in their use of armoured vehicles despite the disadvantage of fielding AFV models often older than its foe.

Western MBTs, if delivered in sufficient numbers, could be a game changer for Ukraine but, as mentioned above, they present a considerable logistic challenge. The training of crews and support personnel will also be a time-consuming endeavour, even if Ukrainians have so far proved to be quick learners and proficient students.

This article aims to describe the main characteristics of the most important tank models employed by the two opponents. It will also briefly analyse the role of tanks in the ongoing conflict, the topic of Western MBT deliveries to Ukraine from friendly countries, and the potential of the Russian military-industrial complex to 'feed' the requirements of their armoured and mechanized units.[5] Some remarks about the future role of tanks will be provided. For the study, research methods will be applied as primary and secondary

[4] **Lee, R**. 2022. The Tank Is Not Obsolete, and Other Observations About the Future of Combat. – War on the Rocks, Texas National Security Review, 6 September. https://warontherocks.com/2022/09/the-tank-is-not-obsolete-and-other-observations-about-the-future-of-combat/ (15.03.2023).

[5] The information provided in the article, when not otherwise specified, refers to the situation as it was at the eve of the Ukrainian offensive in June 2023.

research and case study concerning the respective armed forces, analysis, synthesis, and elements of comparative analysis with respect to tanks used during the war.

2. MBTs and medium tanks in Russian and Ukrainian inventory (2023)[6]

Russia:

Army: T-62M/MV; T-72B/BA; T-72B3; T-72B3M; T-80BV/U; T-80BVM; T-90A; T-90M; T-14 (trials). In store: various T-62 models; T-72; T-72A/B; T-80B/BV/U; T-90; T-90A (an undetermined number of T-55 has been reported as well by various sources).

Naval Inf.: T-72B; T-72B3; T-72B3M; T-80BV; T-80BVM

Airborne Forces: T-72B3; T-72B3M

Former Donbas Secessionist Republics (1st and 2nd Army Corps):

T-64A; T-72A; T-72B

Ukraine:

Army: M-55S; T-62M/MV; T-64BV/BV mod 2017; T-64BM *Bulat*; T-72AV/AV mod 2021/B1/B3/M1/M1R/PT-91 *Twardy*; T-80BV/BVM/U/UK; T-90A; T-84 *Oplot* (the list includes vehicles captured from Russia).

Naval inf.: T-64BV

Airborne Assault Troops: T-80BV mod.

National Guard: T-64; T-64BV; T-64BM; T-72; T-90M (captured)

Western tanks delivered or planned for delivery: *Leopard 1*A5, *Leopard 2*A4/A6; *Challenger 2*, M1A1 SA

[6] **Hackett, J**. (ed.) 2023. The Military Balance 2023. IISS. Routledge. [**Hackett** 2023] Like their opponents, most of the Russian ground forces are organised into independent brigades, however divisions are retained in their organisation, including at least three Tank Divisions (4th, 47th and 90th).

3. Technical characteristics of tanks in Ukrainian and Russian service

The following section will list the basic characteristics of the tanks involved in the Russo-Ukrainian war (earliest model when not otherwise specified), as reported by the Jane's Tank Recognition Guide[7]. It will then describe the relevant features of specific variants employed in more detail.

T-62

The T-62 entered production in 1961 and was the first operational tank in the world with a smooth-bore main gun. The tank has a conventional configuration with driver in the front hull and three crewmen in the turret. It is notoriously cramped and uncomfortable to operate.

Basic specifications:

Crew: 4

Armament: 1×115 mm (40 rds), 1×7.62 mm MG (coaxial), 1×12.7 mm (anti-aircraft)

Combat Weight: 40 t

Engine: V-55-5 V-12 diesel, 580 hp at 2000 rpm

Max. road speed: 50 km/h

Max. road range: 450 km; 650 km with auxiliary tanks

Armour: steel

Despite being obsolete, a number of T-62s (perhaps 50) have been spotted in Ukraine since June 2022[8], and in October it was reported that Russia is refurbishing and possibly upgrading 800 more[9]. The T-62s being used in Ukraine are T-62M with additional passive appliqué armour on the turret,

[7] **Foss, C. F**. 1996. Jane's Tank Recognition Guide. Glasgow: HarperCollinsPublishers; **Foss, C. F**. 2000. Jane's Tank and Combat Vehicle Recognition Guide. London, New York: HarperCollins Publishers.

[8] **Axe, D**. 2022. Russia's Ancient T-62 Tanks Are On The Move In Ukraine. – Forbes, 6 June. https://www.forbes.com/sites/davidaxe/2022/06/06/russias-ancient-t-62-tanks-are-on-the-move-in-ukraine/ (10.03.2023).

[9] **Axe, D**. 2023. Russia's Tank Plan: Take A 60-Year-Old T-62, Install New Optics, Send It To Ukraine To Get Blown Up. – Forbes, 25 February. https://www.forbes.com/sites/davidaxe/2023/02/25/russias-tank-plan-take-a-60-year-old-t-62-install-new-optics-send-it-to-ukraine-to-get-blown-up/ (20.03.2023).

and T-62MV with *Kontakt-1* ERA (Explosive Reactive Armour). *Kontakt-1* is the first generation Russian ERA and provides some protection against HEAT (High-Explosive Anti-Tank) warheads, but is ineffective against kinetic ammunition.

The T-62M was introduced in 1983 and has a combat weight of about 41.5 tonnes[10]. It has a 620-hp diesel engine and a manually loaded 115mm smoothbore U-5TS gun[11]. Like in most Soviet MBTs, gun depression is limited by the low turret profile. Fire control includes a laser rangefinder. The old Soviet BM-28 115 mm DU APFSDS round has poor penetration capability by modern standards, unless the Russians have obtained more modern ammunition. A more effective round, the BD/36-2 with tungsten alloy penetrator, has been developed by UK and Egypt and has an estimated penetration capability of 520 mm RHA (Rolled Homogeneous Armour) at 71° angle and 1000 m range. Max effective day range probably does not exceed 2000 m. The gun can also fire an improved version of the *Sheksna* (AT-10) AT guided missile with tandem shaped charge, providing an estimated armour penetration of over 700 mm RHA at a max day range of 4000 m[12].

The original armour had a max thickness of 230–240 mm on the frontal arc of the hemispherical, cast-steel turret[13]. It is evident that, even with additional appliqué and ERA modules, the T-62 is quite vulnerable on the modern battlefield and its employment on the Ukrainian front reflects the challenge faced by Russia in replacing severe tank losses.

T-64

The T-64 entered service in the Soviet Army in the second half of the 1960s and represents an important step in the evolution of Soviet tanks. The T-64 introduced two revolutionary features: an autoloader for the new smoothbore 2A26 125 mm tank gun (later replaced by the more advanced 2A46/D-81TM) which allowed the reduction of the crew to three; and the introduction of composite armour, intended to improve protection, particularly against HEAT warheads.

---

[10] **T62 Series Tanks** 1999. – FAS Military Analysis Network. https://man.fas.org/dod-101/sys/land/row/t62tank.htm (10.03.2023). [**T62 Series Tanks** 1999]

[11] **Koch, F**. 1999. Russian Tanks and Armored Vehicles. 1946–to the Present. Atglen, PA: Schiffer Publishing, pp. 44–45. [**Koch** 1999]

[12] **T62 Series Tanks** 1999.

[13] Ibid.; **T-62** 2015 (updated to 2022). – Tankograd. https://thesovietarmourblog.blogspot.com/2015/12/t-62.html (10.03.2023).

Basic specifications (T-64B):

Crew: 3

Armament: 1×125 mm (36 rds), 1×7.62 MG (coaxial), 1×12.7 mm MG (AA)

Combat weight: 39.5 t

Engine: 5TDF 5-cilinder diesel, 700 hp

Max road speed: 75 km/h

Max road range: 400 km; 550 km with long-range tanks

Armour: laminate/steel/reactive

The T-64 tank family provided enhanced mobility compared to its predecessors; after the initial, unreliable 4TPD diesel engine was replaced with the more advanced 5TD and 5TDF versions, it could reach a top road speed of 70+ km/h, with a range of about 450 km extended to 700 km with add-on fuel tanks.[14] In the 1980s a turbine engine was introduced on the T-64BM[15]. The original T-64 had armour with aluminium inserts. The models T-64A and B initially (until 1985) had inserts made of ultra-porcelain balls (up to 70 mm diameter) in several rows (Figure 1).

Figure 1. Section of front turret armour with rows of ultra-porcelain balls (courtesy of M. Salamakha)

The tank was produced in the Kharkiv tank plant (now KMDB/Malyshev). It is no longer in the Russian inventory but constitutes an important part of the

[14] **T-64 Main Battle Tank** 2023. – Military-Today.com. http://www.military-today.com/tanks/t64.htm (20.04.2023). The Soviet BM version should not be confused with the BM variant of the Ukrainian *Bulat*.

[15] **Koch** 1999, p. 51.

Ukrainian mechanised forces. Some are in service with units of the 1st and 2nd Army Corps (Donbas).

The T-64s in Ukrainian service consist mainly of the models T-64BV (partly upgraded to mod 2017) and the T-64BM/BM2 *Bulat*. Some vehicles of older versions are in service with the National Guard.[16] The *Bulat* is an upgrade of the T-64B and was developed in two versions: BM (also referred as 'U') and BM2, of which the former was chosen for mass-upgrade[17]. It entered service in 2005 and is powered by a 5TDFM diesel engine developing 840 hp, more reliable than the older power plant but underpowered for the increased weight of 45 t, resulting in lower mobility. The T-64BM *Bulat* is fitted with advanced Ukrainian *Nozh* ERA modules. The T-64BV is a 1980s upgrade of the T-64B with enhanced anti-radiation protection and ERA. Many Ukrainian T-64BV have been upgraded to the 2017 model with improved sight, protection and engine.[18] (Figure 2)

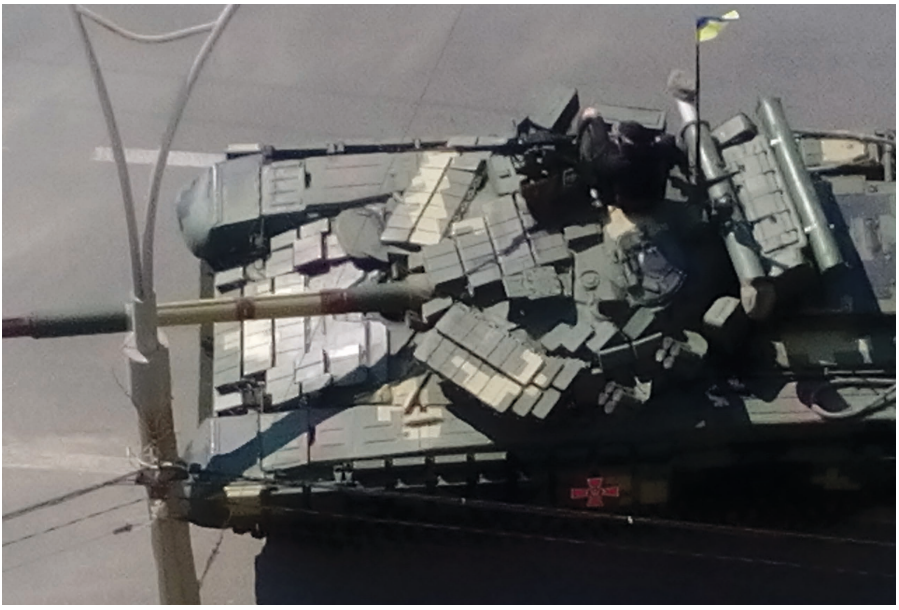

Figure 2. Ukrainian T-64BV mod. 2017 (author's collection)

[16] **Hackett** 2023, p. 204.

[17] **T-64BM Bulat Main Battle Tank** 2023. – Military-Today.com. http://www.military-today.com/tanks/t64bm_bulat.htm (20.04.2023).

[18] **Zaffar, H**. 2022. Ukraine Tests Modernized T-64BV Main Battle Tank. – The Defense Post, February 13. https://www.thedefensepost.com/2022/02/13/ukraine-modernized-t-64bv-tank/ (15.06.2022).

The *Bulat* is equipped with the locally developed TPN-4/TPV thermal sight, while the T-64BV mod 2017 sports the TPN-ITPV model which is effective up to 4000 m[19]. The autoloader of the T-64 models in Ukrainian service has a rotating carousel which can accommodate the 3BM44 *Mango* APFSDS round with tungsten heavy alloy (WHA) penetrator. Earlier APFSDS ammunition, as well as HE and HEAT rounds, can be carried. Apart from the earlier, obsolete machines whose numbers are difficult to assess, the most numerous version in the Ukrainian arsenal is the T-64BV, of which over 600 existed before the war, including more than 200 mod 2017. Some are in service with the naval infantry, the Airborne Assault Troops and the NG.[20]

T-72

The original model of T-72 (known as *Ural*) entered production in the early 1970s. It was intended as a simpler, less expensive alternative to the T-64 from which it can be easily distinguished by the much larger road wheels. It was armed with the 125 mm 2A46 smoothbore gun also installed on the T-64.

Basic specifications (T-72B1):

Crew: 3

Armament: 1×125 mm (45 rds), 1×7.62 mm MG (coaxial), 1×12.7 mm MG (AA)

Combat weight: 44.5 t

Engine: V-46 V-12 diesel, 840 hp at 2000 rpm

Max road speed: 80 km/h

Max road range: 480 km, 550 km with long-range tanks

Armour: composite/steel

The T-72, in its numerous versions, is still the most important tank in the Russian arsenal and equips many Ukrainian armoured units. Hundreds have been provided to Ukraine by the Eastern European members of NATO (including the Polish upgraded model PT-91 *Twardy*).

---

[19] Technical information by courtesy of Col. **Alexandr Schulmann** and Col. (ret) **Mykola Salamakha**, Ukrainian Armed Forces. Mr. Salamakha is Project Manager at LLC Energy 2000 Scientific and Production Enterprise, and is currently involved in the development of equipment for armoured vehicles.

[20] **Hackett** 2023, pp. 203–204. See also **Hackett, J**. (ed.) 2022. The Military Balance 2022. IISS. Routledge.

The initial model of the T-72 was soon followed by the T-72A, equipped with laser range-finder, which was also retrofitted to many of the original *Ural* tanks. The T-72B was introduced by the Soviets in the 1980s and featured revised hull and turret armour, a new autoloader, a guided missile firing capability, new sighting systems, a new engine, etc.[21] (A simpler B1 variant was also built, without ATGM capability, while the improved B2 was not serially produced). T-72B is the most numerous tank in the Russian arsenal and is being upgraded to the B3 version (2011, 2016 and 2022 mod.) and to the B3M version. Over 550 machines were upgraded to 2011 and 2016 mod. by 2020.[22] Both the T-72B and T-72B3/B3M are provided with NERA arrays on the turret front which enhance protection against both HEAT and kinetic attacks. The T-72B thickened turret front was fitted with two internal armour cavities, each filled with 19 or 20 arrays consisting of three layers glued together. Each array is 30 mm thick and consists of a 21 mm heavy armour plate, a 6mm rubber layer, and a 3 mm metal plate. According to Warford (2002), this armour conferred the T72B levels of protection approaching contemporary Western MBTs.[23] It can be reasonably assumed that the NERA installed on the new T-72B3 is significantly improved. In comparison, the original *Ural* and the T-72M were built with monolithic turret armour, while the T-72A have 'sandbar' or 'sandstick' inserts in the front of the turret (Figures 3, 4).

These are made with a silicate compound which should improve protection against HEAT rounds. Similar inserts found on Iraqi T-72s captured during Desert Storm were found to be scarcely effective.[24] Like on other tanks in Russian and Ukrainian service, protection is enhanced by the extensive use of ERA (Explosive Reactive Armour). The most advanced type used by Russia in the war is *Relikt*. It has been installed on some aspects of the T-72B3 (turret and hull sides) while other sections are still protected by the less advanced *Kontakt-5*. Both types enhance protection against HEAT and APFSDS, but *Relikt* is said to be twice as effective. The main reason why *Relikt* is only installed on the more vulnerable parts of the tank is due to the constrained

[21] **T-72: Part 1** 2015 (updated to 2022). – Tankograd. https://thesovietarmourblog.blogspot.com/2015/05/t-72-soviet-progeny.html (10.03.2023).

[22] **T-72B Main Battle Tank** 2023. – Military-Today.com. http://www.military-today.com/tanks/t72b.htm (14.05.2023); **T-72B3 Main Battle Tank** 2023. – Military-Today.com. http://www.military-today.com/tanks/t72b3.htm (14.05.2023).

[23] **Warford, J. M**. 2002. The Soviet T-72B Main Battle Tank. The First Look at Soviet Special Armor. – Journal of Military Ordnance, Vol. 12(3), May, pp. 4–7.

[24] **Houlahan, T**. 1999. Gulf War. The Complete History. New London, NH: Schreker Military Publishing, p. 124.

production capabilities of the Russian industry[25]. At least some T-72B3s are also equipped with the *Arena* APS[26].

Figure 3. Wreck of T-72 with monolithic turret armour (courtesy of M. Salamakha)

Figure 4. Section of turret armour of T-72A showing 'sandstick' insert (courtesy of M. Salamakha)

[25] **Salamakha; Russian T-72B3 receives armor upgrades** 2017. – Below the Turret Ring. https://below-the-turret-ring.blogspot.com/2017/04/russian-t-72b3-receive-armor-upgrades.html (14.05.2023).

[26] **T-72B3 MBT** 2019. – Army Recognition. https://www.armyrecognition.com/russia_russian_army_tank_heavy_armoured_vehicles_u/t-72b3_mbt_main_battle_tank_russia_technical_data_fact_sheet.html (01.03.2023); **T-72B3M Main Battle Tank** 2023. – Military-Today.com. http://www.military-today.com/tanks/t72b4.htm (14.05.2023).

The rotating carousel for the autoloader is of a new design compared to the T-64. On the T-72B3 the carousel is modified to fit longer projectiles. Additional rounds are stored in the hull. In the event of penetration of the fighting compartment, the risk of catastrophic detonation is high, as shown by the many images of destroyed Russian tanks with blown-off turrets circulating on the Internet.

The T-72B tank series (B1 excluded) are capable of firing the 9M119 *Svir* laser-guided anti-tank missile. The B3 upgrade gives the commander complete access and control of the main gun and provides the gunner with a modern sight with thermal imager (*Sosna-U*). This is a device of Belarusian origin based on French technology. The training of Russian gunners is, however, deemed insufficient to exploit the full range provided by this sight.[27] On the T-72B3M the commander has a panoramic sight that gives it a 'hunter-killer' capability. Ukrainian T-72AVs have been upgraded with the TPN-ITPV thermal sight.[28]

The main ammunition carried by the T-72 family consists of a mix of HE-Frag, HEAT and APFSDS rounds. While Russia possesses DU penetrators, it is not clear if they are being used in Ukraine. The T-72B3 can fire the modern *Svinets 1* 3BM59 (DU) and *Svinets 2* 3BM60 (WHA) rounds with elongated penetrators. The other models can fire the 3BM44 *Mango* (WHA) and 3BM32 *Vant* (DU), as well as older types. As for the T-64, The *Mango* is the most powerful 125 mm APFSDS round available to Ukrainian T-72s at the start of the war, even if it is possible that more advanced ammunition has been obtained from abroad. Penetration estimates for the *Mango* and the *Vant* are around 230–250 mm RHA at 60° and 2000 m[29], and for the *Svinets 1* and *2* respectively 410 mm and 350 mm/60° /2000 m[30]; but these figures should be taken with caution.

---

[27] **Salamakha**.

[28] Ibidem. In addition to older T-72s, dozens of PT-91s, a Polish improved version with modern fire control and Polish ERA modules, have been sent to Ukraine. See also **Hackett** 2023, p. 202.

[29] **Fofanov, V**. 2009. 125mm APFSDS Rounds – Modern Russian Armor. http://fofanov.armor.kiev.ua/Tanks/ (01.04.2023).

[30] **Manev, N.; Nikolov, E**. 2022. Lethality of Russian Contemporary APFSDS Tank Rounds Against NATO's Main Battle Tanks. – Contemporary Macedonian Defence, Vol. 22, Issue 42, pp. 115–123.

T-80

The T-80 was supposed to constitute a technological leap compared to the T-72 and the T-64. Its most innovative characteristic was the adoption of a turbine engine. The latter proved unreliable, however, and the poor performance of the tank during the First Chechen War (even if it was mostly due to inept use rather than to technical flaws) led Russia to develop the more reliable T-72 as the backbone of its tank forces.

Basic specifications:

Crew: 3

Armament: 1×125 mm (36 rds, 5 AT-8 ATGW), 1×7.62 mm MG (coaxial), 1×12.7 mm MG (AA)

Combat weight: 42.5 t

Engine: gas turbine, 1000 hp

Max road speed: 70 km/h

Max road range: 450 km

Armour: composite/steel/reactive

The original T-80 was only produced in small numbers. The first mass-produced version was the T-80B. It was followed by the T-80BV, adopted in 1985, with improved composite armour at the front and ERA. All the operational T-80B were upgraded to T-80BV standards, and this model is in service today in both Russian and Ukrainian armed forces. In 2018 Russia started upgrading this model to the T-80BVM version.[31] It has improved fire control with the *Sosna-U* sight, and it was the first operational tank fitted with *Relikt* ERA which, as mentioned above, has subsequently been installed on other Russian MBTs too in combination with *Kontakt-5*. The T-80BVM also mounts a new 125 mm gun version, 2A46M-4, and is compatible with the *Svinets 1* and *2* APFSDS ammunition and with the 9M119M *Refleks* (AT-11) ATGM. In the late 1980s the Soviets also introduced the T-80U equipped with the 9K120 *Svir* laser-guided AT missile in place of the older 9K112 *Kobra* (AT-8)

[31] **T-80BVM Main Battle Tank** 2023. – Military-Today.com. http://www.military-today.com/tanks/t80bvm.htm (15.05.2023).

and fitted with a more powerful and fuel-efficient 1250hp turbine engine.[32] A number of these tanks are still in service in the Russian army and have been employed in Ukraine. A few exemplars of a diesel powered version, the T-80UD, are in Ukrainian service and have also been used in combat.

Because one of the T-80 manufacturers is located in Kharkiv, Ukraine further developed this MBT into an indigenous model, the T-84 *Oplot* (Figure 5). While the T-84 offers significant improvements in protection and fire control and is powered by a more reliable diesel engine, the tank was mainly intended for export; only 6 vehicles are in Ukrainian service today.

Figure 5. Ukrainian T-84 *Oplot* (author's collection)

T-90

The T-90 is a development of the T-72 series which was deemed more reliable and less demanding than the T-80 in terms of maintenance. Produced from 1992, its last versions are the most advanced MBTs in the Russian arsenal, if we exclude the T-14 *Armata* (not yet fully operational).

[32] **T-80 Tank** 2000. – FAS Military Analysis Network. https://man.fas.org/dod-101/sys/land/row/t80tank.htm (10.03.2023).

Basic specifications:

Crew: 3

Armament: 1×125 mm gun (43 rds + AT-11 ATGW), 1×7.62 mm MG (coaxial), 1×12.7 mm MG (AA)

Combat weight: 46.5 t

Engine: V-84MS diesel, 840 hp

Max road speed: 60 km/h

Max road range: 550 km

Armour: composite/steel/reactive

The basic version was followed by the T-90A, with an improved fire control system and an upgraded *Shtora* optronic counter-measure system (not effective against top-attack AT missiles like the *Javelin*). The new T-90M/AM, introduced in 2019, has a commander panoramic sight with thermal vision and is fitted with *Arena* APS (it is reported, however, that the first T-90M lost in Ukraine was knocked out by a Karl Gustav 84 mm RL rifle, hinting at the vulnerability of even the latest Russian MBTs)[33]. The tanks of the T-90 series have advanced composite armour with NERA inserts and the A and M versions can fire the powerful *Svinets 1* and *2* APFSDS rounds. They are also fitted with *Kontakt 5* and *Relikt* ERA panels.

Leopard 1

The *Leopard 1* entered service in the Bundeswehr in the mid-60s. Originally it was intended as a medium tank characterised by high mobility and firepower provided by the installation of the British 105 mm L7 rifled gun. Conversely, protection was modest (steel armour with a max thickness of 70 mm); when it was designed no protection scheme was judged adequate to defend against the HEAT warheads proliferating at the time.

Basic specifications:

Crew: 4

Armament: 1×105 mm (60 rds), 1×7.62 mm MG (coaxial), 1×7.62 mm (anti-aircraft)

[33] **T-90 Main Battle Tank** 2023. – Military-Today.com. http://www.military-today.com/tanks/t90.htm (15.05.2023); **T-90M Main Battle Tank** 2023. – Military-Today.com. http://www.military-today.com/tanks/t90m.htm (15.05.2023).

Combat Weight: 40 t

Engine: MTU MB 838 Ca M500 multi-fuel 830 hp at 2200 rpm

Max. road speed: 65 km/h

Max road range: 600 km

Armour: steel

The *Leopard 1s* sent to Ukraine belong to the A5 version[34], a greatly upgraded variant introduced in the early 1990s. It is fitted with modern computerised fire control and advanced night vision equipment (included thermal sight). It also carries add-on armour panels. While its protection is sub-par compared to modern MBTs, its excellent mobility and advanced fire control makes it a useful addition to the Ukrainian arsenal. At least 200 *Leopard 1*A5 are being delivered to Ukraine by The Netherlands, Belgium, Denmark and Germany.

Leopard 2

The *Leopard 2*, in service with the Bundeswehr since the late 1970s, was a shift in German tank design towards heavy protection and firepower without compromising mobility. This was achieved by the installation of a powerful 1500 hp engine, at the cost of increased size and weight.

Basic specifications:

Crew: 4

Armament: 1×120 mm gun (42 rds), 1×7.62 mm MG (coaxial), 1×7.62 mm (anti-aircraft)

Combat Weight: 55 t

Engine: MTU MB 873 Ka 501 multi-fuel, 1500 hp at 2600 rpm

Max. road speed: 72 km/h

Max road range: 550 km

Armour: Laminate/steel

The *Leopard 2* is the most prolific modern MBT in service or storage in Western Europe. It is relatively simpler and cheaper to maintain and use than the

[34] **Axe, D**. 2023. Good Gun, Thin Armor: The Ukrainian Army is Getting Leopard 1 Tanks. – Forbes, 3 February. https://www.forbes.com/sites/davidaxe/2023/02/03/good-gun-thin-armor-the-ukrainian-army-is-getting-leopard-1-tanks/ (10.03.2023).

American M1 *Abrams* whose turbine engine is notoriously 'fuel thirsty'. Most of the *Leopard 2s* available for transfer to Ukraine belong to the A4 version which is over 30 years old. It is still a powerful machine but is probably not on a par with the latest versions of Russian MBTs. The Turkish *Leopard 2*A4 suffered serious losses during the fighting against Kurdish militias a few years ago, and even if these losses were largely due to faulty tactical employment they show the vulnerability of this model.[35] Upgrade kits are available but it is not clear if they will be provided for the machines delivered to Ukraine. Ukraine is currently trying to enhance their protection by installing ERA modules.[36]

Germany and Portugal also sent 21 *Leopard 2*A6s to Ukraine. This is a much improved machine with advanced electronics and sighting systems (including a stabilised panoramic commander periscope-sight and an enhanced navigation system) and greatly improved protection[37].

In particular, the A6 sports the distinctive arrow-head armour modules on the turret front, already introduced on the preceding A5 model. These modules consist of spaced NERA/NXRA arrays which are purportedly designed to dramatically decrease the effect of APFSDS rounds. The A6, however, lacks the add-on modules installed on the front hull of newer versions. This could be a significant weakness against the latest Russian ammunition, especially considering that over half of the rounds on the *Leopard 2s* are stored in the front hull, to the left of the driver.

The *Leopard 2*A6 also mounts a new version of the Rheinmetall 120 mm smoothbore gun with an L/55 barrel in place of the old L/44. The new gun can use the same ammunition but the longer barrel increases the muzzle velocity of APFSDS rounds, conferring greater precision and penetrating power. The modifications come at the cost of increased weight (62 t) but apparently this has not significantly affected mobility.

---

[35] **Roblin, S**. 2019. Turkey's Leopard 2 Tanks are Getting Crushed in Syria. – The National Interest, 9 November. https://nationalinterest.org/blog/buzz/turkeys-leopard-2-tanks-are-getting-crushed-syria-95396 (30.07.2022).

[36] **Salamakha;** see also: **What is the Point of Adding Reactive Armor on Leopard2A4: Who Made This Before and What the Conclusion Was** 2023. – Defense Express, 31 March. https://en.defence-ua.com/weapon_and_tech/what_is_the_point_of_adding_reactive_armor_on_leopard_2a4_who_made_this_before_and_what_the_conclusion_was-6248.html (15.05.2023).

[37] **Leopard 2A6 MBT** 2023. – Army Recognition, 01 June. https://www.armyrecognition.com/germany_german_army_heavy_armoured_vehicle_tank_uk/leopard_2a6_main_battle_tank_technical_data_sheet_specifications_description_pictures_video.html (02.06.2023).

Challenger 2

The *Challenger 2* is the successor of the *Challenger 1*—which gave good performance in the 1991 Gulf War—and entered service in the UK army in 1998. Like its predecessors, its design focuses on firepower and protection. It is equipped with the L30A1 120 mm gun, a development of the L11A5 gun mounted on the *Chieftain* and *Challenger 1*. The gun is rifled, which allows the firing of HESH ammunition, but it has inferior performance when firing HEAT and APFSDS rounds compared to the smoothbore guns adopted by other countries.

Basic specifications:

Crew: 4

Armament: 1×120 mm gun (50 rds), 1×7.62 mm MG (coaxial), 1×7.62 mm (anti-aircraft)

Combat Weight: 62.5 t

Engine: P.E. Condor V-12, 1200 hp at 2300 rpm

Max. road speed: 56 km/h

Max. road range: 450 km

Armour: chobam/steel

The UK has so far delivered 14 *Challenger 2s* to Ukraine.[38] While no longer state-of-the-art, the British tank is still a capable machine, particularly because of its excellent protection. But unless more vehicles are delivered in the future, it is unlikely that they will make a huge impact.

Besides the MBTs described above, 28 M-55S medium tanks have been also donated to Ukraine by Slovenia. These are a modernised version of the Soviet T-55 of 1950s vintage, up-gunned with the 105 mm L7 gun. Their survivability on the modern battlefield is debatable, even if their gun may allow them to engage older enemy tanks and provide fire support to the infantry.[39]

[38] **Thomas, R**. 2023. UK completes Challenger 2 deliveries to Ukraine. – Army Technology, 24 April. https://www.army-technology.com/news/uk-completes-challenger-2-deliveries-to-ukraine/ (15.05.2023).

[39] **Axe, D**. 2023. Ukraine's Super-Upgraded T-55S Tanks are Urban Demolition Vehicles. – Forbes, 28 March. https://www.forbes.com/sites/davidaxe/2023/03/28/ukraines-super-upgraded-m-55s-tanks-are-urban-demolition-vehicles/ (16.04.2023).

In early 2023 the US announced their intention to ship 31 M1 *Abrams* to Ukraine. They will be M1A1 SA, not the more advanced M1A2 model. According to American sources, the complexity of the A2 would complicate training and delay its deployment.[40]

Compared to the older M1A1, the SA (Situational Awareness) version is upgraded with improved sensors and communications gear, and 3rd generation DU armour. It lacks, however, the commander independent panoramic thermal sight installed on the M1A2 which provides the ability to shoot at two targets in rapid sequence without the need to acquire each one sequentially.[41] The Abrams will not be delivered before next autumn, so they will play no part in the coming summer operations[42].

This review does not include the new Russian MBT T-14 *Armata*, which is still in its trial and evaluation phase. The characteristics of this new tank are of course classified, but it seems that it is still suffering from teething troubles, and in any case Russian manufacturing capabilities, struggling to replace war equipment losses, do not allow its mass production. Despite Russian claims[43], there is as yet no evidence that they are actively involved in operations. The negative publicity that would result if any of these new 'super-tanks' were lost will probably prevent them from playing any significant role in the current conflict.

4. Role and employment of tanks in the Ukrainian war

During 2022 and early 2023 the Russians suffered heavy losses in equipment, including MBTs. As mentioned above, these losses are in large part due to mistakes in their employment and in combined arms tactics. It is likely that

[40] **US to accelerate delivery of tanks to Ukraine** 2023. – CNN Politics, 21 March. https://edition.cnn.com/2023/03/21/politics/us-abram-tanks-accelerate-ukraine/index.html (16.04.2023). [**US to accelerate delivery of tanks to Ukraine** 2023]

[41] **M1A1 SA Situational Awareness main battle tank** 2023. – Army Recognition, 30 January. https://www.armyrecognition.com/united_states_army_heavy_armoured_vehicles_tank_uk/m1a1_sa_situational_awareness_main_battle_tank_technical_data_sheet_specifications_pictures_video.html (16.04.2023).

[42] **US to accelerate delivery of tanks to Ukraine** 2023. The *Abrams* have been delivered to the Ukrainian Armed Forces by October 2023.

[43] **Snodgrass, E**. 2023. Russia's best tanks are in Ukraine, Russian state media says, but they're not assaulting Kyiv's forces, just shooting at them from a distance. – Insider, Military & Defense, 25 April. https://www.businessinsider.com/russias-best-tanks-in-ukraine-but-not-assaulting-kyivs-forces-2023-4 (20.05.2023).

these tactical mistakes reflect a lack of adequate preparation due to expectations on the part of the Russian leadership of a short campaign without any serious or prolonged enemy resistance. However, they also stem from flaws in training and leadership that have deeper roots. The key question, of course, is if the Russian army will be able to learn from its mistakes and improve tactical proficiency. There have been indications that some improvements have occurred since the early phase of the conflict.[44]

The main problems faced by the Russian armed forces, common to most units besides armoured formations, are:

- The Russian army was not prepared or organised for a prolonged high-intensity conflict. Their ground forces on the eve of the conflict relied principally on BTGs (Battalion Tactical Groups) formed from various units (brigades and divisions) manned principally by semi-professional contract personnel backed by short-term conscripts. These BTGs were principally designed to be deployed on short notice in limited conflicts, like the interventions in Chechnya and Georgia.[45]
- In 2022 Russia suffered heavy losses of company and battalion level commanders. Newly-promoted junior officers lack the training and experience for complex combined operations. This resulted in many instances where tank formations were employed without proper coordination with other units or support from other arms, like during the battle of Vuhledar. This resulted in further officer losses and in a progressive degradation of tactical performance.[46]
- Losses of modern equipment, which Russian industry is struggling to replace, has in turn resulted in the deployment of older, less capable gear. The inability of the industry to keep pace with the high rate of material attrition and to replace losses of modern equipment is one of the main challenges faced by Russia. While the Russian industrial base is large, modern weapon systems are extremely expensive and the acquisition of

[44] **Milburn, A**. 2022. 'They own the long clock' – How the Russian military is starting to adapt in Ukraine. – Task & Purpose, 21 March. https://taskandpurpose.com/news/russian-military-tactics-ukraine/ (10.01.2023); **Galeotti, M**. 2022. Putin's Wars. Oxford: Osprey Publishing, p. 349.

[45] **Barrie, D.; Hackett, J**. (eds.) 2020. Russia's Military Modernization. IISS. London: Arundel House, pp. 23–26, 70.

[46] **Salamakha**.

the necessary technologies creates production bottlenecks. In particular, Russian industry lacks the capacity to produce certain electronic equipment, like advanced sights which are essential to modern AFVs, and even some other parts like high-quality ball-bearings. The Russian military relies on foreign imports for many of these key components. International sanctions have largely closed these sources of supply, forcing Russia to depend on home-made solutions and on the help of a few friendly countries like Iran and Belarus. According to some sources, Russia can only build 20 tanks a month at the UralVagonZavod plant[47], even if more plants are reportedly being refurbished for AFV production. This is about one order of magnitude less compared to Soviet tank production during the late phase of the Cold War, and also compared to the massive losses suffered so far in the war which, after a little more than a year, have been estimated at about 1800 to well over 2500 tanks. According to Oryx, an open source intelligence website, almost 2500 tanks have been lost, of which almost 1600 have been destroyed and 550 and 140 captured by the enemy.[48] According to Col. (ret) Salamakha, by the end of April 2023 irreplaceable Russian tank losses amounted to 2000 vehicles, with a further 1700 in need of repair. The skilful use of artillery and ATGWs on the part of the Ukrainians has been responsible for much of this material attrition. The use of improvised armour to enhance Russian tank protection against HEAT warheads has not been very successful.

The Ukrainians have so far employed their tanks in small units in close cooperation with other arms. The relatively small size of the two armies compared to the length of the front and the density of built-up areas has so far resulted in the absence of large armour battles like those on the Eastern Front during WW2, or those expected in a hypothetical war between the old

[47] **Lendon, B**. 2023. Russia having difficulty making new weapons, but might have enough older ones, report says. – CNN, 19 April. https://edition.cnn.com/2023/04/19/europe/russia-weapons-production-report-intl-hnk-ml/index.html (15.05.2023); **Zitser, J**. 2023. Russia has just one tank factory churning out 20 tanks a month, with demand outstripping production by a factor of ten, says report. – Insider. Military & Defense, 28 February. https://www.businessinsider.com/russia-demand-tanks-outstrips-production-by-factor-of-10-report-2023 (10.06.2023).

[48] **Mitzer, S.; Janovsky, J**. 2023. Attack On Europe: Documenting Russian Equipment Losses During The 2022 Russian Invasion Of Ukraine. – Oryx (updated). https://www.oryxspioenkop.com/2022/02/attack-on-europe-documenting-equipment.html (27.10.2023). The data has been updated to late October 2023.

Warsaw Pact and NATO in central Europe. In general, the Ukrainians have employed tanks in platoon or company-sized formations, and the Russians have sometimes used battalion-size formations, usually of three MBT companies and one mechanised infantry company comprising a few dozen tanks.

The density of urban areas and field fortifications is one of the factors that have limited the use of massed armoured formations. Such an environment requires the careful support of tanks by infantry and other arms. Particularly in the early phases of the war, there have been many instances—sometimes shown in videos spread on the Internet—of Russian tanks employed carelessly without adequate support falling victim to Ukrainian ambushes.

While the Russian leadership is certainly aware of these mistakes, the losses of experienced officers make it difficult to improve the situation on the battlefield. As already mentioned, Ukraine has been more successful than their opponents in mastering combined arm warfare. This has allowed them not only to carry out an effective defence, but also launch several counter-offensive operations. The most successful of them, the liberation of Kharkhiv Oblast in September–October 2022, was however possible because that sector of the front was unsupported and thinly manned with low-quality personnel. Wherever defences have been well organised in depth and adequately supported by reserves, it has been hard for both sides to achieve rapid advances and clean breakthroughs.[49] The Western tanks and AFVs recently delivered to Ukraine will likely boost Ukrainian capabilities, particularly thanks to their superior electronics, communication equipment, sights and night-vision gear, which will improve battlefield awareness and management, tactical coordination, combined arms warfare, and the ability to quickly engage and hit targets. The training provided by NATO to Ukrainian personnel, which so far have shown an impressive capability to learn and adapt, may be even more important than the quality of the equipment itself. As past experience in the Middle East has shown, sophisticated equipment is no substitute for personnel quality, training and tactical skill.

One telling example of tank employment in Ukraine is the series of engagements known as the battle of Vuhledar. Some of the most intensive armoured actions of the war occurred in February during Russian attempts to overcome the Ukrainian forces defending that town. The Russian forces that engaged in operations in the Vuhledar sector in early February belonged to

[49] **Biddle, S**. 2022. Ukraine and the Future of Offensive Maneuver. – War on the Rocks, Texas National Security Review, 22 November. https://warontherocks.com/2022/11/ukraine-and-the-future-of-offensive-maneuver/ (01.03.2023).

the 40th Naval Infantry Brigade, supported by mechanised units of the 155th Brigade and the Alga Volunteer Battalion.[50] By late January Russian troops had managed to reach the road that connects the village of Pavlivka to the city of Maryinka in the Donetsk region. This road runs from the southwest to the northeast, separating Vuhledar from suburbs consisting mainly of summer houses and cottages. The Russian troops, however, could not enter the city itself; Ukrainian forces began to put up fierce resistance, and then committed reserves.

Then the Russian command decided to execute a flanking manoeuvre in order to bypass the city from the east. Russian columns moved from the village of Mykilske, which they controlled, along roads dividing large fields. The roads were lined with strips of forest which provided some cover but, apparently with the help of drones, the Ukrainian military detected the movement of the Russian columns on which they opened fire. Apparently the Russian armour became entangled in minefields, leaving them exposed to enemy artillery.

It is difficult to establish exactly when this battle took place. Video footage of destroyed, knocked down or abandoned armoured vehicles was published on Ukrainian Internet sources on February 9. However, reports that a Russian convoy was fired upon near Vuhledar, with about 30 armoured vehicles having been damaged or destroyed, appeared as early as February 6.

On video footage taken from drones it can be seen that tanks and armoured vehicles advanced in rather dense columns. When some vehicles blew up on mines, others tried to go around them and also ran into mines. In the end, the cluster of armoured vehicles was blanketed by artillery fire. This Russian setback evidences a lack of coordination between formations not used to operating together, led by inexperienced officers replacing those lost during the previous year.[51]

[50] **Eckel, M**. 2023. What Happened in Vuhledar? A Battle Points to Major Russian Military Problems. – Radio free Europe, 17 February. https://www.rferl.org/a/ukraine-russia-battle-vuhledar/32276547.html (15.04.2023).

[51] **Salamakha**.

5. The end of the tank era?[52]

Tanks are still valuable assets when used properly within combined-arms tactics providing all necessary support for armoured formations by infantry and reconnaissance based on the quality of well-trained tank crews. Such mobile armoured platforms, being important contributors of firepower, must also be supported by sufficient logistics and short-range air defence assets to operate effectively. It could be recognised that the major Russian losses were caused by a lack of those critical assets making tanks very vulnerable. At the same time, losses among Ukrainian armoured formations were much lower based on proper use and camouflage. What is significant is that properly used tanks are critical for offensive operations, not only in open terrain but in other environments as well. They deliver firepower which cannot be provided by other armoured vehicles possessing smaller-calibre weapon systems. Good examples of such are the US '*Stryker*', '*Bradley*' or '*Marder*' Infantry Fighting Vehicles, and the Russian BMPT '*Terminator*' armoured fighting vehicle (AFV) whose purpose is to support tanks and other AFVs in urban areas. Armour has also played a role in conflict between nations possessing similar technology as "Azerbaijan's ability to protect its tanks and employ them effectively, and Armenia's inability to do so, was one of the main factors that explained Azerbaijan's success in the war."[53]

There is a valid impression that in previous decades, after the Cold War, armoured forces tended in general to be neglected in European armies. It was an overall trend based on threat assessment and connected with the need to spend reasonable funds to maintain tank units; it includes decisions to decrease the number of tanks. Another issue was an overall shift from conventional warfare toward expeditionary operations, which were linked with different types of combat platforms, and this was a factor for many European nations. The war in Ukraine caused many nations to continue the development of armoured vehicles as platforms to fight future warfare. This includes such aspects as the continuity of upgrading existing tanks or developing new concepts. In parallel, some nations are increasing the number of tanks by creating armoured units including required training facilities, storage, simulators and training equipment. This is closely connected with the necessity to form other service and combat service support units. The Ukrainian war

[52] The chapter was written by Col. (ret) *Dr. habil*. **Zdzislaw Sliwa**, Dean of the Baltic Defence College (Estonia).

[53] **Lee** 2022.

experiences have evidenced that a number of different tanks are causing major problems with respect to logistics linked to spare parts, crew training, simulators, ammunition, exploitation materials, etc. The variety of tanks was presented in more detail in part 3, including their characteristics showing the differences between them which cause multiple challenges. One valid example with respect to a number of platforms is the US land forces as they only possess two types of tanks, the light and the medium in a few versions (M10 '*Booker*', M1A1 AIM, M1A2B and M1A2C), and only those would be the required platforms to fight future missions in all terrain conditions. This simplifies many aspects related to logistics. To compare, Poland possesses six types of tanks (Korean K-2; M1A2 '*Abrams*', *Leopard 2*, *Leopard 2*PL, PT-91 '*Twardy*', T-72) and the country is trying to limit such variety as many T-72s, PT-91s and some *Leopard 2*s were sent to Ukraine. Additional aspects are command and control systems affecting effectiveness on the battlefield. Decisions in Warsaw are now moving towards recognising the challenges linked with such complexity by limiting the number of platforms.

Experiences of war have raised concerns related to the ability to fight future wars causing, among others, the need to revise the approach towards tank units. One of the tendencies, as mentioned previously, is the drive to upgrade existing tanks. This is not only linked to firepower, command and control systems or manoeuvrability, but also to "advanced computing, 'big data' analytics, artificial intelligence, autonomy, robotics, directed energy, hypersonic, and biotechnology - the very technologies that ensure we will be able to fight and win the wars of the future".[54] Those are providing new opportunities specifically for technologically developed nations investing in research and development. It is obvious that "emerging technologies will change the way tanks are designed and perceived."[55] Russia is still working on the T-14 '*Armata*' main battle tank project, which was already mentioned. Although significantly delayed, the project is continuing[56] and will be upgraded based on experiences from combat and the recognition of tanks' vulnerabilities. It

[54] **Sayler, K. M**. 2022. Emerging Military Technologies: Background and Issues for Congress. – Congressional Research Service Report, updated 01 November, p. 1. https://sgp.fas.org/crs/natsec/R46458.pdf.

[55] **Singh, A**. 2020. Future of Tank Warfare. – Forceindia.net, 18 August. https://forceindia.net/guest-column/future-tank-warfare/ (18.08.2023).

[56] **Russia to Receive Advanced Armata Tanks in 2022**. 2021. – The Moscow Times, 04 March. https://www.themoscowtimes.com/2021/03/04/russia-to-receive-advanced-armata-tanks-in-2022-a73149 (16.08.2023).

is, however, facing technological problems because of sanctions; therefore, although production of T-90s has tripled, it has not been one of "the kind of game-changers for Russia in its ongoing conflict in Ukraine"[57]. This is what industry could manage, having specific limitations; in parallel, the attractiveness of Russian as a tank exporter is shrinking. China is carefully observing the war and is constantly upgrading its Type 99 tank (Type 99A2), developing the exportable third generation main battle tank MBT 3000 and the light tank Type 15 '*Black Panther*'. The new Japanese Type 10 is a 4th generation main battle tank reflecting the need to respond to emerging anti-tank warfare capabilities and technologies. It is fitted with modular armour to enhance survivability in future battlefields along with enhanced C4I[58] capabilities, increased protection, firepower and mobility.[59] The US Army is systemically upgrading its M1A1 *Abrams* to M1A2 SEPv3 (System Enhanced Package 3) to enhance firepower, first shot hit and survivability in all terrain and weather conditions, including urban terrain[60]. In parallel, DARPA is working on Ground X-Vehicle Technologies (GXV-T) which will create future combat platforms to overcome challenges caused by the growing lethality of modern warfare. The GXV-T will have specific characteristics as it is supposed to be not a heavy platform, thus allowing rapid deployment; it is linked with US global interests asking for deployability as an important feature.

In July 2023, Germany and France decided to renew the long-delayed battle tank project, initially agreed in 2017 and aiming to replace the German '*Leopard 2*' and the French '*Leclerc*'. Another aspect was a desire to reduce Europe's dependence on the US.[61] The financing of the project will allow the building of a new, capable tank using all the experiences coming from using West-built tanks in support of the Ukrainian fight for national integrity. It will also limit the number of platforms, allowing better cooperation during

[57] **Kadam, T**. 2023. Russia's 'Game Changing' T-90 Tanks Disappoint in Ukraine War; Expert Decodes Why the MBTs Failed To 'Change The Game'. – Eurasian Times, 08 May. https://www.eurasiantimes.com/russias-game-changing-t-90-tanks-disappoint-in-ukraine-war/ (17.08.2023). [**Kadam** 2023]

[58] C4I – command, control, communications, computers, and intelligence.

[59] **Type 10. Main battle tank**. – Military Today, no date. https://www.militarytoday.com/tanks/tk_x.htm (18.08.2023).

[60] **Abrams M1A2 SEPv3 Main Battle Tank**. – US, Army Technology, no date. https://www.army-technology.com/projects/abrams-m1a2-sepv3-main-battle-tank/ (17.08.2023).

[61] **Gonultas, B**. 2023. Germany, France agree to accelerate long-delayed battle tank project. – Anadolu Ajansi, Update 11 July. https://www.aa.com.tr/en/europe/germany-france-agree-to-accelerate-long-delayed-battle-tank-project/2941880 (18.08.2023).

combined joint operations. There could be a "massive leap in technology from the project, which is to be implemented between 2035 and 2040."[62] Experiences from the war are being closely followed, allowing recognition of Western tanks' advantages, thus supporting new projects to make them more effective. At the same time, the vulnerability of Russian tanks has been exposed as presented in part 4 and this factor will be exploited.

There is also a human factor as advanced systems are reducing dependency on people for completing combat tasks, as in the case of simple subsystems, e.g. fire-and-forget, but still an operator must have proper training about the application of such systems in combat[63]. This will require technically skilled personnel to operate modern tanks and not all nations will have enough staff when competing in the labour market. The war in Ukraine has revealed the value of tanks, despite the fact that the first days of the war and significant losses among Russian tank units caused some doubts about their value when they were able to be destroyed by a variety of anti-tank weapon systems. This was more the outcome of the fact that the war was being fought in urban or semi-urban areas of threat with loitering munitions such as *Switchblade* and *Lancet*, against which most of the current land systems are not adequately effective.[64] The *Bayraktar* TB2 unmanned combat aerial vehicle was a symbol of the massacre of invaders' armour columns at the beginning of the war. The tank development tendencies presented above show that tanks will not be disappearing from the battlefields, but they will be used more effectively within combined arms teams, allowing them to fight effectively in future wars. Historically, tanks have played a significant role in past wars and conflicts and the era of the tank is not ending; they will still be present on the battlefield but in more advanced form, and for sure some will be unmanned. The evolution of technology has been a factor changing all domains of warfare and armour warfare will be affected as well. This is a natural and never-ending constituent of competition between nations, armed forces and the military industry. Inevitably, the Russian aggression against Ukraine has been the message to NATO that there is an urgent need to develop "new capabilities, operational

[62] **MGCS: New phase for Franco-German main battle tank project** 2023. – Europäische Sicherheit & Technik, 10 July. https://esut.de/en/2023/07/meldungen/43294/mgcs-neue-phase-fuer-deutsch-franzoesisches-kampfpanzerprojekt/ (18.08.2023).

[63] **Śliwa, Z**. 2022. The Synergy Between Technology and Soldiers in Warfare – The Russian Armed Forces Image During the War in Ukraine. – Wiedza Obronna, Vol. 281(4), p. 54.

[64] **Kadam** 2023.

concepts, and defence design."[65] This includes tanks with their sustained role as a reliable combat platform, especially when used following the tactics of combined arms fighting.

6. Conclusion

The majority of MBTs employed by both sides are upgrades of Cold War Soviet models and retain the basic characteristics of such machines: moderate weight and low profile, with a compact turret and a three-man crew with autoloader. Compact features generally give these machines good mobility with less powerful engines compared to Western third generation MBTs and reduce their vulnerability by presenting smaller targets to enemy fire. The drawbacks of these design choices are: a higher workload for the reduced crew; cramped accommodation that worsens crew fatigue; poor range of gun depression, which makes them less suitable for employment in hull-down position; ammunition located under the fight compartment, near the crew and with no blow-up panels, greatly increasing the risk of catastrophic detonation in case of penetration and dramatically lessening the chances of survival for the crew in such an event. Sights and electronic components are generally inferior to contemporary Western models, which makes target acquisition more difficult and reduces the chances of first-hit. Some of these drawbacks are the results of conscious choices. For instance, the ability to fight in a hull-down position was considered less important in tanks whose primary intended role was offensive. This also demonstrates the old Soviet tendency to prioritise quantity over quality, with simpler and cheaper weapon systems that can be easily mass-produced in war conditions and are easier to use for an army of mass conscripts. The quality of electronic equipment and fire control, however, also reflects the technological limitations of Soviet and Russian industry. This is an important weakness because past experience of armoured warfare shows the importance of quick target acquisition and first-hit capability. On the other hand, the Soviets and their Russian heirs have spent great resources in providing good passive and active protection, with technological solutions often being innovative and ingenious. The development of composite armour and advanced ERA/NERA technology and the introduction of active protection systems like *Shtora* often give their tanks

[65] **Ellyatt, H**. 2022. Russia says it fired hypersonic missiles in Ukraine. What are they and why would Moscow use them? – CNBC, 22 March. https://www.cnbc.com/2022/03/22/hypersonic-missiles-why-would-russia-use-the-kinzhal-in-ukraine.html (18.08.2023).

protection levels which approach the much heavier contemporary Western models. The introduction of the T-14 *Armata* apparently indicates a shift in modern Russian military spheres towards quality and high-end technology. The limited production capabilities of the Russian industry, the difficulty of acquiring advanced electronics on the international market, and teething problems due to the introduction of untested technologies—coupled with the loss of prestige if any *Armata* tank were destroyed—suggest that the T-14 will probably play no significant role in the current conflict.

The Ukrainian army, while mostly equipped with older tank models compared to those in the Russian arsenal, has been able to upgrade their capabilities with ingenious local improvements and access to Western technology. One factor that likely reduces the capabilities of their Soviet-era tanks is that their ammunition stocks are of late Cold War vintage, even if delivery from friendly countries may improve the situation somewhat.

Ukraine has the advantage of being provided with a number of MBTs of Western origin from NATO countries, together with assistance in training. One should however notice that many of these tanks are older models too. Later *Leopard 2* variants, the *Challenger 2* and the M1A1 SA could provide them with a significant technological advantage, but only a relatively small number of these tanks have been delivered so far. On the other hand, heavy battlefield attrition has resulted in the loss of many of the best Russian tanks, forcing them to field older machines from storage. While Russia still possesses a significant numerical superiority in armour, their overall quality seems to in decline.

One of the main challenges faced by Russia is the inability of their industry to replace losses of modern equipment. The procurement of state-of-the-art electronics for modern MBTs is causing quite a headache for the Russian military leadership. Battlefield attrition and ammunition expenditure, however, are a problem for Ukraine and its allies too.[66] Some NATO countries have dangerously depleted their equipment stocks to arm Ukraine, and even for the industrial might of the United States gearing up the production of war material is proving a challenge. Like in previous conflicts, the rate of material attrition and expenditure is higher than expected and the cost of producing modern military equipment places a serious burden even on the strongest economies. As already mentioned, the employment of AFVs in massed

[66] **Mansoor, S**. 2023. Why the West Is Getting Nervous About Ammunition Shortages for Ukraine. – Time, 16 March. https://time.com/6263802/ukraine-west-ammunition-shortages/ (15.04.2023).

formations has not been—and likely will not be—a feature of this war. Tanks, while traditionally not at their best among the dense field fortifications and the urban environment that characterise much of the battlefield in Ukraine, still play and will play a vital role if properly employed in combination with infantry and other arms.

So far, the Russian armed forces have been less skilful in combined arms warfare than their opponents. At present, the Ukrainian armed forces are engaged in offensive operations, in anticipation of which the Russians have been preparing for months, building extensive fortifications. Is it yet to be seen if the improved capabilities of the Ukrainian military will be able to unlock the prevailing stalemate.

Acknowledgements

This article would have not been possible without the help and contributions kindly provided by Col. **Alexandr Schulmann** and Col. (ret) **Mykola Salamakha** of the Ukrainian armed forces**,** and by Col. (ret) *Dr. habil*. **Zdzislaw Sliwa**, Dean of the Baltic Defence College in Tartu, Estonia.

ANTON PAIER, PhD, is an independent researcher
(modern and contemporary military history,
armed conflicts and the use of influence).