Tanks – Past, Present and Future

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1. Introduction

A tank is not a simply vehicle within the classic meaning of the term, but rather a weapon system. As a tank incorporating the products of the most recent technologies, it reaches a level of excellence on each traditional quality: mobility, protection, fire power.

It is a tracked armoured fighting vehicle, designed primarily to engage enemy forces by the use of direct fire. A tank is characterized by heavy weapons and armour, as well as by a high degree of mobility that allows it to cross rough terrain at relatively high speeds. While tanks are expensive to operate and logistically demanding, they are among the most formidable and versatile weapons of the modern battlefield.

While tanks are powerful fighting machines, they seldom operate alone, being organized into armoured units in combined arms forces. Without such support, tanks, despite their armour and mobility, are vulnerable to infantry, mines, artillery, and air power. Tanks are also at a disadvantage in wooded terrain and urban environments, which cancel the advantages of the tank's long-range firepower and limit the crew's ability to detect potential threats.

Tanks were first used in the First World War to break the deadlock of the trenches, and they evolved to gradually assume the role of cavalry on the battlefield. The name *tank* first arose in British factories making the hulls of the first battle tanks: the workmen were given the impression they were constructing tracked water containers for the British Army, hence keeping the production of a fighting vehicle secret.

Tanks and armour tactics have undergone many generations of evolution over nearly a century. Although weapons systems and armour continue to be developed, many nations have been reconsidering the need for such heavy weaponry in a period characterised by unconventional warfare.

2. Short History

No one individual was responsible for the development of the tank. Its design can be drawn back to the eighteenth century.

Rather, a number of gradual technological developments brought the development of the tank as we know it closer until its eventual form was unveiled out of necessity by the British army – or rather, navy, since its initial deployment in World War One was, perhaps surprisingly, overseen by the Royal Navy.

Having already seen Rolls Royce armoured cars used by Royal Naval Air Service in 1914, and aware of schemes to create a tracked fighting vehicle, First Lord of the Admiralty Winston Churchill sponsored the Landships Committee to oversee development of this new weapon. The first successful prototype tank, nicknamed Little Willie, was tested for the British Army on September 6, 1915. Although initially termed *landships* by the Admiralty, the initial vehicles were colloquially referred to as water-carriers, later shortened to *tanks*, to preserve secrecy. The word tank was used to give the workers the impression they were constructing tracked water containers for the British army in Mesopotamia, and it was made official on December 24, 1915.

The first tank became operational when Captain H. W. Mortimore of the Royal Navy took a Mark I into action at Delville Wood during the Battle of the Somme on September 15, 1916. The French developed the Schneider CA1 working from Holt caterpillar tractors, and first used it on April 16, 1917. The first successful use of massed tanks in combat occurred at the Battle of Cambrai on November 20, 1917.

The tank would eventually make trench warfare obsolete, and the thousands of tanks fielded during the war by French and British forces made a significant contribution.

Initial results with tanks were mixed, with problems in reliability (and impatient high command) causing considerable attrition in combat. Deployment in small groups also lessened their tactical value and impact, which was still formidable during first encounters. German forces suffered from shock and lacked counter-weapons, though they did (accidentally) discover solid anti-tank shot, and the use of wider trenches to limit the British tanks' mobility.

Changing battlefield conditions and continued unreliability forced Allied tanks to continue evolving for the duration of the war,

producing models such as the very long Mark V, which could navigate large obstacles, especially wide trenches, more easily than many modern armoured fighting vehicles (AFVs).

Germany fielded a small number of tanks, mainly captured, during World War I. They only produced approximately twenty of their own design, the A7V.

Tank Production 1916-1918

Year	UK	France	Germany	Italy	USA
	Tank Production				
1916	150	–	–	–	–
1917	1,277	800	–	–	–
1918	1,391	4,000	20	6	84

Demands from infantry to have tanks close by during attacks would have pernicious effects on British tank design and tactics well into World War II.

With the tank concept now established, several nations designed and built tanks between the two world wars. The British designs were the most advanced, due largely to their interest in an armoured force during the 1930s. France and Germany did not engage in much development during the early inter War years due to the state of their economy, and the Versailles Treaty respectively. The US did little development during this period because the Cavalry branch was senior to the Armoured branch and managed to absorb most of the funding earmarked for tank development. Even George S. Patton, with tank experience during WWI, transferred from the Armoured branch back to the Cavalry branch during this period.

Throughout this period several classes of tanks were common, most of this development taking place in the UK. Light tanks, typically weighing ten tons or less, were used primarily for scouting and generally mounted a light gun that was useful only against other light tanks. The medium (or cruiser tanks as they were known in the UK) were somewhat heavier and focussed on long-range high-speed travel. Finally, the heavy or infantry tanks were heavily armoured and generally very slow. The overall idea was to use infantry tanks in close concert with infantry to effect a breakthrough, their heavy

armour allowing them to survive enemy antitank weapons. Once this combined force broke the enemy lines, groups of cruiser tanks would be sent through the gap, operating far behind the lines to attack supply lines and command units. This one-two punch was the basic combat philosophy of the British tank formations, and was adopted by the Germans as a major component of the blitzkrieg concept.

World War II saw a series of advances in tank design. Germany for example, initially fielded lightly armoured and lightly armed tanks, such as the Panzer I, which had been intended for training use only. These fast-moving tanks and other armoured vehicles were a critical element of the Blitzkrieg. However, they fared poorly in direct combat with British tanks and suffered severely against the Soviet T-34, which was superior in armour and weaponry. By the end of the war all forces had dramatically increased their tanks' firepower and armour; for instance, the Panzer I had only two machine guns, and the Panzer IV, the "heaviest" early war German design, carried a low-velocity 75mm gun and weighed under twenty tonnes. By the end of the war the standard German medium tank, the Panther, mounted a powerful, high-velocity 75mm gun and weighed forty-five tonnes.

After WWII, tank development proceeded largely as it had before, with improvements to both the medium and heavy classes. Light tanks were now limited to the reconnaissance role, and in US use, airborne support as well. However, the weight limitations of air transport made a practical light tank almost impossible to build, and this class gradually disappeared over time.

3. The Tanks – Nowadays and Future

Being able to resist the most severe stresses of combat of high intensity and to attack the most hardened targets, the tank is a powerful tool able to assume all the missions reserved for the units of the armoured forces whatever the environment, the type and the form of engagement (traditional, chemical or nuclear, high average or low intensity).

The three traditional factors determining a tank's effectiveness are its firepower, mobility and protection. The psychological effect

on enemy soldiers of a tank's imposing battlefield presence is called shock action.

Firepower is the ability of a tank to defeat a target. This takes into account the maximum distance at which targets can be engaged, the ability to engage moving targets, the speed with which multiple targets can be attacked, and the capability to defeat armoured vehicles or entrenched infantry.

Mobility includes the speed and agility of driving cross-country, the types of terrain that can be covered, the dimensions of obstacles, trenches, and water that can be crossed, the ability to cross small bridges, and the distance that can be covered before refuelling is required. "Strategic mobility" also includes the ability to travel at high speed on roads, and the ability to be carried on rail or truck transport. Traditionally AFV mobility is measured by the following metrics:

– engine power;
– engine torque;
– power-to-weight ratio;
– road speed;
– off-road speed (a somewhat nebulous figure given the possible variation);
– road range;
– off-road range;
– weight (bridge classification);
– ground pressure;
– width of trench crossed;
– vertical step climbed;
– angle of slope that can be climbed;
– angle of side slope that can be negotiated;
– ground clearance;
– unprepared fording depth;
– prepared fording depth (if different).

Protection is the amount of armour, the type(s), how it is arranged (i.e., sloped or not), and which areas are given more protection (e.g., the turret and tracks) and which receive less (e.g., the rear of the chassis). It also includes low profile, low noise and thermal signature, active countermeasures and other methods of avoiding enemy fire, and the ability to continue fighting after damage has been sustained.

Tank design is traditionally held to be a compromise between these three factors – it is not considered possible to maximise all three. For example, increasing protection by adding armour will increase weight and therefore decrease manoeuvrability; increasing firepower by using a larger gun will decrease both manoeuvrability and protection (due to decreased armour at the front of the turret). How the compromise is achieved is influenced by a combination of factors, including military strategies, budget, geography, political will, and the requirement to sell the tank to other countries.

The main weapon of any modern tank is a single large *gun*. Tank guns are among the largest-calibre weapons in use on land, with only a few artillery pieces being larger. Although the calibre has not changed substantially since the end of the Second World War, modern guns are technologically superior. The current common sizes are 120mm calibre for Western tanks and 125mm for Eastern (Soviet and Chinese legacy) tanks. Tank guns have been able to fire many types of rounds, but their current use is commonly limited to kinetic energy (KE) penetrators and high explosive (HE) rounds. Some tanks can fire missiles through the gun. Smoothbore (rather than rifled) guns are the dominant type of gun today. The British Army and the Indian Army are now the only ones to field main battle tanks carrying rifled guns.

Modern tank guns are generally fitted with thermal jackets which reduce the effect of uneven temperature on the barrel. For instance, if it were to rain on a tank barrel the top would cool faster than the bottom, or a breeze on the left might cause the left side to cool faster then the right. This uneven cooling will cause the barrel to bend slightly and will affect long range accuracy.

Usually, tanks carry other armament for short range defence against infantry or targets where the use of the main weapon would be ineffective or wasteful. Typically, this is a small calibre (7.62 to 12.7 mm) machine gun mounted coaxially with the main gun like romanian tanks. However, a couple of French tanks such as the AMX-30 and AMX-40 carry a coaxial 20mm cannon that has a high rate of fire and can destroy lightly armoured vehicles. Additionally, many tanks carry a roof-mounted or commander's cupola machine gun for close-in ground or limited air defence. The 12.7 mm and 14.5 mm machine guns commonly carried on US and Russian tanks

and the French Leclerc are also capable of destroying lightly-armoured vehicles at close range.

Some tanks have been adapted to specialised roles and have had unusual main armament such as flame-throwers. These specialised weapons are now usually mounted on the chassis of an armoured personnel carrier.

Historically, tank weapons were aimed through simple optical sights and laid onto target by hand, with windage estimated or assisted with a reticule. Range to the target was estimated with the aid of a reticule (markings in the gun sight which are aligned to frame an object of known size, in this case a tank). Consequently, accuracy was limited at long range and concurrent movement and accurate shooting were largely impossible. Over time these sights were replaced with stereoscopic range-finders. These were eventually replaced by *laser range-finders.*

Most modern main battle tanks in the armies of industrialised countries use laser range-finders but optical and reticule range-finders are still in use in older and less sophisticated vehicles. Modern tanks have a variety of sophisticated systems to make them more accurate. Gyroscopes are used to stabilise the main weapon; computers calculate the appropriate elevation and aim-point, taking input from sensors for wind speed, air temperature, humidity, the gun-barrel temperature, warping and wear, the speed of the target (calculated by taking at least two sightings of the target with the range-finder), and the movement of the tank. Infrared, light-amplification, or thermal night vision equipment is also commonly incorporated. Laser target designators may also be used to illuminate targets for guided munitions. As a result modern tanks can fire reasonably accurately while moving.

There are several types of *ammunition* designed to defeat armour, including High explosive squash head (HESH, also called high explosive plastic, HEP), High explosive antitank (HEAT), and kinetic energy penetrators (KEP, or armour-piercing discarding sabot APDS). For accuracy, shells are spun by gun-barrel rifling, or fin-stabilized (APFSDS, HEAT-FS, etc.).

Some tanks, including the M551 Sheridan, T-72, T-64, T-80, T-90, T-84, and PT-91 can fire ATGMs (anti-tank guided missile) through their gun barrel or from externally mounted lauhchers. This

functionality can extend the effective combat range of the tank beyond the range afforded by conventional shells, depending on the capabilities of the ATGM system. It also provides the tank with a useful weapon against slow, low-flying airborne targets like helicopters. The United States has abandoned this concept, phasing the M551 and M60A2 out of their forces in favour of helicopters and aircraft for long range anti-tank roles, but CIS countries continue to employ gun-missile systems in their main battle tanks.

Tank's *armour* is designed to protect the vehicle and crew against a wide variety of threats. Commonly, protection against kinetic energy penetrators fired by other tanks is considered the most important. Tanks are also vulnerable to antitank guided missiles; antitank mines, larger bombs, and direct artillery hits, which can disable or destroy them. Tanks are especially vulnerable to airborne threats. Most modern MBTs (main battle tanks) do offer near complete protection from artillery fragmentation and lighter antitank weapons such as rocket propelled grenades. The amount of armour needed to protect against all conceivable threats from all angles would be far too heavy to be practical, so when designing an MBT much effort goes into finding the right balance between protection and weight.

The most heavily armoured vehicles today are the main battle tanks, which are the spearhead of the ground forces, and are designed to withstand anti-tank missiles, kinetic energy penetrators, NBC threats and in some tanks even steep-trajectory shells. The Israeli Merkava tanks were designed in a way that each tank component functions as additional back-up armour to protect the crew. Outer armour is modular and enables quick replacement of damaged armour.

For efficiency, the heaviest armour on an AFV (armoured fighting vehicle) is placed on its front: on the gun mantlet and glacis plate. Tank tactics require the vehicle to always face the likely direction of enemy fire as much as possible, even in defence or withdrawal operations.

Since the 1970s, some tanks have been protected by more complex composite armour, a sandwich of various alloys and ceramics. One of the best types of passive armour is the British-developed Chobham armour, which is comprised of spaced ceramic

blocks contained by a resin-fabric matrix between layers of conventional armour. A form of Chobham armour is encased in depleted uranium on the very well-protected M1A1 Abrams MBT and Challenger 2.

Most tanks carry smoke grenade launchers which can rapidly deploy a smoke screen to visually shield a withdrawal from an enemy ambush or attack. The smoke screen is very rarely used offensively, since attacking through it blocks the attacker's vision and gives the enemy an early indication of impending attack. Modern smoke grenades work in the infrared as well as visible spectrum of light.

Some tanks also have smoke generators which can generate smoke continuously, rather than the instantaneous, but short duration of smoke grenades. Generally smoke generators work by injecting fuel into the exhaust, which partially burns the fuel, but leaves sufficient unburned or partially burned particles to create a dense smoke screen.

Modern tanks are increasingly being fitted with passive defensive systems such as laser warning devices, which activate an alarm if the tank is "painted" by a laser range-finder or designator.

Other passive defences include radio warning devices, which provide warning if the tank is targeted by radar systems that are commonly used to guide antitank weapons such as millimetre and other very short wave radar.

4. Conclusion

The Armour Branch is one of the Army's most versatile combat arms, and is continually evolving to meet worldwide challenges and potential threats.

The latest battle tanks show a growing trend for computerization and automation of components. Future tank designs such as the Russian T-95 and the US MCS are proposed with unmanned turrets, with the crew in a single compartment in the hull of the tank, from which they can control the turret remotely. The turret's automatic loading system can then fire ammunition faster and of a size too large for a human loader, as well as store ammunition more efficiently since there is no need for crew space in the turret. Because the crew are contained in a single compartment

space in the hull, the tank's size and mass can be reduced. Composite designs and lighter chassis are also proposed to reduce the tank's weight further to improve deployment and logistics.

Armour's most essential role is to carry out close combat, heavy missions, to close with and destroy enemy forces using firepower, mobility, and shock action, or to destroy the enemy's will to continue the battle. Some of the missions conducted by Armour task forces are:

– Movement to Contact;
– Hasty Attack;
– Deliberate Attack;
– Cover;
– Defend in Sector or from a Battle Position;
– Delay in Sector;
– Breakout from Encroachment.

Armour is a fast paced dynamic branch. It represents the decisive force that ultimately determines the fate of battle.

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