**Future Armies: wheels versus tracks**

After World War II, most armies believed that the hard currency of power of the future would be medium to heavy tanks - accompanied by tracked platforms carrying infantry and artillery. Wheeled armour, if used at all, would be confined to the roles of light reconnaissance, liaison and armed area control. The British army followed this line of thought. The Warrior has gone through six upgrades since its introduction in 1988, yet support vehicles rely upon the earlier FV-430 series.

The Soviet Army was an exception. During the 1950s the Warsaw Pact's military leaders put the bulk of their infantry on wheeled armoured carriers for two reasons. First, wheeled transport is better than tracked in moving large masses of soldiers over long distances; second, wheeled vehicles cost less and are cheaper to produce, operate, maintain and repair. Wheels are easier to steer, less susceptible to combat damage, are cheaper than tracks and last longer.

In 2001 the US Army Chief of Staff, General Eric Shinseki, suggested future American ground forces may ride entirely on wheels, forseeing a wheeled main battle tank, weighing 25 - 30 metric tonnes instead of currently twice that weight. Technology is already compensating for weight-loss; offering lighter armoured protection and improved suspension that enhances the mobility, availability and stability of wheeled combat vehicles whilst allowing them to keep up with tracked systems in most terrains. More powerful, fuel-efficient engines have greatly improved the ability of wheeled vehicles to operate in soft soils/mud. New drivetrains have been developed carrying power from engines to wheels, increasing speed and stability, reducing maintenance, which are readily adapted to diverse climate conditions and terrain. The eight-wheeled Stryker is the product of these advances.

A much lighter mechanised force will improve the Army's capabilities for rapid power projection across strategic distances. Wheeled armour can also ‘self deploy’ using existing road infrastructure where tracked vehicles need to be transported on tractor trailers. For every Challenger tank, Scout SV/Ajax and upgraded Warrior there must be one heavy equipment transporter. Britain has less than 200 HETs, whereas the US has over 2500! Being a large landmass (one of the largest in Europe - twice the size of Germany for example) France avoided the issue by keeping wheeled armour. Unless you are dealing with rasputitsa there’s no *significant* advantage a 20 ton tracked vehicle has over a 20 ton wheeled modern 8x8, except for the historical reason: NATO armies acquired large numbers of tracked vehicles when wheeled technology wasn't so well developed and widespread.

When travelling under their own power, tracked vehicles risk becoming immobilised if fuel logistics cannot match the speed of advance, both for modern blitzkrieg type tactics where seizing ground fast becomes important, and for an army in defence or retreat where supply lines may easily be cut.

On roads the rolling resistance of tracked vehicles equals four per cent of their weight, on average, while that of their wheeled counterparts (fitted with cross-country tyres) equals only two per cent resistance. For this reason, they also consume significantly less fuel (and other lubricants) than tracked armoured vehicles of equal weight, are generally faster and can travel further between refuelling stops. These advantages lead to faster operational deployment. Tyres can be air-dropped; stuck vehicles can be towed out more easily than heavier tracked armour. Wheeled vehicles are better able to zig-zag and accelerate, are more easily steered and their running gear is more responsive. Rubber tracks for road-use have a much shorter running life than wheels.

Direct confrontation with an enemy imposes at least two tactical requirements:

- Good off-road **mobility** for advancing to contact and to exploit unexpected avenues of approach, or else evade enemy action.
- **Agility** - a combination of high speed, good acceleration and the ability to zig-zag is vital to responding flexibly to rapidly changing opportunities and challenges.

However, the advantages of wheeled vehicles - particularly speed and manoeuvrability – disappears when they move off roads. Their fuel consumption may then be *at least* as high as that of tracked vehicles of equal weight and their wheels, drivetrain and suspension may incur greater damage off-road. For a wheel to drive over an obstacle, the wheel needs to be at least twice as tall as the vertical obstacle. Tracked vehicles tend also to be more compact, offering greater chances of not being seen and fired upon. (It was to keep the Ferret compact that the H-configuration and trailing-arm suspension was adopted). Tracks offer greater power efficiency off-road, have greater traction on slippery surfaces and have a much lower ground pressure. They also look more aggressive and so are capable of inspiring fear into enemy troops and civilians.

The problem with wheeled vehicles operating off-road is they fast reach an upper weight limit, around 20 tons, where performance goes completely out the window; wheels just offer far less footprint to spread the weight around than tracks, especially in the softer soils found in temperate areas of the world. Tracks have a lower ground pressure [typically 200 - 270 kN/m$^2$] than wheels [300 - 450 kN/m$^2$] and are more suited to soft surfaces. For this reason, the Ferret maintenance schedule recommended that the tyre pressures of the Dunlop T-56 900 X 16 Trackgrips, which are inflated to 30 lbf/in$^2$ (2.0 bar) at the front and 36 lbf/in$^2$ (2.5 bar) at the rear, are deflated to 18 lbf/in$^2$ (1.2 bar) and 25 lbf/in$^2$ (1.7 bar) respectively for cross-country off-road use. Larger tyres can be used for some soft surfaces, but this option is limited and cannot work in all conditions – for example on snow. Nevertheless, with the exception of France, there is no significant movement amongst major nations to embrace wheeled vehicles for tactical use. Where wheeled armour is used, its mission role is to support the tracked force. The Ferret did this successfully for over forty years. (One reason the Ferret was retired from long and successful service was due to the army switching to diesel).

The Ajax family of six armoured reconnaissance vehicles has been specifically developed for the British armoured cavalry, which is being significantly reorganised under Army 2020 Refine. Further details regarding the Ajax are given here and from the *Tank Encyclopedia*. It is a heavy (approximately 40 tonnes) tracked armoured vehicle. The weight primarily results from the high level of protective armour. The British Army will restructure to form two Armoured Infantry and two Strike Brigades, one of each held at high readiness. These will incorporate Ajax, but the main combat power will be mechanised infantry travelling in a new 8x8 wheeled APC, currently termed the Mechanised Infantry Vehicle. This long-standing project is likely to be accelerated and for this reason it is probable that an existing 'off the shelf' wheeled AFV will be used, to meet both the APC and support-vehicle requirements. It is likely the Challenger 2 fleet will be significantly reduced.

With wind-up becoming increasingly severe from 4x4 through the 6x6 Stolly to 8x8, why is a modern 8x8 configuration being adopted? Wind up in a Stalwart or other Alvis FV600 series vehicles, or Ferret and FV721 Fox is attributed to the 'H' drive train layout with one central differential in them. In this design all wheels on one side theoretically have to travel at same speed but almost impossible when on bends or tight turns.

Modern configurations, properly designed for prolonged road use automatic differential locking to allow for steerable axles and limited-slip differentials, instead of simple bevel boxes, to be incorporated into the driveline design. On the 8x8 Pandur II there is independent single wheel suspension and automatic drivetrain management (ADM) controlled differentials. Other features on modern 8x8s include central tyre inflation system (CTIS) allowing automated inflation and deflation of tyres for different terrains. Large footprint off-road tyres enable vehicles to cross soft ground with ease, incorporating an advantage of tracked vehicles.